

**Madeira, Portugal**  
**14-16 March**



**13th International Conference**

# **e-Society 2015**

## **Proceedings**

**Edited by:**  
**Piet Kommers**  
**Pedro Isaías**



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international association for development of the information society

**13<sup>th</sup> INTERNATIONAL CONFERENCE**

**e-Society 2015**



**PROCEEDINGS OF THE  
13<sup>th</sup> INTERNATIONAL CONFERENCE  
e-Society 2015**

**MADEIRA, PORTUGAL**

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# FOREWORD

These proceedings contain the papers and posters of the 13<sup>th</sup> International Conference e-Society 2015, which was organised by the International Association for Development of the Information Society, in Madeira, Portugal, March 14 – 16, 2015.

The e-Society 2015 conference aims to address the main issues of concern within the Information Society. This conference covers both the technical as well as the non-technical aspects of the Information Society. Broad areas of interest are eSociety and Digital Divide, eBusiness / eCommerce, eLearning, New Media and eSociety, Digital Services in eSociety, eGovernment / eGovernance, eHealth, Information Systems, and Information Management. These broad areas are divided into more detailed areas (see below). However innovative contributes that don't fit into these areas have also been considered since they might be of benefit to conference attendees.

Topics related to e-Society are of interest. These include best practice, case studies, strategies and tendencies in the following areas:

- **eSociety and Digital Divide:** Connectivity may imply social coherence and integration. The opposite may result as well, when systematic measures are taken to exclude certain individuals or certain groups. Papers are welcomed on the next keywords: Social Integration, Social Bookmarking, Social Software, E-Democracy
- **eBusiness / eCommerce:** Business Ontologies and Models, Digital Goods and Services, eBusiness Models, eCommerce Application Fields, eCommerce Economics, eCommerce Services, Electronic Service Delivery, eMarketing, Languages for Describing Goods and Services, Online Auctions and Technologies, Virtual Organisations and Teleworking
- **eLearning:** Collaborative Learning, Curriculum Content Design & Development, Delivery Systems and Environments, Educational Systems Design, E-Citizenship and Inclusion, eLearning Organisational Issues, Evaluation and Assessment, Political and Social Aspects, Virtual Learning Environments and Issues, Web-based Learning Communities
- **New Media and eSociety:** Digitization, Heterogeneity and Convergence, Interactivity and Virtuality, Citizenship, Regulation and Heterarchy, Innovation, Identity and the Global Village Syndrome, Internet Cultures and New Interpretations of “Space”, Polity and the Digitally Suppressed
- **Digital Services in eSociety:** Service Broadcasting, Political Reporting, Development of Digital Services, Freedom of Expression, E-Journalism, Open Access
- **eGovernment /eGovernance:** Accessibility, Democracy and the Citizen, Digital Economies, Digital Regions, eAdministration, eGovernment Management, eProcurement, Global Trends, National and International Economies, Social Inclusion
- **eHealth:** Data Security Issues; eHealth Policy and Practice; eHealthcare Strategies and Provision; Legal Issues; Medical Research Ethics; Patient Privacy and Confidentiality
- **Information Systems:** Electronic Data Interchange (EDI), Intelligent Agents, Intelligent Systems, IS Security Issues, Mobile Applications, Multimedia Applications,

Payment Systems, Protocols and Standards, Software Requirements and IS Architectures, Storage Issues, Strategies and Tendencies, System Architectures, Telework Technologies, Ubiquitous Computing, Virtual Reality, Wireless Communications.

- **Information Management:** Computer-Mediated Communication, Content Development, Cyber law and Intellectual Property, Data Mining, ePublishing and Digital Libraries, Human Computer Interaction, Information Search and Retrieval, Knowledge Management, Policy Issues, Privacy Issues, Social and Organizational Aspects, Virtual Communities, XML and Other Extensible Languages

The e-Society 2015 Conference had 115 submissions from more than 28 countries. Each submission has been anonymously reviewed by an average of four independent reviewers, to ensure the final high standard of the accepted submissions. Out of the papers submitted, 27 received blind referee ratings that signified acceptability for publication as full papers (acceptance rate of 24%), while some others were published as short papers, reflection papers and posters. The best papers will be selected for publishing as extended versions in the Interactive Technology and Smart Education (ITSE) journal (ISSN: 1741-5659) and also in the IADIS International Journal on WWW/Internet (ISSN: 1645-7641).

In addition to the presentation of full papers, short papers, reflection papers and posters, the conference also includes a keynote presentation and an invited speech. Special thanks go to Dr. Gitte Bang Stald, Associate Professor, IT University of Copenhagen, Denmark, for her keynote presentation. We would also like to express our gratitude to Jonathan Bishop, Principal Researcher & Developer, Centre for Research into Online Communities and E-Learning Systems, Wales, for being our invited speaker.

As we all know, a conference requires the effort of many individuals. We would like to thank all members of the Program Committee (116 top researchers in their fields) for their hard work in reviewing and selecting the papers that appear in this book. We would also like to thank all the authors who have submitted their papers to this conference.

Last but not least, we hope that everybody has a good time in Madeira, and we invite all participants for next year's edition of the International Conference e-Society, in 2016.

Piet Kommers, University of Twente, The Netherlands  
*Conference Program Chair*

Pedro Isaías, Universidade Aberta (Portuguese Open University), Portugal  
*Conference Chair*

Madeira, Portugal, March 2015

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# KEYNOTE LECTURE

## EVOLUTION OR REVOLUTION? DIFFUSION AND ADAPTATION OF (SMART) MOBILE PHONES AMONG CHILDREN AND ADOLESCENTS

**By Dr. Gitte Bang Stald,  
Associate Professor, IT University of Copenhagen, Denmark**

### Abstract

The emergence of new media and communication technologies and the subsequent potential and actual changes in social practices are often associated with revolutionary consequences. When advanced digital communication devices reach a certain level of diffusion within society they become very visible as obvious choices for information, communication, entertainment and management of everyday life. It is definitely important to expose and explain the qualitative transformative consequences of the diffusion and adaptation of in this case especially the smart mobile devices. It is, however, often less prominent to identify and explain the process of continuity, appropriation and normative adjustments of new technologies as they blend into the everyday routines and practices. I claim that there are good reasons to try and to discuss the simple correlation between diffusion and adaptation of new media and processes of change. The aim of this presentation is to provide such insights based on empirical data and to raise adequate questions for research and debate. Empirically I draw on results from the two European projects Net Children Go Mobile and EU Kids Online and from a five time repeated study of young Danes uses of mobile phones.

I present two main arguments: First, that European children's and adolescents' appropriation of smart mobile communication technologies predominantly take place in an evolutionary process which is rooted in continuity of adaptation processes, in everyday routines, and in patterns of social interaction rather than in a revolutionary transformation of communication strategies. Secondly, following the first argument, that we must understand the emergence and momentum of digital communication technologies in society in the context of media and communication history, culture, and social structures. Hence, the diffusion of (smart) mobile phones may have revolutionary consequences in some cultures, whereas it is obviously the result of a long process and continuity in others. The social consequences differ according to context.

# INVITED TALK

## **THE MISREPRESENTATION OF DIGITAL TEENS AS TROLLS: CONSIDERING POLITICAL, NEWS AND FEMINIST AGENDAS**

**by Jonathan Bishop,  
Principal Researcher & Developer,  
Centre for Research into Online Communities and E-Learning Systems, Wales**

### **Abstract**

If one pays attention to popular culture and the mass media, Internet trolls are unemployed young men in their 20s at home in their parents' basement spending their time posting abusive messages online. This study finds that this stereotype, whilst common in the mass media, is not representative of the empirical data collected. The research found that most trolling on blogs and defriending is done by women and because of other women. It finds that the people who troll are unlikely to be youths not in education, employment or training (NEETs), but more likely to be those in wealthy areas who are bored. It equally finds that those who troll, or indeed troll-call, are likely to show the symptoms of antisocial personality disorder and histrionic personality disorder respectively. With the media focussing on represent young people as trolls, the research finds that the existence of benevolent sexism in the police perpetuates this myth, meaning women are getting more favourably treatment, either as trolls or troll-callers. In fact the research finds trolls are as likely to be men or women, and they will change the way they troll based on their target, meaning feminists deemed misandrist will face sexist posts including from women, but the same trolls, regardless of their sex, would have used racist remarks if the feminists calling for more rights for women were Black and calling for more rights for Black people. The research concludes that deterring trolling requires a community-led approach, where local government can use their law enforcement powers, such as to issue fixed penalty notices or anti-social behaviour orders, against those trolls they can prove took part in trolling by using their surveillance rights.



# **Full Papers**



# THE DOMESTICATION OF ICTS IN HOUSEHOLDS LOCATED IN DEVELOPING COUNTRIES

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## ABSTRACT

Today's wide spread of Information Communication Technologies (ICTs) has transformed the way people live their everyday lives and communicate. Although, they are seen as intrinsic contributors to the domestic world, ICTs are also considered as a threat to children, due to exposure of inappropriate content such as material of a sexual or violent nature containing unsuitable gender, cultural or social stereotypes. It is therefore important to study the implications of ICTs within the household context, since little is known about the ways in which ICTs are impacting social relations of domesticity. The aim of this study is to understand and compare the process of integration of ICTs in households located in developing countries such as South Africa and Rwanda. The findings of the research show that ownership and level of integration of ICTs depend on households' culture and lifestyle characteristics. Finally the study provides a foundation and proposals for further research and investigation.

## KEYWORDS

Information Communicating Technologies (ICTs), Domestication theory, households, developing countries.

## 1. INTRODUCTION

There is an ever-growing presence and utilisation of ICTs within households (Lim & Soon, 2010). In a domestic space, ICTs are seen as intrinsic contributors. However, little is known about how technology enters and gets integrated into households, especially in developing countries. The main objective of this study is to understand the process through which ICTs are domesticated into households. Major emphasis is on the factors that affect the integration of ICTs into the families and identification of perceived advantages and disadvantages of the ICTs in households located in developing countries.

The research questions which are addressed in this study are:

- What factors influence the domestication of ICTs in households situated in developing countries?
- What challenges do households encounter while integrating technologies?

This study aims at filling the gap by investigating how households cope while domesticating technologies. The sample of the literature shows a relatively uneven coverage across the levels of domestication of ICTs in households in developing countries, due to various factors. Poor households appear to struggle to reach the appropriation stage which is related to the acquisition of a technology. Households which reach the acquisition stage are likely to acquire cheap ICTs. Hence, there is a need to understand the reasons why full domestication may not necessarily be attained. This study explores the benefits gained and challenges faced by households while trying to domesticate technologies. We focus on Rwandan and South African households to compare the patterns of ICT domestication for a wide range of economic and cultural spectrums.

This research follows an explanatory approach. To answer these questions, the domestication theory guided this study and probed deeply to ask what the technologies mean to people. A qualitative research approach is used. Data was collected using fifteen semi-structured interviews. A thematic analysis technique was utilised to analyse the data by examining the patterns across the data, based on the domestication theory.

## 2. CONCEPTUALISING HOUSEHOLDS

A household is bound by social, psychological, cultural and economic considerations. Helle-Valle and Slette-meås (2008) claim that a household needs to be viable in all the contexts since they fundamentally illustrate how a household should function as a unit. To understand domestication of ICT, people need to appreciate the household's negotiations, relationships and the beliefs which lie behind a household's collaboration process (Haddon, 2007).

### 2.1 Factors Influencing ICT Adoption in Households

Factors influencing ICT adoption in households can be contextual or psycho-sociological. Contextual factors are the primary aspects of the environment in which the ICT is used; psycho-sociological could be both psychological and sociological factors which relate directly to people in charge of using the technology (Kozma, 2008). Table 1 summarises the factors influencing ICT domestication in households.

Table 1. Summary of factors influencing the integration of ICT in households

Category	Factors	Reference
Contextual	Income	Olatokun (2009)
	Socio-influence	Haddon (2011)
	Infrastructure	Shonali and Jiang (2008)
Psycho-sociological	Age	Olatokun (2009)
	Education level	Silva et al. (2011)
	Image	Richardson (2009)
	Gender	Lim and Soon (2010)

Contextual factors relate to the efficiency of relationship or cooperation such as infrastructures required for the use of ICTs. Shonali and Jiang (2008) claim that there is a growing need for electricity in households due to increasing acquisition of ICT appliances. Additionally, the income level of individuals in a household has a considerable impact on people's ability to acquire and maintain technologies. Thus, with the increase of household income, affordability of power housing gets stronger (Ke, Chang-bin, & Yu-meng, 2009). Furthermore, social influence may impact the decision of ICT acquisition due to people's attitudes towards technology. People with ICT experience may largely influence beliefs of those who haven't adopted ICT yet. These beliefs often result in shaping people's views about technologies and it may compel them to arrive at a premature decision about which ICT to adopt (Haddon, 2011). Privacy and confidentiality concerns in the households are classified as contextual factors. Despite the many opportunities offered by ICTs', people value privacy (Kennedy & Wellman, 2007)

Socio-cultural factors such as gender play a role in the use and access of ICTs. Though many studies indicate that males are usually more accustomed to a wide range of technologies than women, there is a growing interest in ICTs among women, especially among the younger generation (Maleka & Mokebe, 2012). Additionally, women normally use the Internet and mobile phones to strengthen existing personal relationships with people around them (Wei & Kolko, 2005). The use and attitude of women towards ICTs is mediated by their roles in the household. Since women maintain primary responsibility for the smooth running of the home and for the reproduction of domestic order and comfort, this means according to this enquiry, that women have or perceive themselves to have very little leisure time. Richardson (2009) notes that some women feel guilty for spending a long time on the Internet while they are at home, because they believe that their needs should come after the household chores and after the family has been taken care of.

People with computer access are likely to have required skills to use computers at home (Lim & Soon, 2010). The education level and age impact positively on the probability of adoption and usage of a new technology, up to a certain level; it then decreases (Chabossou et al., 2010). Hence, learning is associated with concepts of prior experience with similar technologies and may be indicated by the length of time the ICT has been used.

## 2.2 Perceived Benefits of ICTs in Households

“With growing societal adoption of technologies, computers are no longer seen as a luxury but as essential products which help individuals scale greater heights in school, at work or in social life” (Lim & Soon, 2010, p. 206). For certain people, ICTs at home are crucial because their jobs require some level of Internet and mobile phone connectedness (Leung, 2011). Therefore, ICTs are perceived as a welcome means of managing work, especially for teleworkers who bring work into the home environment (Stewart, 2003).

ICTs such as mobile phones improve the social and economic aspects of people’s lives and help them to communicate in emergencies as well as in real time from almost anywhere (Silva, Ratnadiwakara, & Zainudeen, 2010). House members can afford physical separation since ICTs can keep people connected as they communicate socially while they run other household responsibilities (Fusaro & Bonneau, 2007). Additionally, mobile phones are seen to be of great benefit to parents because they can monitor their children while they are outside the domestic sphere to assure that their children are safe (Lim & Soon, 2010). Parents use ICTs as a parenting resource and as a disciplinary device, because they are aware of the appeal which technologies such as television and computer games hold for their children (Harwood, 2011). For instance, ICTs may be used as rewards for children’s good behaviour (Lim & Soon, 2010). Parents may also acquire ICTs to help their children excel in ICTs competencies and future successes in education.

## 2.3 Perceived Risks of ICTs in Households

Since home is perceived as a private space (Stewart, 2003), ICTs, as objects and media, bring public life into the domestic sphere, hence threaten to break down the moral borders that surround, and help to define, the household (Helle-Valle & Slette-meås, 2008). Households have become less stable in composition and role relationships (Kennedy & Wellman, 2007). Richardson (2009) reports that some husbands felt neglected since spouses spend more time on ICTs such as the Internet and cell phones. Hence, many women experience a great deal of domestic pressure when struggling to balance their work-life.

ICTs may also prevent the family from spending ‘quality time’ together (Helle-Valle & Slette-meås, 2008). Shah and Godiyal (2009) point out that ICT introduction into the home reduces human interaction, which may lead to anti-socialism, which normally results in aggressive behaviour, especially for children who grow up in such environment. Each household has its own way of applying the technology. Teenagers often conflict with parents due to their misuse of ICTs such as the Internet and TV (Kennedy & Wellman, 2007). Parents claim that they exercise several kinds of formal and informal control over the use of ICTs in the household (Fusaro & Bonneau, 2007). When ICTs have been sufficiently integrated into people’s lives, it is difficult for them to imagine being back to a stage without them (Baliamoune-Lutz, 2003). Through time individuals develop an attachment to their ICTs which often results in addiction.

## 3. THEORETICAL FRAMEWORK: DOMESTICATION THEORY

Domestication theory focuses on the social, cultural, political and economic consequences (Silverston & Haddon, 1996) of technologies. This paper is based on the Domestication theory since it is the appropriate tool to use for this research and because of its explanatory power which can be applied to qualitative methodologies. The theory distinguishes three main stages: commodification, appropriation and conversion (Silverston & Haddon, 1996). Other researchers further divide the appropriation stage into objectification and incorporation, thus making five stages (Habib, 2005). These stages are the different phases that a user goes through when confronting new technology (Hynes, 2010). Every stage builds up on the preceding one, thereby illuminating the step-by-step process by which the domestication is achieved.

*Commodification* refers to the way the users think about the product. Commodification is often seen as the imagination stage because the customer is still evaluating potentials of the product. Thus, the design of the product is a central component of the wider process of commodification (Silverston & Haddon, 1996).

*Appropriation* refers to when the technology is introduced into the owners’ daily routine and they decide whether to make the technology acceptable or not (Habib, 2005). The appropriation stage may be split into *objectification* and *incorporation*. Once the technology has been acquired, the object is awarded a space

within the environment that it find itself in. This space is created within the structures, routines and values of the household, thus *objectivation* (Silverston & Haddon, 1996).

*Incorporation* constitutes another dimension of appropriation which focuses upon the functionality of the technology and its role-fit within the daily routine. An object becomes incorporated when it starts being integrated into people's habits. *Conversion* is the final stage of domestication from which the owner of the ICT is trying to persuade other people to acquire the same technology by indicating the importance of the technology (Verdegem & Verhoest, 2009).

The domestication process shows how people appropriate and find their own uses for new technology and shape them to fit their own homes, activities and values. This is especially important in the home situation, where there is a mix of many generations of technologies, and the need for their integration into activities and routines may be established over many years.

This framework is widely adopted (Silverston & Haddon, 1996) to distinguish elements of the dynamics of a household comprising the five stages of symbolic and cultural work (commodification, appropriation, objectification, incorporation and conversion). The stages are not discrete, but interlinked facets of the biography of a domestic technology and the home. Although these processes are primarily related to the initial adoption of a product, they are on-going, as usage, the household and technology change (Howard & Mazaheri, 2009). Domestication includes many social features important in the adoption and consumption of new ICTs, including exchange and gift giving. Rituals of possession and grooming can be seen in the continual process of domestication, as products are constantly reassessed and given new value (Stewart, 2003).

## 4. RESEARCH METHODOLOGY

The study uses the interpretive approach to provide a holistic perspective of the household's situation, through a rich, in-depth explanation of the underlying factors impacting the integration of ICTs in households (Dhillon, 1999).

### 4.1 Target and Sample Population

The study focuses on households with or without children. In households with children, we assessed parental control over ICTs at home and how the children cope with surveillance. A convenience sampling procedure was adopted. To verify the reliability of data, we followed a triangulation method by using a case study technique which consisted of interviewing the whole household at once. Participants were selected based on the information that they could potentially contribute and their willingness to participate in the research. Table 2 summarises the demographic information of the respondents.

Table 2. Demographic information of the respondents of the study

Participants	Gender	Age	Family role	Country
Participant A	Female	30-40	Lives with her husband and two teenagers	South Africa
Participant B	Male	30-40	Lives with his wife and a one-year -old child	Rwanda
Participant C	Female	50-60	Lives with her husband and two teenagers	Rwanda
Participant D	Male	50-60	Single father living with his daughter	South Africa
Participant E	Male	20-30	Lives with parents and three younger siblings	Rwanda
Participant F	Male	20-30	Lives with his single mother and two siblings	South Africa

Participant G	Male	30-40	Lives with wife and three-year-old child	Rwanda
Participant H	Female	10-20	Lives with both parents and seven siblings	Rwanda
Participant J	Female	10-20	Lives with parents and two siblings	South Africa
Participant K	Male	10-20	Lives with parents and three brothers	South Africa
Participant M	Female	10-20	Lives with her single mother and six older sisters	South Africa
Participant N	Female	30-40	Lives with husband and two children	Rwanda

## 4.2 Data Collection

The interview questions were created using the domestication framework. Questions were mainly open-ended. The first author did all the interviews in person. Half of the interviews were done in the households of the interviewees, where the researcher could observe the ICTs and their locations. The digital recordings of the interviews formed the basis of the data analysis. The data was transcribed verbatim immediately after each interview. The researcher also recorded details observed about the ICTs' locations in the homes.

## 4.3 Data Analysis

Data analysis commenced soon after each interview. Using the domestication framework in each stage of the model, the themes were noted and evaluated. The data set was analysed iteratively (Colwill, 2009). We compared and evaluated the findings with the literature reviewed. Results in each household were then compared and discussed which led to the identification of factors influencing the integration of ICTs in families.

# 5. DISCUSSION AND RESULTS

## 5.1 Commodification

The commodification process is the way an ICT product is designed and is given an image by the users as it emerges in the public space. The participants' view of ICTs was mostly based on their consumer personal sphere. Most participants had an image of the ICT product before acquiring it. They gathered information from a number of sources such as media and people around them. Participant C best illustrates that the people around have a massive impact on what people think about technologies. *"Before I went to University, I used to have a Blackberry and I was quite happy with it but at some point all my friends started talking about the way Blackberry phones are outdated, then I started feeling the urge to change."* This finding supports Habib's (2003) claim that a consumer's decision to purchase a technology is mostly influenced by its design and that consumer's experiences along with, for example, status and peer pressure. When asked about their level of computer literacy before the acquisition of ICTs at home, most respondents reported they had had a little knowledge about the product, but that their knowledge had gradually improved with time after the purchase. Participant K who owned a smartphone claimed that: *"I watch YouTube videos to understand functionalities of some applications in my phone"*. Older people mentioned that they ask people around for their opinions, watch adverts and do research about the technologies before acquiring them. Older children helped their parents to do the research.

## 5.2 Appropriation

The appropriation process is the acquisition stage; this is where the members introduce the technology into the house. A household acquires a technology depending mainly on the income, status, peer pressure and

their age (Shonali & Jiang, 2008). Participant K demonstrated that although his family could not afford expensive technologies, instead of living without a technology, his mother had bought the cheapest TV on the market: *"We didn't take time to think about the model to acquire, when my mother got the money, we just went and bought the cheapest TV we could find"*. Participant K also added that, due to economic struggles, he had grown up with limited exposure to ICTs such as smartphones or laptops until he could afford them himself. *"My mum cannot afford to buy cell phones . . . , so we wait until we can work or get money to buy them ourselves, I bought my first cell phone when I was 17 years old."* On the other hand, children from wealthier backgrounds are usually exposed to various ICTs at a young age. Participant A's daughter who was 11 years old claimed that while walking in a shopping centre, a phone captured her attention. When she told her mother about the phone, two days later that same phone was bought for her.

Parenting style has a large influence on how and when the ICTs are introduced into the home (Kennedy & Wellman, 2007). Controlling parents tend to refrain from buying ICTs such as cell phones for their children because they think they are a form of distraction. Additionally, parents reported that gender had an impact on how technologies were acquired at home. More attention was given to daughters as parents feared that the daughters might expose their bodies to get the ICTs they needed. Although daughters were given ICTs at an early age, the usage of the ICTs was fully controlled. Participant H, an 18-year-old young woman, reported that when she went home on vacation, her mother exercised too much control on her use of her cell phone. *"Though I have my own phone, when I am at home I use my mum's phone because she wants to know who I call and who calls me."*

### 5.3 Objectification

The objectification process is the familiarisation stage; families tend to understand objectives of the technology which leads to finding a place for it in the household. Participant N reported that the main use of a laptop at home was primarily to facilitate and to complete work and education-related tasks: *"Since my husband and I are both lecturers, we often use our laptops at home to prepare teaching materials and also to research on the Internet"*. This action could be seen as an inhibitor to social interaction among house members, since parents spend most of their time at home trying to finish work. On the other hand, ICTs such as cell phones and computers are used predominantly for communication purposes (Balioune-Lutz, 2003). Participant A claimed that communication would be impossible without cell phones: *"I sometimes get projects which send me away for the whole day; the cell phone is the only way I use to talk to my son and daughter"*.

The location of the ICTs is often chosen depending on where the parents can easily monitor the use of ICT by their children. This explains why parenting style influences objectification. In these instances, mothers exercised significant influence over where and how ICTs were placed within the home, making informed decisions about where they could best exercise supervision. Mothers perceived themselves to have a bigger responsibility than fathers in deciding where ICTs were to be positioned at home. Most families claimed that they placed ICTs such as the TV and radio in the living room because it was the most suitable place where the family met. In cases where children shared a PC, it was also placed in the living room. When a household had more than one TV, the second one was mostly placed in the parents' bedroom. Participant K's family had three TVs, one located in the living room, one in the study room and one in his parents' room. *"When my parents find us playing . . . games on the living room TV, they directly go in the bedroom where they can watch whatever they want without us disturbing them."*

### 5.4 Incorporation

In the incorporation stage, ICTs are part of the owner's daily life. At this stage the owners tend to get attached to their technology to the point that they cannot imagine themselves without it. This is why it is also labeled the integration stage. Participant K who lived with his parents and three brothers mentioned that the TV had helped the family to bond. *"Every Tuesday night, my sibling and parents watch a documentary together. After the documentary, we usually engage in random conversations about life and school."* Participant M, who had seven siblings all located in different places, reported that ICTs such as cell phones helped them to communicate with family members, using a WhatsApp group that they had created. *"WhatsApp is so far best way to communicate with my sisters since it is cheap and can talk to them at any time I want. It is very convenient since we send each other pictures and videos without having to spend a dime."*



Although, ICTs facilitate communication among household members, Shah and Godiyal (2009) indicate that technologies at home may reduce human interaction. This is supported by the fact that most respondents mentioned that relationships among house members had changed due to the introduction of ICTs. Participant D, a divorcee living with his 15-year-old daughter, felt that ICTs had affected the relationship between him and his daughter: "...my daughter doesn't communicate with me face-to-face any more. She sends me WhatsApp messages even when she is in her room. . . . even though these technologies are making communication easier they are also breaking us apart...".

## 5.5 Conversion

The conversion process is called the reach-out stage because the person owning the technology tends to directly or indirectly advertise the technology. Most participants reported that ICTs exceeded the needs they had in mind when they first bought them. The level on which people talk about their gadget is highly dependent on age and gender. Most female participants claimed not to talk about their gadgets. This finding contradicts Silverston and Haddon (1996) who claim that all ICT owners talk about their gadgets. However, young and male participants showed interest in spending time explaining to their friends the functionalities of their gadgets. Participant K often talked about his cell phone's apps (applications), but only to the people who have the same cell phone or an even better phone: "*Before I start talking about the features of my Samsung Galaxy S3, I first check whether the person I going to be to have a conversation with has at least a smart-phone*". He explained that the reason why he did that was because he felt that having that kind of conversation with someone who had a feature phone would be considered boasting to them.

## 6. CONCLUSION AND RECOMMENDATIONS

The primary objective of the study was to explore how technologies are introduced in households and the processes house members go through to make ICTs fit into their daily lives. Domestication theory constituted the major theoretical framework employed to carry out this analysis. This framework comprises of five dimensions: In the commodification dimension, house members in question construct an image of the ICTs based on what they see, read or hear from numerous sources. In the appropriation dimension, which combines the objectification and incorporation stage, the house members accept the use of ICTs in their physical environment. This space is situated within the confines of their lifestyle and daily routines and the ICTs find a physical place within public and private environment. For instance, the technology is awarded a symbolic space within house members' daily rituals, structures and routines. In the conversion stage, house members share their ICT experiences with people around them, based on the factors which define their existence.

Participants mentioned benefits of ICTs at home such as facilitating communication and work, helping children to complete school work, entertaining house members and, finally, keeping house members informed about what is going on in the outside world. On the other hand, participants claimed that ICTs mostly serve as a distraction which leads to poor family quality time, children being exposed to inappropriate content and conflict between parents and children trying to control their use around the household. Briefly, although there are numerous risks involved in the use of ICTs in households, the introduction of ICTs into households is beneficial in the long run.

There are limitations to this study and further research is needed. This enquiry has been a small and localised study based on two developing countries and has focused on ICTs' use in families. Future studies should consider investigating and comparing the results with other developing countries. It is important to analyse why, when, where and how household members use technology, especially by comparing the people living in rural areas to those living in larger towns.

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# THE ACCEPTANCE OF SOCIAL MEDIA IN INTRA-ORGANIZATIONAL RELATIONS IN A HIGHER EDUCATION INSTITUTION

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## ABSTRACT

The popularity of social media causes that in many cases they take over the informational functions of organization websites. The article presents the results of the survey of such service users in an academic environment. The study shows that students evaluate positively the use of social media by academic authorities. They accept extending functionality of traditional websites by social networking sites, and the possibility of using social media in intra-organizational communication in a workplace environment.

## KEYWORDS

E-society, social media, social networking services, intra-organizational communication.

## 1. INTRODUCTION

The first websites which deserve to be called social networking sites emerged in the late nineties of the twentieth century (Boyd & Ellison, 2007). They were formed mainly as the initiative of individuals or groups in order to create the best environment for the integration of people around certain spheres of activity (for example: social, cultural or ecological).

Although social media are addressed to general public, some authors aim their content to private audience, for example members of an organization to which they belong, including work colleagues (Dutta, 2010). Following that path, social networking services addressed to the intra-organizational communities, such as universities or corporations, emerged usually as bottom-up initiatives of individuals, small groups or associations. Such is also the origin of Facebook. It was launched in February 2004 at the Harvard University, and at that time it was accessible only to students of that institution. Later, it expanded its range to other Ivy League universities, until it spread to other American and Canadian universities and finally worldwide (Phillips, 2007).

Growing popularity of social media led to the business recognition of social networking services as valuable media, first by non-profit organizations (Curtis at al, 2009), later by commercial companies (Mikalef at al, 2013). First, they used them in marketing and public relations (Brown, 2009; Eyrich at al, 2008; Petrescu and Korgaonkar, 2011; Ramsaran-Fowdar and Fowdar, 2013) then to get feedback in market research (Casteleyn at al, 2009). Organizations also recognized the potential application of social media services as a platform for intra-organizational communication and collaboration (Cao at al, 2012; Leftheriotis and Giannakos, 2014). Therefore from the point of view of a business organization two main areas of social media utilization can be distinguished:

- external communication addressing current and potential customers,
- intra-organizational communication.

Further considerations in this article pertain to the second area of application.

Social media have been particularly strongly explored by academic institutions. They use them not only for marketing purposes to draw attention of potential students, but also for integrating academic communities and in a teaching process (Moran et al, 2011). Most social networking sites in academic environment are initiatives of individuals, e.g. faculty staff commenting academic life and current research, students organizing social activities. However, some academic institutions or their organizational units run official social networking services, including blogs (Polak, 2014).

## 2. SOCIAL NETWORKING SERVICES OF ACADEMIC AUTHORITIES IN THE WARSAW SCHOOL OF ECONOMICS

Academic communities are numerous and very diverse collectivities. They include three main groups: academic staff, administration employees and students. The last of these groups is the least associated with the university. Students come and go. At the beginning of the studies they tend to be lost in a new environment. They poorly know their rights and obligations, and they do not know much about the events happening at the university. Later they often lack time and inclination to participate in university social life and activities exceeding requirements arising from the program of study. This threat is particularly possible in city universities (Haidrani and Haidrani, 2014). In such case, the social networking services can play important role in communication and integration among students as well as between students and academic organizations and university authorities.

An issue an unsatisfactory level of communication between academic authorities and students was diagnosed in 2012 by a newly elected dean responsible for graduate studies at the Warsaw School of Economics (WSE). The WSE is a typical city university oriented towards economics, management and related fields. Students of that institution often hold internships or work parallel to their studies. It causes that they restrict participation in academic life and staying at the university to a required minimum. In response to this challenge the Dean of Graduate Studies Dr. Magdalena Kachniewska and the Vice Dean of Graduate Studies Dr. Katarzyna Górak-Sosnowska started an initiative to create official social networking services of the Graduate Dean's Office (GDO). According to the deans, the purpose of their initiative was "to improve the flow of information and to make simpler (and even enable!) obtaining the opinions of students and faculty members on procedures, rules and service quality of the Graduate Dean's Office" (Kachniewska and Górak-Sosnowska, 2012).

Within the framework of the project established by the Graduate Dean's Office, three mutually related social networking sites were created:

- The Facebook page: Yes for the Graduate Dean's Office (*Tak dla DSM*) – <https://www.facebook.com/pages/Tak-dla-DSM/206263802749991>,
- The official Twitter account of the WSE Graduate Dean's Office – [https://twitter.com/Dzieknanat\\_SM](https://twitter.com/Dzieknanat_SM),
- The blog of the Graduate Dean's Office: On the other side of the window (*DSM: po drugiej stronie okienka*) – <http://takdladsm.blogspot.com/> (see Figure 1).

All three sites are linked together. They contain similar content provided by the creators of those services. However, the leading informative role is played by the blog. In case of longer posts, the other sites provide links to the main text on the blog.

Within two years since the creation of the GDO blog (from 29 September 2012 to 28 September 2014) 321 main entries appeared on the blog, an average of more than 13 entries per month. However, monthly distribution of these entries is not equal. Least entries, only two, appeared in the month of the holiday season in August. On the other hand the most, as many as 71, in October, the first month of an academic year. Most of the entries are accompanied by numerous comments of students and additional explanations of the blog authors.

Since their establishment, the GDO social networking sites have become an additional channel of communication not only with students but also with faculty members. The emergence of the services and their content have been widely discussed in the academic environment. They exemplify a qualitative change in communication of the university authorities with the students. In contrast to the formalism and laconic content of official websites, the GDO social networking services provide an opportunity for in-depth explanation of different issues concerning students and draw their attention to the important details often overlooked when communicated by traditional and more formal channels.

However, there were no robust data to confirm the actual usage and acceptance of those services. Hard data from a blogging service on the number of visits and the number of comments do not inform about popularity and acceptance of the services.

## DSM: po drugiej stronie okienka

Strona główna
Netykieta
Regulamin studiów w SGH
Organizacja roku akad.
Kontakty
Oświadczenia do POL-on
Magdalena Kachniewska

Katarzyna Górak-Sosnowska

13 wrz 2014

### Zamieszanie wokół magisterki



Zasypują mnie Państwo pytaniami o ew. losy tych, którzy nie złożyli w terminie (i co więcej już wiedzą że nie złożą także we wrześniu) prac magisterskich. Zgodnie z obowiązującymi regulacjami (regulamin studiowania plus Ustawa o szkolnictwie wyższym) poza tym jednym przedłużeniem (do końca września) nie ma więcej możliwości przedłużania terminu złożenia pracy.

Niezłożenie pracy w terminie oznacza skreślenie studenta; najpierw wysyłamy ostrzeżenie o grozącym skreśleniu, a następnie informację o skreśleniu. (Tu mizerna, ale jednak, podpowiedź, że daje to Państwu jakieś dwa tygodnie zwłoki).

Większym problemem jest dla mnie odpowiedź na pytanie, co dalej. Dotychczas (na mocy starego regulaminu) istniała możliwość odpłatnego wznowienia na czas obrony lub powtarzania IV semestru (w praktyce samego seminarium magisterskiego), ale sąd odrzucił obie te formy jako niezgodne z Ustawą. Sąd dopuszcza wyłącznie powtarzanie całego semestru, a nie samego seminarium -

Zapisz się, żeby nie przegapić ważnych informacji!

Szukaj w tym blogu

Łączna liczba wyświetleń



Figure 1. An entry “Confusion over the thesis” in the blog of the WSE Graduate Dean’s Office (<http://takdladsm.blogspot.com/>)

### 3. THE DESCRIPTION OF A STUDY

The purpose of a study was to examine whether the Graduate Dean’s Office social networking sites actually fulfilled the communication function and whether the usage of social networking services in intra-organizational environment was accepted by potential users, in that case graduate students. The survey was conducted using a group administered questionnaire, hence the respond rate was 100%. The high level of external validity was achieved due to the distribution of questionnaires to the students of randomly selected classes from all different majors studied in the WSE at the graduate level. The survey was conducted over a year after the start of the social services, in December, the third month of a semester. A total of 113 properly filled questionnaires were analyzed.

The survey consisted of two parts. The aim of the first was to examine the extent to which those services met the assumed role. That verification was quantitative. It was examined what part of the student population to which social networking sites were addressed actually used them and what was the declared frequency of visiting them.

The second part of the study was designed to test the opinion of students on the GDO social networking sites, as well as their assessment of the reasonableness of the use of social media in intra-organizational relations. A series of questions regarding their individual assessments of the usefulness and usage satisfaction of the sites was formulated using a five-level Likert scale.

### 4. THE USAGE OF DEAN’S OFFICE SOCIAL NETWORKING SITES

The first aim of the questions in the survey was to find out how many students use the GDO social networking sites and how often they visit them. It turned out that just over 20% of respondents had never visited those services (see Figure 2). Moreover, most of the students who responded that way explained that they just had never heard about them. These responses were quite surprising, because the information about the social networking sites and links to them had been published both on a regular university website and in other media, including notes in traditional showcases in front of the Dean’s Office.

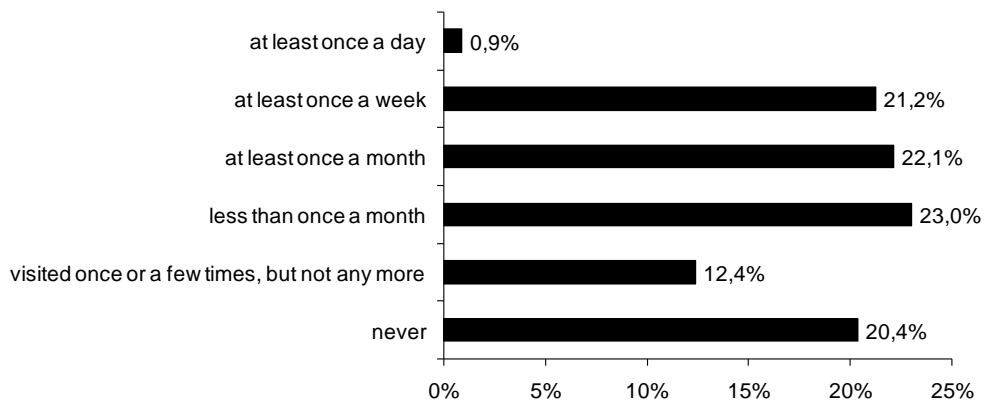


Figure 2. The frequency of visiting by students the social networking services of the Graduate Dean's Office at the WSE.

In order to recognize a web service as an important communication medium, it should be visited reasonably frequently by persons to whom it is addressed. In case of the Graduate Dean's Office social networking services, taking into account the incidences of new messages, it can be assumed that a student should visit the sites at least once a month, and it is desirable that he visits them at least once a week. The study showed that only 44.2% of respondents use the services at least once a month or more, and 22.1% do so regularly, at least once a week. Polak (2014) presented the discussion of the detailed quantitative results of this part of the study.

## 5. QUALITATIVE EVALUATION OF DEAN'S OFFICE SOCIAL NETWORKING SITES

Since the Dean's Office social networking sites were supposed to serve primarily as a communication medium between the Dean's Office and students, the questions in the survey were to verify students' subjective perceptions regarding being informed about important for them university issues. These questions were directed only to those students who declared that at least once visited those sites. Therefore, students questioned in this part of the study constitute 79.6% of the original study population.

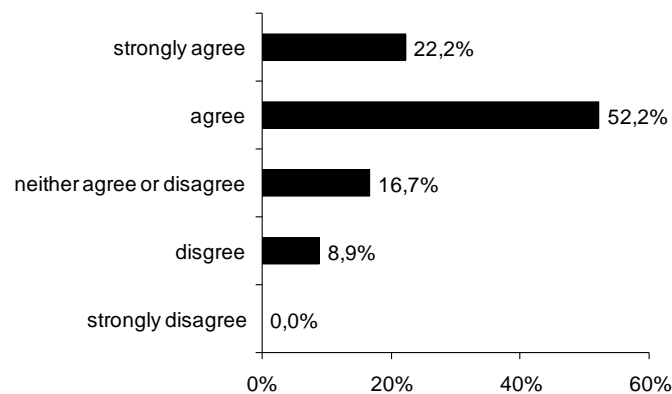


Figure 3. Respondents' answers to a question whether they are better familiarized with study matters due to Dean's Office social networking services.

The first question in that part of the survey examined whether students are better informed about study matters due to the Dean's office social networking services (see Figure 3). 74.4% of respondents answered positively to this question, while only 8.9% disagreed. Moreover, no one indicated an extremely negative response.

More conclusive, not based so strongly on subjective feelings, effects of the use of social networking sites were studied with a question whether it had ever happened that the information important for the respondents would not have been found out in time from other sources, if not the GDO social networks sites (see Figure 4). The occurrence of such a situation was confirmed by the vast majority of respondents, as many as 65.5%. In contrast, a negative answer to this question was given precisely by one fifth of respondents.

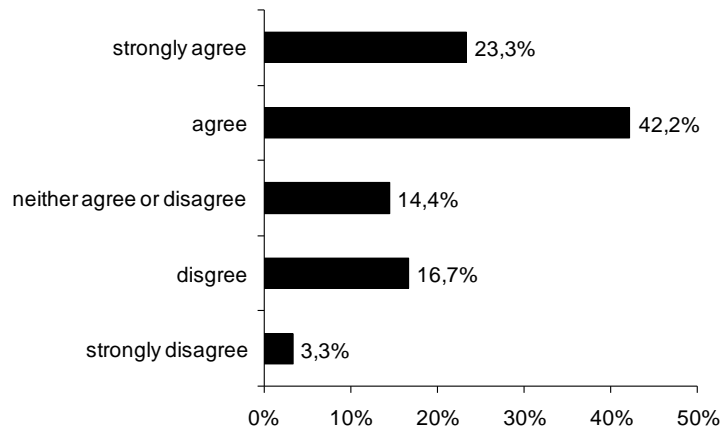


Figure 4. Respondents' answers to a question whether it occurred that the information important for the respondents would not be found out in time from other sources, if not the GDO social networks sites.

The importance of those social networking sites for students and their attachment to them was verified by answers to the question whether the respondents would be disappointed if the GDO social networking services ceased to function (see Figure 5). The distribution of responses was similar to the previous questions. 68.9% of respondents answered positively, and only one-tenth of questioned students gave negative answers.

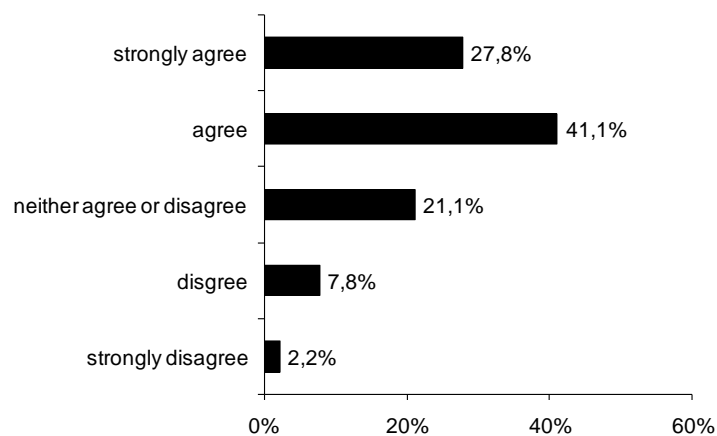


Figure 5. Respondents' answers to a question whether they would be disappointed if the GDO social networking services ceased to function.

Answers to three questions presented above clearly confirm that the vast majority of students assess positively the GDO social networking services and they feel better informed about matters related to university life. However, it is not possible on this basis to determine whether the cause of this phenomenon is general positive reception of social media as communication tools in intra-organizational relations or the cause of the success of those sites lies in the weakness of traditional communication channels of the WSE including standard internet service. The next group of questions was aimed on the verification of those doubts.

## 6. RECEPTION OF SOCIAL MEDIA IN INTRA-ORGANIZATIONAL RELATIONS

Satisfaction and positive user experience with the use of social media for communication within a single organization should be reflected in a positive attitude towards the use of such services in other organizations. Therefore, the last group of questions concerned the respondents' opinion on the possibility of the use of social media by other academic units and by present or future employers.

The first question in this group concerned people's views on the possible creation of social networking sites operated by other organizational units of the Warsaw School of Economics, e.g.: other deaneries, a library, etc. The study showed that students are very favorably to such initiatives (see Figure 6). 65.6% of respondents believe that such services should be developed. While only 13.3% disagreed, including only 3.3% strongly opposed to that idea.

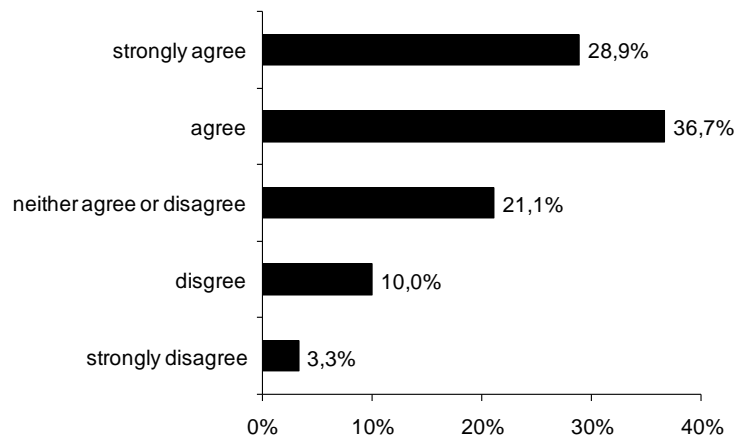


Figure 6. Respondents' answers to a question whether other organizational units of the WSE should create their own social networking sites.

The study participants were also asked whether they would like to see the use of social networking sites to distribute information to employees in their current or future work (see Figure 7). This question was issued again to all study participants. And in this case, the majority of respondents (57.6%) supported that idea. However, the amount of positive opinions was lower than in all the above cases. The number of answers "strongly agree" was reduced by almost 10% compared with the question about the services of university units. At the same time, there was a significant number of strongly negative responses (8%), compared to the amount of such responses not exceeding 3.3% in all other questions concerning the use of social networking sites. Hence, students supported the idea of the use of social media in the workplace, but they were more cautious in their opinions than in case of using them by academic institutions.

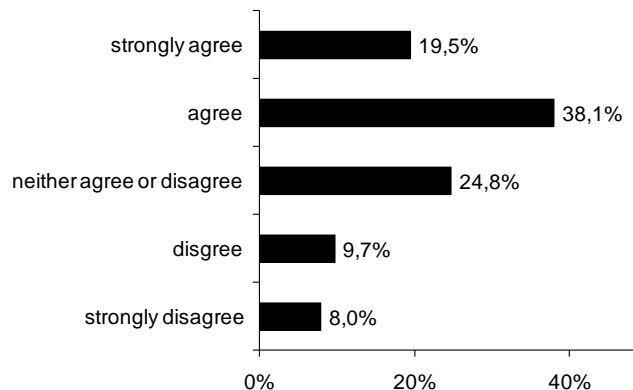


Figure 7. Respondents' answers to a question whether they would like to see the use of social networking sites to distribute information to employees in their current or future work.



The GDO social networking services provide only supplementary information channel. The respondents were asked whether in their opinion those services, after appropriate additions and extensions, can completely replace the GDO traditional website (see Figure 8). In this case most answers (56.7%) were negative. However, a significant group, more than one quarter of the students saw such a possibility.

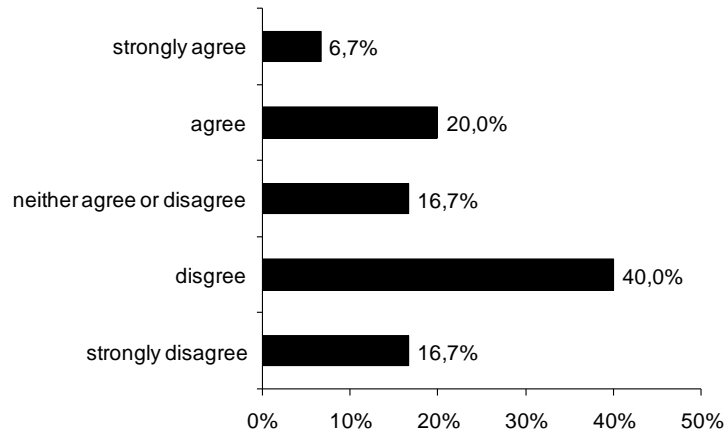


Figure 8. Respondents' answers to a question whether the GDO social networking services can completely replace the GDO traditional website.

## 7. CONCLUSION

The study showed that social networking sites can be used to enrich information content in communication between the university authorities and students. The usage of social media was positively evaluated by the students. They also expect the expansion of social media usage to other areas of university life. However, students do not think that social media can completely replace traditional websites.

Most respondents expressed positively about the possibility of the use of social media in intra-organizational communication in their current or future workplace. The dominant positive attitude of potential users suggests that the popularity of social media applications for internal communications will grow in future. However, a significant proportion of respondents did not use the social networking services at all. They were satisfied with existing communication channels, primarily traditional internet service.

The study examined only the users of social networking sites. Further research is needed to study an attitude of managers and administration staff towards such services. It is worth noting that within 2 years since the establishment of the Graduate Dean's Office social networking sites, despite the general positive response, none of the other units of the Warsaw School of Economics has created similar services. Therefore, potential barriers to the spread of social media applications in intra-organizational communication are not on the side of users, but rather organization authorities.

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# COMMUNICATION AND TOURISM 2.0: ANALYSIS OF CONTENTS AND TOOLS IN GOVERNMENT SOCIAL NETWORKS AND WEBSITES IN IBEROAMERICA

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## ABSTRACT

The contribution of tourism as a promoter of social and economic development is strengthened at the international level thanks to the emergence of new destinations. The activity has become one of the economic sectors of broader global growth. The tourist digital communication acquires special relevance and is taken advantage of by the national Governments of the countries of Iberoamerica as a platform for the promotion and dissemination of their offer. This research identifies the tourist communication channels used by government agencies and analyzes the content and tools used for the positioning of countries as a tourist destination.

## KEYWORDS

Tourist communication, digital communication, tourism promotion, tourism in Iberoamerica.

## 1. INTRODUCTION

Digital tourist communication acquires relevance depending on the behavioral changes that have appeared in the traveller, especially in the process of selection and purchase that are influenced by the growing use of the Internet and social networks. Currently, the user takes center stage because "goes from being a mere spectator and consumer of providing Internet to become creator and generator of contents and services... participate actively (Nafría: 2007: 15)." In this way, being tourism a global activity, the promotion and dissemination of the destinations and tourist services must be adapted and updated to meet the needs of the customer". Aspects such as the growing trend of eliminating intermediaries and direct purchase online packages or tourism products; the independent (without an established program) travel; the emergence of search engines of low-cost tourist services that provide rating service and customer service; portals and blogs of recommendation for travellers; sites of geo-referencing, among others, have changed the conception of communication tourist promoting a convergence towards digital and social. These changes have also allowed new destinations through the promotion and dissemination on the Web from entering the international market, generating significant economic growth in the sector. According to the reports published by the World Tourism Organization (UNWTO), specialized agency of the United Nations and in charge of the promotion of responsible, sustainable tourism accessible to all, "in 2013, total income derived from exports that generated international tourism reached the \$ 1.4 trillion. Income earned by the tourist destinations due to visitors from other countries grew at a 5%, reaching 1.159.000 million dollars".

Iberoamerica countries have chosen tourism as an alternative for sustainable development, reason by which national Governments have created specialized agencies in the sector in order to strengthen the supply and position itself as tourist destinations. To meet these objectives plans and policies of communication have been generated which are strengthened with digital strategies and 2.0, being discussed as the object of this research to study: identify the Government agencies responsible for the promotion of tourism and communication processes used; (b) analyze and classify the contents that are published on web portals and social networks of the tourist agencies in Latin America to identify the type of tourism that promote and c) recognize the resources used on the official website for promoting tourism in the region.

## **2. METHODOLOGY**

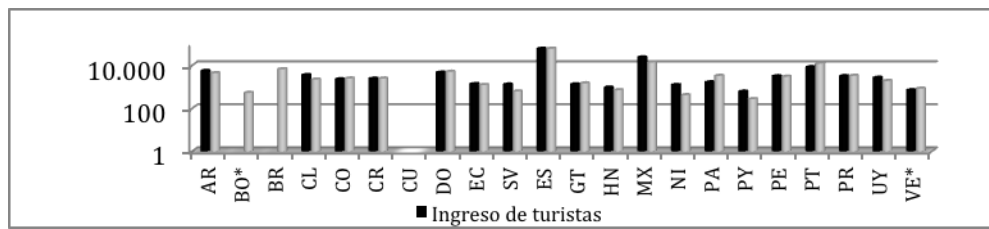
Through the bibliographic collection this research enabled us to identify and analyze communication processes that have been developed in Iberoamerica countries. Digital communication through web portals and Government social networks of international tourism which the Iberoamerica countries present to identify the published contents that allow tourists to select a specific product or advise in planning the trip were examined. Analysis of web profiles was conducted during the month may 2014, prior to the international tourist high season period as identified by the WTO. That monitoring helped us to select the governmental institutions responsible for the tourist communication and web portals used for this purpose. Using research cards and classifying the diffused contents, origin and trend, number of tourists, economic impact of tourism, specific promotion plans were determined.

Web information of 22 countries that make up Iberoamerica were examined to identify tourism promotion platforms linked directly from the governmental agencies responsible for this activity. Institutional websites and social networks were selected for cataloging content and digital resources used; use of digital media; segments of tourist communication by geographical criteria or by type of tourism; available information for tourists to plan the trip; use of resources from support, maps, mobile applications, tourist guides, explanatory brochures, guided tours, audio guides and augmented reality simulators; multimedia resources and presence and activity in social networks generic such as Facebook, Google, Twitter, Flickr, Pinterest, Instagram, and YouTube. The diffused contents and formats used as tourist visualization tools were also discussed and analyzed. To meet the aimed objectives a matrix of research was designed to record the results from the monitoring conducted at communication platforms in the month of may 2014, which allowed to carry out a qualitative and quantitative evaluation of them.

## **3. TOURIST COMMUNICATION IN IBEROAMERICA**

The Iberoamerica countries have developed tourism in different periods, the European states that make up the region, found a century ago, favorable conditions and invested in infrastructure to strengthen the tourist offer, according to the report by the WTO in 2014 Spain is the only country in the region that is part of world based list of the 10 main tourist destinations on the number of tourists visiting the country and economic growth generated by the activity. In the mid-20th century in the countries of North America, Central and the Caribbean tourism emerges thanks to the economic boom in the United States, new important tourist destinations arose that have managed to position internationally, as in the case of Mexico, which ranks the second in the region with higher incomes thanks to this activity. The development of the activity in South America begins with domestic tourism until countries get gradually enter the international market by investing in infrastructure and betting on the international tourism promotion. According to Panorama 2014 Issue, 3% in South America growth remained in line with the average in the region. Against this background, national Governments ministries, secretariats, offices or institutes - of each country begin and enter to compete in the international market making a very similar offer, due to the geographical and social features that the region show and present, which extend the offer to attract and generate new market segments to satisfy the needs and tastes of tourists who increasingly demand a more customized product and a more participative and less contemplative travel experience .

Convergence towards the promotion and tourist digital broadcasting is reflected by the use of web portals and social networks by government agencies of tourism promotion. Out of the 22 countries that make up the Iberoamerica region only Venezuela and Puerto Rico lack of a portal for the tourism promotion using an institutional portal to disseminate the Organization's information. Brazil, Spain, Paraguay, and Uruguay have developed mixed portals, divided into sections that are intended for a specific tourist communication and organizational communication. On the other hand, countries such as Argentina, Bolivia, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru and Portugal in their institutional portal link an independent tourist portal aimed at the international promotion.



Source: Proceedings online magazine Latin: <http://www.revistalatinacs.org/14SLCS2014actas.html>

Graphic 1. Tourists and foreign exchange revenue.

Social networks are also part of the strategy of communication employed by government agencies; Due to its acceptance in the region.

Table 1. Presence in social networks

Social Network	AR	BO	BR	CL	CO	CR	CU	DO	EC	SV	ES	GT	HN	MX	NI	PA	PY	PE	PT	PR	UY	VE	
Facebook																							
Google +																							
Twitter																							
YouTube																							
Instagram																							
Pinterest																							
Flickr																							

Source: Author s Personal research

### 3.1 Content, Tools and Digital Resources

Tourism is one of the economic activities in which the influence of new communication and information technologies has generated important changes incorporating a myriad of platforms, applications, and opportunities to promote and disseminate tourism products, becoming a strategy of international visibility that the Governments of Iberoamerica, have implemented to add and ease the possibility of establishing a direct relationship through interaction enabling thus social networks. Content management is extremely important at the time of implementing the strategy of digital communication by which the 68.2 % of the governmental portals distributed the contents in two types of search: by location or geographic area or according to segments of tourism, facilitating the experience collecting information and trip planning. The 18.2% used as the sole criteria segmentation by type of tourism and the 13.6 % does not employ these criteria for publication of information.

**Argentina** presents its offer concerning sport and adventure in its web site. City tourism, gastronomy, nature, family on the web portal and is the only country in the region to identify a new market segment; the tourism of bird watching. Social media makes visible segments different to those intended to enter. This way on Facebook, with a rare update (16 posts in a month), the 31.25% of publications are answers and interaction with the public, 25% to disseminate activities relating to sports and adventure, the 12.5% presents information about institutional news, city and gastronomy tourism and the 6.25 % encourages cultural tourism. Sports and adventure and City tourism is promoted on Google with 2 % post. On Twitter, with an average of 4 daily publications, spreads the institutional news (48), 25 % offer city tourism, 13% cultural, 5.3%, sports and adventure, and in the same proportion interacts with his followers; 1.5% posts promote tourism and dissemination of institutional information. On Flickr, 7 publications 28.6% are used to portray a fair city, gastronomy and nature tourism segments, and the 14.2% to disseminate culture and traditions. Instagram with an average of 3 daily publications, the 89.9% published photographs sent by the followers, encouraging interaction. In a smaller proportion (3.8%), nature tourism is promoted; cultural and gastronomic (2.5%) and city (1.3%). On Pinterest with 236 posts since its creation (40.7%) promotes City tourism; (20.3%) publicize cultural nature; (16.5%) gastronomy; (11.4%) sports and adventure (11.1%). With two videos YouTube promotes sports and adventure and City tourism. Segments as family tourism and birding are excluded from promotion in social networks giving way to cultural tourism. For the promotion of the tourist destinations on the web pictures and videos are used, however, the text does not have hyperlinks to broaden information; Unlike the narrative used to promote on social networks, which uses videos, photographs, hyperlinks, hash tags and mentions. Another difference that makes visible the communication on different platforms is that on the web portal advice in the trip planning process, providing information

about what to do, how to get? And tourist calendar too; provides data on mobility in the country; and delivered resources such as maps, brochures, augmented reality, guides, travel, mobile applications and audio guides, information and resources that are not used in social networks.

**Bolivia.** On the website of this country cultural tourism, sport and adventure, rural or existential, nature, shopping is offered and a new market segment is opened: Mystic tourism. New segments are identified in their promotion on social networks, this way on Facebook with an average of 3 daily publications tourism in city (34.5%); gastronomy (15.5%), cultural (9.5%), sport and adventure (7.1%), also news broadcasting (4.8%) and information (1,2%) institutional and interaction is promoted in the 3.5% publications. Tw (10%), sports and adventure (16%), cultural (3,4%), and the accessible (1%); There is also News (14.6%) and institutional information (3,%). YouTube shows only one video aimed at the promotion of the country. It can be concluded that messages intended for the promotion of tourism do not maintain a relationship in its various channels, as rural and experiential tourism, shopping and mystic segments are not broadcast on social networks, in these spaces are new alternatives such as gourmet, from town and accessible tourism. For the elaboration of messages for the promotion of tourist destinations only photographs are shown, unlike the narrative in social networks, which includes photographs, videos, hyperlinks, mentions and hash tag. The website advises tourists in the planning process providing references on entry requirements, weather information, what to do, how to get? tourist calendar; it also shows tourist accommodation and mobilization services and allows to download maps and mobile applications, which are not possible on social networks.

**Brazil.** On its website promotes sun and beach, sport and adventure, experiential, or rural nature, conventions and events, cultural and idiomatic tourism. Additionally it identifies two new market segments which, thanks to investment in tourism infrastructure, can serve the accessible tourism and for senior people. Social media presents new market segments and avoids promoting tourism whether idiomatic or experiential, conventions and events, or rural t. On Facebook with an average of 2 daily post the Government agency disseminates information regarding sport and tourism adventure (20.8%), city (18%), nature (12.5%), gastronomy (4.2%), cultural, religious (2.8%) and sustainable tourism (1,3%). 4.2% of content generate interaction with the public, 20.8% disseminates institutional information, 4.2% organization news, 2.8 % are greetings and congratulations. Travel advice is also considered on social networks, 2.8% of publications consist of information for tourists and motivation to travel. Google with 2 daily post advertises tourism sport or adventure (21%), city (15.5%), nature (11.2%), cultural (5,6%), gastronomy (4.2%), religious (2.8%), sun and beach tourism (1.5%). 17% of posts are intended for institutional information, 4.2% to social campaigns against child prostitution and violence to women and 1.4% correspond to greetings and congratulations. The network also provides information (2.8%) and (4.2%) tools for tourists; It encourages travel, (2.8%) and interacts with users (4.2%). In Twitter the network is being saturated with an average of 24 daily publications, of which the 2.2% correspond to the interaction between the Organization and his followers, 16% institutional information disseminated, the 12.7% guides tourists through the information provided and 8.6% delivers tools for the traveller, 5.5% encourages travel, 0.7% are news and institutional greetings, 7.5% are dedicated to social campaigns to stop child sex tourism; the network promotes tourism city (9.2%), cruises (8%), sports and adventure (7.6%), sustainable tourism (6.4%), and beach (4%), senior (3.6%), nature (3.3%), cultural (2%) food (1.5%) and religious (0.7%). Instagram shows an average of 3 photos per day that promote tourism to nature (31%), sun and beach (30%), city (15%), cultural (6%), sports and adventure (3.1%), gastronomy and religious (1%). 6% motivates to travel and 2% of total content are tools for tourists and greetings and congratulations; 1% is dedicated to social campaigns against child sex tourism and news of the organization. With t 2399 publications since its creation Pinterest promotes: (63%) City tourism, gastronomy (3,.) sport and adventure (2%), nature (1.6%), Sun and Beach (1.3%), religious (0.08%) and cultural tourism (0.5%). Institutional news is broadcasted in 22 publications and encouraging and inviting to travel in a 6.5 % of the posts. The web portal as well as in social networks information to tourists to help trip planning is provided. Advising on what to do, how to get, tourism calendar and weather information appear there. A complete listing of all tourist services is provided along with the possibility to download maps. In terms of digital storytelling on the web portal are completed with text and photographs in contrasts with content in social networks which shows images, videos, hash tag and mentions.

**Chile.** On its website sports and adventure, rural or experiential, gourmet, nature, wellness and relaxation, business, cruises, romantic, archaeological tourisms are offered being the only country that due to its geographical location promotes astronomical tourism, which is not mentioned however, in their social networks. During the month of may the Agency published 29 ads related to tourism of nature (69%), city (10.3%), sun and beach, gastronomy (6.9%), cultural and sports and adventure (3,4%) appeared on Facebook.

Update is very infrequent in Google +; with 6 monthly publications promotes the gastronomic tourism (33.2%), nature, city, sport and adventure and culture (16.7%). On Twitter with 9 post during the month of analysis sport and adventure tourism (33.4%) gastronomic, cultural tourism (22.2%), nature, city (11.1%) are promoted. Flickr features a publication of City tourism. Pinterest account has 198 photos since its creation aimed at promoting tourism of nature (86.9%), country (11.1%) and provides information for tourists (2%). The tourism organization portrays on the web more complete information to help in the process of planning the trip such as currency, what to do, how to arrive, tourist calendar and weather information. In terms of tourist services only mobility is directed, but it permits maps and brochures download, completing the promotion of the country with virtual tours. Another advantage of institutional web is the narrative that includes videos, photos and hyperlinks of tourist attractions, however, social networks fail to show video, complementing the information with photographs, links, hash tag and mentions. **Costa Rica.** Alternatives of cultural, sun and beach, sport and adventure, rural or existential, nature, wellness and relaxation, business, cruises, romantic, archaeological and family tourism are offered on its website. With the publication of a daily post on Facebook promotes tourism for: nature (26.5%), sun and beach, sport and adventure (23.5%), cultural (11.8%), city (8.8%) and sustainable (3%). Information for tourists is delivered in addition in 3 of its records. Using Twitter, which is updated less frequently, 11 posts were displayed during the month of May to advertise nature tourism (36.4%), Sun and Beach (27.3%), sports and adventure (18.2%), and gastronomy (9%). Pinterest network with little activity since its creation has published 69 photographs to promote tourism of city (53.6%), nature (33.3%), cultural (8.7%), religious (2.9%) and sports and adventure (1.5%). YouTube presents two videos to promote nature, sun and beach tourism. As it can be noted segments such as rural or experiential, well being and relaxation, business, cruises, romantic, archaeological tourism are not disseminated in the social networks. The web portal provides information for trip planning such as the country entry requirements, currency, how to arrive, tourist services as accommodation, travel agencies and rent of vehicles. It is designed to accompany tourists during the journey with maps, brochure, travel guides download, mobile applications, and provides a virtual guided experience. Images and hyperlinks are used on the web portal to disseminate contents. Facebook shows videos and photographs as opposed to Twitter that includes links, pictures and hash tag.

**Cuba.** Cuban website meets the demands of 7 tourist segments: cultural, Sun and beach, sport and adventure, health, city, nature, conventions and events, showing a slight variation with the offer proposed on the unique relevant social network, Facebook, with an average of 8 daily activities, 41.4% posts are information 0.4% greetings of the institution; the network is also used to promote tourism in city (13.8%), cultural (9.3%), sport and adventure (7%), nature (6.25%), religious, rural or experiential (5.9%), Sun and Beach (5.5%), gastronomy (1.6%) The 3% left are information that helps the tourist. Cuba on the web portal geared to tourists with information of how to get? Admission requirements, providing besides with information for currency, a search engine to look accommodation services and travel agencies and guided tours services. The information on the web is explained with photography only in contrast with Facebook, which includes other resources such as videos, links, and hash tag.

**Dominican Republic** tourist website promotes cultural, sun and beach, sports and adventure, city, nature, wellness and relaxation, shopping, cruises, romantic, archaeological and family tourism. This trend is kept on social networks. Posting on average twice a day, Facebook promotes the cultural tourism (22%), sport and adventure tourism (17.6%), Sun and beach, romance (8.8%), gastronomy (7.4%), city (4.4%), nature, wellness and relaxation, shopping and accessible tourism (3%). A (16%) is used to provide information for tourists and (3%) for institutional greetings. Twitter account is updated 6 times a day to disseminate content relating to sport and tourism adventure (13.6%), Sun and Beach (12.5%), cultural (12%), gastronomy (8.5%), town (4.5%), romance (4%) nature (2.8%), well-being and relaxation, accessible tourism (1%), health, shopping (0.6%). Information to plan the trip is provided to the tourist through this network (4%). There is a space for institutional communication of (24.4%), institutional greetings (3.4%) and 6.8% of the post are dedicated to interaction with the user. Instagram updates are less frequent (22 post in a month), are used to disseminate content related to sport and adventure (18.2%) tourism, gastronomy, Sun and Beach (13.6%), cultural (9%); nature, city (4.5%); information for tourists (4.5%) and advertising of tourist services (31.8%). A total of 369 pictures that promote tourism of Sun and Beach in (52.5%), city (15.5%), nature (7.6%), romance (6.8%), gastronomic (6.2%); have been published on Pinterest. Images also motivate travel and delivery information for tourists (5.7%). YouTube account was not updated during the analysis period. In terms of the resources that the organization uses to advise in travel tourism website is one of the most comprehensive since advises tourists in the Organization of navigation with content related to the

requirements for entry into the country, currency, climate, what to do, how to get? tourist calendar; It displays tourist services such as r housing, mobility with tourist maps download. The organization uses pictures and hyperlinks to distribute the information on the website adding videos, hash tag and mentions on social networks.

**Ecuador** promotes cultural, on its website tourism of many types: cultural, religious, of sun and beach, sports and adventure, gastronomy, city, nature, conventions and events and archaeological keeping the same trend of promotion on social networks. Facebook with an update of two daily publications, invites to enjoy tourism of nature (43%), gastronomy (20.3%), cultural (8,9%)sports and adventure, city (7.5)%, Sun and Beach (6.3%), shopping (3.8%); information and institutional greetings (1.3%) are also displayed in this network., In Google only 4 post can be found, allocated to the promotion of tourism in city (50%), gastronomy and nature (25%). In sharp contrast, Twitter shows an plentiful update which saturates information by publishing an average of 23 post, which aims to promote the tourism of nature (33.8%)gastronomic (25.8%), cultural (6.8%), city (5.2%), sport and adventure (4%), Sun and Beach (3.7%), internal (1%), religious (0.7%), well-being and relaxation, conventions and events (0.1%), information for tourists (0.9%). information (8.7%), news and institutional, greetings (0.1%) interacts with fans (7.9) are also issued, and this is the only country that markets its export products in this network (1,2%).A weird upgrade rate is applied to Instagram , with 4 publications in the month of analysis which advertise sport and adventure ,cultural, nature and gastronomy tourisms. On Pinterest there are 236 pictures published since its creation aimed to promote tourism of city (41%), cultural (20%), nature (16.5%), gastronomy (11.5%) and sports and adventure (11%). Videos posted on YouTube motivate the development of domestic tourism (50%) and shows the results of a national contest for rating and preferences. Similar to the trend in social networks in the tourist portal little accompanying is provided to tourists in planning the trip, finding only advises on what to do, mobility services and travel agencies presenting the application for mobile devices. For content transmission multimedia resources are used in ever platform, adding links, hash tag and mentions in social networks

**El Salvador** seeks access to the segments of tourism of sun and beach, sport and adventure, city and nature using social networks, there is a daily update on Facebook with one publication. This social network that distributes content related to tourism of nature (29.8%), gastronomy (21.3%), religious, cultural (10.6%), country (8.5%) sport and adventure, Sun and Beach (6.4%) and additional institutional information (6.4%). Flickr with 29 publications in the analyzed month serves to generate content to promote the tourism of nature (38%), Sun and Beach (31%), religious (17%), country gastronomy (7%). Institutional account on Pinterest shows 787 photographs that advertise cultural tourism (31.3%), nature (20%), gastronomy, Sun and Beach (15%), city (10.2%), religious (5.5%), sports and adventure (1%) motivation to travel (2%). Updating in YouTube is lower with only three videos where institutional information is disseminated and promotes nature and gastronomic tourism. The website includes instructions on what to do, How to arrive, currency information and travel agencies. There is also possibility to download maps and brochures. For content management on the web only photographs are included, differently from social networks where hyperlinks, hash tag and mentions are added.

**Spain**, which is considered one of the major world tourist destinations promotes on its website, cultural, beach, rural, or experiential, health, of city, gourmet, nature, shopping and idiomatic tourism. Accessible tourism is also offered, therefore it is the only country that has adapted its website to meet the communication needs of this population segment. Social media adds new segments, on Facebook with a daily publication disseminates information relating to tourism of Sun and Beach (39%), city, cultural (21.2%), nature (15%), religious (3%). On Twitter tourism organization saturates information with an average of 19 daily publications that promote tourism in city (26%), cultural (22.5%), Sun and Beach (14.5%), nature (13.7%), gastronomy (5.8%), sports and adventure, religious (3%), accessible, conventions and events, and scientific (0.2%), information for tourists (1.3%), organizational (2.6%), institutional (4.6%) greetings, motivation to travel (0.2%) interaction with fans 2.2%. 9 updates during the month of may on Instagram account give way to motivate the tourism of Sun and beach, nature (33.3%), city (22.2%) and cultural (11.1%) . YouTube broadcasts a video about sports tourism. In contrast with the scarce advice provided to the tourist on social networks, web portal includes information of interest for visitors as the requirements for admission to the country, currency, climate, what to do, how to arrive, the tourist calendar, tourist accommodation, mobility, accessible services and download mobile applications, travel guides, brochures, maps and enjoy the experience of a guided tour. On the web pictures and hyperlinks are used for tourist promotion; Facebook makes uses of photos and hash tag, in the case of Twitter links and videos are added.



**Guatemala** promotes on its website cultural, sport and adventure, health, nature, language learning, wellness and relaxation, business, cruises, romantic and archaeological tourism. The same emphasis is given through social networks: on Facebook with an average of 2 daily updates promotion of tourism of nature (38%), cultural (26.5%), city (14%), Sun and Beach (7%) gastronomic, religious (3.8%), sport and adventure (3%) is done, in addition 3.8% of its publications show the interaction that keeps with his followers. Twitter and YouTube accounts were not updated during the analysis period. Instagram publishes 24 photographs that promote tourism to nature (41.7%), cultural (33.3%), Sun and Beach (16.7%) city (4.2%) and promotion of interaction in 4.1% of the post. Since the creation of Pinterest account 517 photographs have been generated to induce interest towards the city in the traveller (31%), cultural tourism (30.5%), nature (11.5%) romance and beach (8.5%), gastronomy (2.5%) and motivating to travel (8%). The website allows organization to share information for tourists travel coordination, with information such entry to the country requirements, currency, climate, what to do, how to arrive; advice on accommodation and travel agencies; Download in mobile applications of brochures, maps and guided visits are encouraged, which does not happen on social networks. For the digital narrative in social networks both web portal uses photographs, hyperlinks, and hash tag. **Honduras** offer on the web portal portrays tourism of Sun and beach, city, archaeological, cultural, sport and adventure and nature using the platform to advise the traveler in What to do? Along with housing services using photographs in digital narrative these contents are not disseminated in their social networks Facebook and Twitter. No loggings or updates were registered during the analysis period.

**Mexico.** Using a specialized tourist provides segmented content to promote cultural tourism, Sun and beach, sports and adventure, city, romantic and archaeological. This offer is increased with new segments in its social networks dissemination, thus Facebook with two daily publications aims to reach travelers interested in cultural tourism (45%), Sun and Beach (15%) City (14%), nature, (11%) sports and adventure, gastronomy (7%), religious (1%). In Google with less frequent updates (23 post in the month) cultural tourism (48%), religious, country (22%), gastronomy (9%), religious, Sun and beach, sports and adventure, nature, shopping (4.2%) are thus promoted. Twitter account is updated daily with an average of 9 publications concerning cultural tourism (33%), city (15%), sport and adventure (12%), Sun and Beach (8%), gastronomy, nature (6%), religious (1%), travel advices (0.7%) tourists comments (5%) and institutional (0.7%) greetings, also interaction with followers (36%). Using Instagram with 4 publications sport adventure and cultural tourism are shown. Pinterest since its creation has stored 567 photos offering tourism Sun and Beach City (25%), romance (24%) cultural (6%), gastronomy (3.5%), religious (1%), photographs of celebrities visiting the country used as reference (34%). YouTube account has not been updates. As a support tool to tourists in the visit to the country the Government Organization has included in content: entry requirements, currency, weather, what to do, the tourist calendar, tourist mobility services and download maps, using photographs as a resource in the tourist portal and Facebook, adding hyperlinks and hash tag on social networks and video on Twitter.

**Nicaragua** is a country entering the tourism market by promoting tourism whether cultural, Sun and beach, sports and adventure, city and nature on the website, This offer grows on Twitter, this through a daily post generating institutional information (16%), 13% posts interact with fans and provide information to tourists in 7%; promotes tourism sport and adventure tourism (23%), city (19%), cultural (16%), gastronomic and Sun and Beach (3%). Even though the country tourist agency has presence on Facebook and Google, there is not update registered during the analysis period. To strengthen tourism promotion, the web includes information to facilitate the process of planning, proposing what to do, how to arrive, tourist calendar, lodging, travel agencies, restaurants and vehicles rental. To achieve goals the contents are prepared including pictures both on the website and on Twitter, where adds links, hash tag and mentions are added.

**Paraguay** tourist portal disseminates information concerning cultural, sport and adventure, nature and shopping tourism by using the various social networks, so on Facebook with an average of two daily updates cultural tourism (41%), nature (26%), sports and adventure (16%), city (4%) and gastronomy (2%), institutional information (8%) are logged. On Twitter, with an average of 4 updates daily, gives relevance to the interaction with fans in 58, 3% posts, provides institutional information; assigning the 39% for the promotion of tourism, distributing the contents in cultural tourism (17%), nature (11%), sport and adventure (8%), gastronomy (2%) and city (1%). Instagram 3 publications broadcast sport t, and adventure, nature and gastronomy tourism. To meet the tourist information demand the web portal includes information such as requirements for admission to the country, currency, weather, what to do, no information about tourism services is given, and is set to download brochures, maps and conduct guided tours. To disseminate the

information photographs are used on the web portal while social networks add hyperlinks, hash tag and mentions.

**Peru** offers in its web portal cultural, sport and adventure, city, nature, and archaeological tourism; however, social media provides various alternatives, thus on Facebook with 2 daily updates nature tourism (47%), cultural and gastronomic (12.3%), sport and adventure (8%), Sun and Beach (6%) city (4.1%), domestic and religious (2.1%) tourism are offered along with institutional information (2%) and interaction with users (4.1%). On Twitter with 7 publications in the period of analysis the tourism of nature (57%), cultural, sports and adventure (14.3%) are offered for enjoyment and interaction with fans appears in (14.3%). Even though this country appears on Flickr, the account was not updated during the period of investigation, YouTube channel is also used to broadcast content (4 post) related to domestic tourism (50%), cultural and city (25%). The web portal is the most complete in the region in terms of information for tourists, it provides advice on the requirements for admission to the country, currency, climate, what to do, how to get?, the tourist calendar, has a search engine for tourist services to find accommodation, mobilization, travel agencies, restaurants, vehicles, rental accessible services, and contact to tourist guides. It also supports to download mobile applications, brochures, and maps, audio guides and experience a guided visit. For the tourism promotion this Portal uses videos and photographs adding links, hash tag and mentions on social networks.

**Portugal.** On its website this country proposes cultural, religious, sun and beach, sport and adventure, health, food, family, nature, wellbeing and relaxation, romantic tourism and has identified the needs of young people by presenting specific offer for this population segment, being the only country in the region that does it, keeping a similar offer in social networks, so when reviewing Facebook we find an average of daily publications focused on the promotion of tourism sport and adventure (33%), city (21%), cultural (18%), nature, gourmet (8%), sun and beach, religious (5%); and romance (2%). Twitter with an excessive publication of an average of 36 daily posts city tourism with (22%) heads the list, Sun and Beach (19%), gourmet (12.4%), cultural (10.5%), sport and adventure (8.4%), nature (7.4%), accessible (0.5), conventions and events, wellness and relaxation, religious, language (0.2%), family, archaeological, cruise and romance (0,1%). It also publishes information and institutional greetings (0.5%), information (3.5%), (0,1%) tools for visitors and interacts in a 13% of the post with the followers. The country has two accounts to share images on Flickr that was not updated during the period of inquiry and Pinterest storing 13347 photographs intended for the promotion of city tourism (56%), sport and adventure (13.7%), cultural (12%), sun and beach (11%), nature (6.5%), family (0.5%), birds watching (0.3%). In YouTube account two videos that share tourists experiences in the country are published. Unlike social networks on the web portal delivers tourists hints to visit such as: country entry requirements, currency, climate, what to do, how to get?; tourist calendar, tourist services relating to accommodation, mobilization, travel agencies, restaurants and rental of vehicles are mentioned. There is also a availability of access to brochures, maps for download; information is delivered on the website accompanied by photography in contrast to social networks that adds video bonds, hash tag and mentions.

**Uruguay** offers religious, sun and beach, sports and adventure, gastronomy, nature, shopping, convention and events, idiomatic, and cruise touristic experiences, increasing new alternatives in its communication on social networks: Facebook with an unusual update (29 post per month) enter to the race for the tourism of nature (31%), sport and adventure (21%), city (17%) cultural (7%) and internal (3,4%), also advises tourists in planning trip through specialized information, transmitted information and institutional greetings (3,4%) and promotes interaction with the public in cited 10 records. Twitter accounts update more frequently in an average of 3 daily publications that offer cultural tourism (19%), city (15.5%) sport and adventure (6%), nature (5%), internal, gourmet (25%) and religious (1%); Information (22%) and salutations (1%) institutional, information for tourists (19%) are mostly published in this network and interaction with fans in (8%) in the same form on the website is delivered to the tourist information. Regarding the organization of the trip, the country sets the entry requirements, what to do, how to get? and tourist calendar, also accompanies it the trip through mobile applications. For the promotion of the country in web portal photographic resources are used in contrast with the social networks that use video, links, hash tags and mentions. **Venezuela.** Its website portrays three specific segments: tourism of sun and beach, city and nature. Only Instagram is used to enhance its promotion on the Social Web network Instagram, which is not frequently updated amounting 19 publications in the month of analysis in this network broadcasts (5%) institutional information and nature promotion (42%) gastronomy (21%), city (16%), cultural (11%) and sports and adventure (5%). The Government agency promotion channel does not publish information for tourists and only photography are used as a narrative resource.

## 4. CONCLUSION

Digital tourist communication is incipient in Latin America. Despite the fact of being an alternative to internationalize the tourism products, the governmental agencies responsible for the dissemination and promotion of the country have not yet obtained all the benefit they could. It is time to change the concept of communication towards the bi-directional sending of information and generation of digital, interactive and participative content that allow the user to experience and find the strengths and competitive advantages of each of the countries thus contributing in the purchase decision process.

The Content published by Government organizations demonstrates the influence of social networks and the behavior of tourists in the tourist promotion, new information and communication technologies allow tourist dissemination of Iberoamerica governmental agencies updating and adaptation of the offer, either depending on the season or the market trends. The contents differ from those published on the website by increasing ads of new products and discarding others without notice.

Managing and updating content on social networks demonstrates lack of planning in the digital media and 2.0, neither does it display an established plan for the promotion of tourism in the region since the contents are adapted according to the needs of the institution, thus updating them varies from one network to another existing very little update in some and saturation in others within the same country.

The published contents must be adapted to the digital narrative enabling the user navigate freely and managing his personal story. Tourism makes it possible to generate content in video, audio, photographic material that are not currently used in the promotion of the tourist attractions, and that should be included so that the visitor can feel and foresee the experiences that will later live in the country to visit.

There are tourist products positioned at the international level not presented on the web portal as a strength in the country. These references are shadowed by multiple and new tourism alternatives, so to meet the need to reach new market segments too much information has been generated to satisfy everybody and create new market niches by losing the already known strengths.

Tourism is nourished with experiences, so the needs of the user must be considered when generating the contents for the web portals contributing in each of the phases of selection and purchasing that the customer feels confident that the place to visit is the best touristic destination, not only because of the geographical area but essentially because of the experiences to enjoy. That could be envisioned through the supportive help and advise during the travel.

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# TOWARDS ACCESSIBLE E-LEARNING USING ESVI-AL PROJECT RESULTS

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## ABSTRACT

In this paper, the results of ESVI-AL project are presented. This project was worked in conjunction with Latin American and European Universities and was financed by the European Union. The aim of this project is to offer products that can help to the development of an accessible and inclusive e-Learning education. It consists of reports, practical guidelines, courses and software to install Learning Management Systems (LMS) with accessibility features. This work describes each of the main actors involved in e-Learning projects, and for each of them a profile is defined. Each profile consists of a series of recommendations based on the results of the project. The target users, to whom this project will be more use useful, are teachers, students with a physical disabilities, LMS administrators and auditors of the e-Learning quality. The intention of this project is to advance in an inclusive education, via an accessible e-Learning of good quality, by considering the results of the ESVI-AL project and its guidelines.

## KEYWORDS

Accessibility, quality, eLearning, disability, inclusive education, LMS.

## 1. INTRODUCTION

To assure inclusive educational systems at all levels; and through lifelong learning; it is a commitment of the states that conform the United Nations Organizations (UN, 2006). These states must assure that all people with disability have access to an elementary education, high school, university, lifelong learning and professional education without any discrimination and in equal conditions of all others.

In order to move towards an inclusive education, the use of alternative educational practices based on the Information Technology and Communication (ICT), should experience a progressive and substantial increase of implementation of e-Learning systems taking care of accessibility features (Hernández et al., 2012; Hilera and Campo, 2015). In this sense, the main objective of ESVI-AL project, developed from 2011 to 2015 with the support of the European Commission, has been to move towards and inclusive virtual education. The aim is to improve e-Learning accessibility through the implementation of virtual campuses and teaching materials with accessibility features, enabling an inclusive learning to any person, including people with disabilities.

The products generated by the project have been successfully tested and implemented by the ten partner universities participating in the project. These Universities are seven from Latin American countries (Colombia, Ecuador, El Salvador, Guatemala, Paraguay, Peru and Uruguay) and from three countries in Europe (Finland, Portugal and Spain). Nonetheless, other universities and students from Latin American countries like Argentina, Bolivia, Brazil, Chile, Costa Rica, Honduras, Mexico, Nicaragua, Panama, Dominican Republic and Venezuela have been using the products too. All results of the project are available to be used by any one, via the ESVI-AL Cooperation Network website ([www.esvial.org](http://www.esvial.org)).

In this article, the main products created by the ESVI-AL Project are presented. The proposed products can be useful instruments for all the stakeholders involved in online educational processes, interested in provide education to any target student, including those with disability; in order to progress towards achieving an accessible a fairer e-Learning.

In the following section, the identified profiles or roles of the possible users of the proposed products will be presented. In section 3, the project products and the profiles are associated. Then, section 4 consists of a

series of recommendations about how to use the proposed products. Finally, the last section presents the conclusions and it includes ideas on how to improve these products in the future.

## 2. POTENTIAL USERS

In this work it has been identified four general types of user to whom the ESVI-AL project results can be useful: EDUCATOR, STUDENT WITH DISABILITIES, LMS ADMINISTRATOR and QUALITY AUDITOR. Each type of user will be described as follows (figure 1).

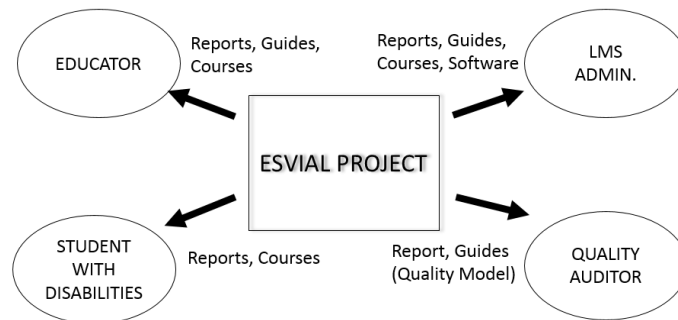


Figure 1. Users of the ESVI-AL results

The EDUCATOR profile refers to those people involved in designing or teaching e-Learning courses. For example, administrators of educational institutions, instructional designers or teachers (professor, lecturers, tutors, instructors). All of these users can find in the results of the project several guidelines, reports, and training courses that can help them to adapt their usual activity as educators to achieve an accessible and inclusive e-Learning. Therefore, they can avoid the possible discrimination of students with any kind of disability by taking into account the possible limitations that the students could face when studying the digital content that is not adapted to their needs. One example can be, if the educator omitted the subtitles in videos that are visited by deaf students. Related to this type of users, more than a thousand of educators in Latin America and Europa have been benefited along the project duration.

The main target of education are the students, and especially in this case, STUDENTS WITH DISABILITIES. This group of users can be benefited by the following results from the project: at least six job training courses for labor inclusion have been created to be used in the e-Learning mode. It has been tested that the proposed job training courses are accessible, and so any student that has a physical or sensorial disability can follow them. More than a half thousand of students with disabilities from Latin American and Spain have participated in the courses created in the project.

The people included in the LEARNING MANAGEMENT SYSTEM (LMS) ADMINISTRATOR profile can also be benefited by the results of the project. This is possible because in the project several guidelines and training courses to install and manage an accessible learning platform have been created. The software for the learning platform, based in Moodle (2014), is available to the LMS administrators so they can download it freely. It is important for the educators, to create accessible digital contents, but it is also important to assure that the learning platform that they are using is accessible and does not give any issues to the students with disabilities (Archee and Gurney, 2007).

Finally, the project is also directed to QUALITY AUDITORS, which are people that can verify the quality of the e-Learning projects. It can be firmly assumed that the accessibility is an indicator of the quality of any product or service, if by quality it is understood that the user is satisfied by the product. It is evident that for a blind person, a printed book cannot have a measurable quality, because it is not in a format that the user can read, for example a Braille (Moreno-Chaparro et al., 2014) or Audio book (Armstrong, 2009). In this way, one of the objectives of the project was to create a model of quality and accessible measurement of the e-Learning courses (Bañuelos et al., 2014). This model is public and the quality auditors can use them as a reference to evaluate any course. The courses created during the project where accredited using the quality model proposed.

### 3. DELIVERABLES OF ESVI-AL PROJECT

In ESVI-AL Project, four types of deliverables have been generated:

- Documents (books, guidelines, reports): Several reports about different aspects related to accessibility of e-Learning have been published. The guidelines addressed to teachers, technicians and auditors, were also published, these guidelines aim to easily explain how to apply the proposed recommendations to achieve accessible e-Learning courses.
- Courses: Three kind of online courses were prepared within the project.
  - o Two courses for educators. One to teach how to plan, design, and implement accessible training programs in e-Learning mode. In addition, the other course is intended to teach how to create accessible digital educational materials, such as documents, presentations, pdf, videos, audio books, and web content. These courses have been taught to more than one thousand teachers from twenty different countries through project's duration.
  - o Six courses for students with disabilities, training for employment. These courses have been useful for all students, including those with disabilities. These are courses on basic computer office skills, entrepreneurship, community management (social networks), preparation for job search, writing for communication essentials and customer service foundations. These courses have been provided to more than five hundred students with disabilities in Latin America.
  - o Two high-level technical courses. These courses are suitable for administrators and developers for educational institutions. The first on the technical requirements to install, maintain and update Learning Management Systems (LMS) platforms with accessibility features. The second one on how to detect and correct accessibility issues detected on web applications, among which one are precisely the LMS platforms, which are a type of web application for e-Learning purposes.
- Software: The Project partners improved and adapted the software code to install accessible LMS platforms based on Open Source Moodle. It has also prepared an extension (plugin) to allow the platform to suit the preferences and need of students, especially students with disabilities.
- Observatory: As one of the main products to ensure the sustainability of the project results, the group of partners has established a Cooperation Network on Accessible e-Learning and e-Society, and as an extension of this Network was created an Observatory. From this observatory all Project results and other additional services will be made available to all interested stakeholders. Any person or institution are invited to join to the proposed network and be part of the different services offered by the observatory available through [www.esvial.org](http://www.esvial.org).

Table 1 presents the main results of ESVI-AL Project described in the four kind of deliverables. As a reference, the results are identified as *Rn*, *Gn*, *Cn*, *Pn* and *On*. Each of the items numbered are explained as follows: *Rn* represents the Reports, *Gn* represents the proposed guidelines, *Cn* identifies the ten courses prepared along the project, *Sn* identifies the software, *Pn* identifies the six publications from international conferences organized by the project partners, and finally *On* identifies the ESVI-AL Observatory services.

Table 1. ESVI-AL deliverables and potential users.  
*Symbol (X) indicates that it is not the main user of this deliverable*

Deliverable	Educator	Student with Disabilities	LMS Admin.	Quality Auditor
R1: Report on accessibility in higher education for people with disabilities	X			
R2: Report on technology supporting the education of persons with disabilities	X		X	
R3: Report on web accessibility and accessible web design			X	
R4: Report on open educational resources that can support the training of people with disability	(X)	X		
R5: Report on semantic and social web technologies for accessibility	(X)		X	
R6: Report on the difficulties of access and permanence of students from vulnerable populations	X			
R7: Report on the accessibility of Learning Management Systems (LMS)			X	
R8: Report on training needs for people with disabilities	(X)	X		
R9: Report on standards and capability maturity models related to the quality and accessibility of e-Learning				X
G1: Methodological guide for the implementation of accessible e-Learning projects	X		X	
G2: Best practices and success stories on implementation of accessible e-Learning projects, and accreditation of quality and accessibility of e-Learning projects	X		X	X
G3: Guide for creating accessible digital content: documents, presentations, videos, web pages	X		X	
G4: E-Learning quality and accessibility accreditation model	(X)		(X)	X
C1: Open online course about pedagogical design of accessible e-Learning courses	X			
C2: Open online course about creating accessible digital contents	X		X	
C3: Open online course about managing accessible LMS			X	
C4: Open online course about programming accessible web pages and applications	(X)		X	
C5: Open online courses to improve employability		X		
S1: Moodle-Esvial LMS (software)			X	
P1: Proceedings of CAFVIR conferences	X		X	X
P2: Proceedings of ATICA conferences	(X)		X	
O1: ESVI-AL observatory services	X	X	X	X

#### 4. RECOMMENDATIONS OF USE

From a pedagogical perspective, this section is intended to provide a group of steps for a stakeholder involved in an educational project, especially if it is the first time hearing about the ESVI-AL initiative. As a first step when the participant get in touch on the initiative towards an accessible e-Learning project, he or she should identify which of the four user profiles best suits her interests. The aim of this section is to provide a summary of the theoretical and state of the art research prepared in three years within ESVI-AL. The reader will explore on the starting steps, finding recommendations on how to take advantage of the project's results towards accessible e-Learning implementations, that are presented for each of the four type of potential users identified in section 2.

## 4.1 Recommendations for EDUCATORS

If an educator intends to improve his/her teaching methods and skills to achieve an accessible e-Learning, the recommendation is to follow the next steps:

1. To read the reports R1, R2 y R6, to understand about the potential problems that students with disabilities may have when dealing with content not prepared to be accessible. If the reader is interested to apply a complete methodology to create an accessible e-Learning course, then he/she should be part of course C1, addressing all the phases in the formative e-Learning cycle.
2. To be part of course C2, in order to learn on how to create digital accessible teaching material.
3. Once the educator has decided to apply the knowledge from course C1, he/she can use the guidelines G1 and G2 as support material to solve frequently asked questions. The guideline G2 has practical examples applying the proposed methodology in real courses.
4. Once the educator has decided to apply the knowledge from course C2, he/she can use the guidelines G3 as support material to solve questions that could find in the process.
5. If the educator teaches a Computer Sciences/Informatics subject, he/she can be enrolled in course C4, to learn how to create web pages and web applications with accessibility features.
6. If the educator prepared an E-Learning course and wants to submit the course to an accreditation process to evaluate quality and accessibility, then he/she should read guideline G4 in order to learn about the details of the accreditation model and especially the tasks that the educator will be asked to perform.
7. If the educator wants to use open educational resources with accessibility features available on Internet, he/she is invited to read the report R4 about the state of the art on the subject; and if he/she wants to explore on further details should read report R5 on resources using semantic and social web.
8. If the educator has plans to create an e-Learning course intended especially for students with disabilities, with a focus on employability skills, he/she should read the report R8, presenting identified topics analyzing required competences and skills needed for different kinds of work positons.
9. To learn about practical experiences and recent research lines related to accessibility in E-Learning, the educator should read the conference proceedings (P1) from CAFVIR conference organized by ESVI-AL
10. To learn about general aspects related to accessibility, the educator could find useful the conference proceedings (P2), from ATICA conference, also organized by ESVI-AL, these conference series include a workshop entitled ATICAccess about topics related on accessibility within Information and Communication Technologies (ICT).
11. Finally, the educator should register to be part of the Cooperation Network ESVI-AL, being part of this network he/she will be informed of all the services offered by the Observatory (O1).

## 4.2 Recommendations for STUDENTS

There are results from ESVI-AL project that have been created for students with disabilities, there are training courses to improve the employability skills. Therefore, students could follow the next steps:

1. Students should read report R8, this report presents a detailed examination of the possible subjects related to courses to learn competences and skills needed by the labor market.
2. Students should read report R4 on the state of the art on supply and demand of accessible courses over Internet.
3. The students could enroll one of the accessible courses prepared by ESVI-AL (C5) with the objective to learn employability skills to improve the changes to apply to the most demanded jobs in the labor market. These courses (C5), are related to competences and skills to improve the employment status of any person, and especially for persons with disabilities. These courses are endorsed by two important organizations for people with disability: Disabled People's International – Latin America (DPI) and Latin American Union of the Blind (ULAC).



4. Finally, students should register to be part of the Cooperation Network ESVI-AL, being part of this network they will be informed of all the services offered by the Observatory (O1).

### 4.3 Recommendations for LMS ADMINISTRATORS

The staff members involved in the Learning Management Systems (LMS) in educational institutions, could also find useful results for them if are willing to have an LMS accessible platform, especially an LMS platform based on Moodle. The recommendation is to follow the next steps:

1. To read the report R2 to learn technologies that students with disabilities use to access e-Learning platforms and possible barriers that they can find.
2. To read the reports R3 y R7, to understand recommendations, standards, regulation and legislation related to accessibility in web pages and particularly on the most used LMS platforms.
3. To read the report R5, that can help him/her to learn and use the advantages of semantic and social web technologies, and explore which of them can be used in LMS platforms and learning content repositories or LMCS.
4. To be part of course C2, in order to learn on how to create digital accessible teaching material with the aim to be able to check and assess if the content published by the teachers is accessible to maintain accessibility in the LMS platform.
5. To download the code software S1 and be part of course C3, intended for staff managing an LMS based on Moodle, where they will learn how to install, maintain and update this software to have an accessible LMS.
6. To use the guidelines G1, G2 y G3 as support material to achieve that the digital contents available in the LMS have accessibility features.
7. To be part of course C4, because while being the administrator of an LMS platform, some web pages or web applications could need changes at code level to achieve accessibility and the administrator could need technical competences.
8. If the institution have plans to submit a course installed on the LMS platform to an accreditation process to evaluate quality and accessibility, the administrator should read guideline G4 to learn about the details related to the accreditation model and especially the information that he/she should prepare and provide to the quality auditor.
9. To learn about practical experiences and recent research lines related to accessibility in e-Learning, they can read the conference proceedings (P1, P2), from CAFVIR and ATICA conferences organized by project ESVI-AL.
10. Finally, the LMS administrators should register to be part of the Cooperation Network ESVI-AL, being part of this network he/she will be informed of all the services offered by the Observatory (O1).

### 4.4 Recommendations for QUALITY AUDITORS

One of the main objectives of ESVI-AL project has been to improve the quality and accessibility of e-Learning. For this purpose, a quality model was proposed with the collaboration from the Iberoamerican and Caribbean Institute of Quality in Distance Education (CALED). The aim of the proposed quality model is to provide a reference model to evaluate the quality of courses. In this sense, the recommendation is to follow the next steps to the quality auditors involved in the e-Learning process:

1. To read the report R9 for a general overview of quality models for e-Learning.
2. To read the guideline G4 to learn about the details of the quality and accessibility model for accreditation proposed by ESVI-AL with the collaboration of CALED.
3. To read the guideline G2 with examples and best practices for courses already accredited by the proposed model.
4. To learn about other case studies the auditors could read the conference proceedings (P1) of CAFVIR, a specialized conference on quality and accessibility in e-Learning.

5. Finally, the educator should register to be part of the Cooperation Network ESVI-AL, being part of this network he/she will be informed of all the services offered by the Observatory (O1).

## 5. CONCLUSION

One of the main goals of any project co-financed with public funds, in this case funds from the European Union, is the sustainability of the results and the dissemination so that the results can be exposed and used for as many people as possible. At the end of the ESVI-AL project duration (2011-2015), the products have been used successfully by hundreds of people from many countries. The aim now is to benefit other stakeholders, and for this, the project partners have identified potential profiles that may be of use for everyone. The four potential profiles identified are educators, students with disabilities, administrators of learning management systems and quality auditors in e-Learning.

In this paper, we have proposed a starting guide to explore on the basic steps towards and accessible e-Learning project, the reader is able to identify suggestions for the use of the project results for each of the proposed profiles. The objective is to collaborate to move towards a universal inclusive education in a fairer society through an accessible e-Learning. For this, the results from ESVI-AL can be used to achieve an inclusive e-Learning, and especially an e-Society.

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# FLIPPED LEARNING IN A UNIVERSITY EFL COURSE: THE MERITS OF A COLLABORATIVE LEARNING APPROACH

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## ABSTRACT

This paper reports on a pilot study in which researchers explored new ways to design and to implement an original English as a Foreign Language (EFL) Flipped Learning (FL) course at a university in Japan. FL in this course-based action research study was defined as a form of Blended Learning in which students in small groups engaged in outside-of-class e-learning preparatory tasks, on a website called Inkling Habitat, for in-class Collaborative Learning activities. A FL approach was adopted in an effort to raise the current low levels of student participation in e-learning activities in EFL courses. In order to sustain the motivation levels needed for on-going engagement in the outside-of-class e-learning tasks, messages were sent by the teacher to the students by means of an online social networking system (SNS) called LINE (<http://line.me/en/>). The messages were available on the students' primary means of internet access and SNS communication with their peers, mobile devices such as cell phones and tablet computers, and also on PC-based platforms. The students' post-course evaluations revealed that the students used their mobile devices for all of the online components of the course and not PC-based platforms. The students described the preparatory materials on the Inkling Habitat website as interesting and the students reported that they conducted research on the topics of the online reading texts by using URL research-site links which were included with the materials. The students reported that the e-mentoring messages sent by the teacher encouraged them to collaborate with each other on the online tasks. Moreover, the students said that they were active participants in the in-class Collaborative Learning tasks. They believed that the support provided by the teacher online and in class helped them engage actively in the in-class discussions. The pilot study indicated that there is justification for the development of other FL courses that are based on teacher support for student collaboration on learning tasks in small groups online and in class. In future the planning of courses which feature e-learning activities should be based on an assumption that students will use mobile devices to access the internet and to communicate with their peers.

## KEYWORDS

Blended Learning, Flipped Learning, Collaborative Learning, the Inkling Habitat website, the LINE Social Networking System, Mobile Online access devices

## 1. A FLIPPED LEARNING APPROACH TO EFL LEARNING

Blended Learning (BL) is a combination of conventional classroom face-to-face delivery of lesson instruction with online-mediated instruction. The online lesson component may take place in class in tandem with the face-to-face components of a lesson, or it may be conducted entirely outside of class (Osguthorpe & Graham, 2003). Flipped Learning (FL) is a BL teaching methodology, currently being developed, which uses the two BL channels of communication to reverse the conventional patterns of classroom teaching and learning.

In FL courses, teachers provide their students with outside-of-class online content lectures or other preparatory materials and tasks while classroom time is used for students to seek advice from the teacher and to help each other understand the lesson topic through peer-instruction activities (Ishikawa, Akahane-Yamada, Smith, Tsubota, & Dantsuji, 2014). Current FL course design intends to take advantage of the on-going developments in ICT to create effective combinations of what can be done best online outside of class and what can be done best in class time.

An FL approach to EFL teaching and learning with its abundant online opportunities for review and practice may support language learners at lower-proficiency levels (Hamdan, McKnight, McKnight, & Arfstrom, 2013), and result in written-language skill improvement (Stuntz, 2013) and listening skill building (Kim, Byun, & Lee, 2012). These three studies found that when a FL approach balances the online outside-of-class learning opportunities with in-class discussion activities which engage all learners in communication with each other and their teacher, it results in improvements in language learning.

There are three reasons an FL approach to BL in EFL education is worth exploring. First, online preparation for lessons offers students easily accessible opportunities for communication with fellow students and teachers while the assignments are being done. Second, collaboration in class in learning teams may be enhanced by collaborative online communication. Finally, PC-based platforms for the provision of learning materials and class communication have enhanced conventional outside-of-class opportunities for students to gather in study groups and to consult with their teachers through the all-inclusive and flexible nature of online communication. However, an apparent student shift away from the use of PC-based platforms for online information gathering and social communication should be taken into account.

The use of mobile devices, such as smart phones and tablet computers, in FL for online teacher-student and student-student communication should be investigated because university students in Japan, and perhaps elsewhere, increasingly rely almost exclusively on mobile devices rather than PC-based platforms for ‘anytime anywhere’ online access and communication with their peers. A recent survey of students in all four years at Kyoto University of Foreign Studies showed that 87.8% of the students use smart phones and that the majority of these students have the messages that is sent to their university email addresses automatically transferred to their smart phones (Kyoto University of Foreign Studies, 2014).

This FL project adopted the Jones Model of Learning (2006) as a guideline for learning task design and implementation. It is a five step process which is centered on the processing of information by the learner from various sources including the instructor’s lectures in class, or in video and written text formats, other written text materials, and in-class peer discussions. The learner plays the following roles in the process: 1) The learner receives a stimulus in the form of information from an instructor, a text, or another learning resource. 2) The learner questions and analyses this information, and examines it from different perspectives. 3) The learner relates this information to what is already known. 4) The learner synthesizes knowledge from the first two steps. 5) The learner attempts to integrate the new knowledge with existing relevant knowledge (Jones, 2006).

The Jones Model of Learning can serve as a guideline for an experimental FL Collaborative Learning EFL methodology if it is reasonable to assume that the learners’ creation of new knowledge about language through collaborative peer interaction leads to making connections with previous knowledge that may be beneficial because interaction with peers, ideally, can accommodate different learning styles more effectively than a ‘one-size-fits-all approach’ (Jones, 2006).

FL rests on an assumption that students will use learning task materials before class, so that classroom time can be devoted to interaction between students and their teacher that will support the outside-of-class study through mutual problem-solving tasks and analytical examinations of learning materials. This study examined a Collaborative Learning approach to generating, and then sustaining, motivation and engagement in an FL course.

## 2. COLLABORATIVE LEARNING

Collaborative Learning is a familiar learner-centered approach to EFL teaching which has been defined as a “personal philosophy, not just a classroom technique” (Panitz, 1999, p. 2). It relies on teams of students working towards the building of team skills and team capacity in order to achieve the team’s goal. The success of the learning tasks depends on cooperation among students for building understanding. Dillenbourg (1999) defines collaborative learning as interaction between people that is expected to create learning mechanisms which make possible the primary purpose of collaborative learning: the achievement of the desired learning product.

In contrast, Cooperative Learning, another learner-centered learning-team EFL methodology has been defined as “the instructional use of small groups so that students can work together to maximize their own and each other’s learning” (Sachs, Candlin, & Rose, 2003, p. 181). It has also been described as an

instructional method that encourages students to work together on a given task, and that prompts students to find gaps in each other's knowledge. The type of task determines the type of cooperation that takes place (Slavin, 1987; Veenman, Kenter, & Post, 2000) but generally, the target of team work is to close the gaps. The tasks are often specific and content based with structured learning tasks (Panitz, 1999), and the instructions originate from the teacher who leads the task (Slavin, 1987).

Collaborative learning is more learner-centered and product-focused with the emphasis placed on students taking autonomous responsibility in purpose-driven groups for achieving the aims of their work, as a group, through good communication. In more process-focused cooperative learning approaches, teachers design and manage the language-learning events and learners are less involved in learning task design and management.

Thus, although both approaches can usefully inform FL practices in a BL approach to EFL education, FL in this study in terms of its philosophy and aims has been predominantly guided by Collaborative Learning methodology. The primary FL aim in this project is to explore ways to encourage students to take responsibility for their own learning, as members of a team, and to encourage students to focus their attention on building productive team communication. Furthermore, the aim of creating a learning environment in which the teacher is a facilitator, a mediator and a motivator of the learning process, not its controlling director may match with a student sensitivity towards ownership of their online communication, particularly via their mobile devices.

### **3. RESEARCH QUESTIONS**

This study sought to answer the following two research questions:

- 1) Would the flipped learning approach in this study encourage students to work together on learning tasks?
- 2) Would the flipped learning approach in this study establish interaction between students and their teacher during in-class and outside-of-class components of the course?

### **4. COURSE DESIGN: THE EFL FLIPPED LEARNING COURSE**

In order to encourage students to work together on learning tasks and to establish student-teacher, student-student interaction both in class and outside of class, an original EFL flipped learning course was implemented from May, 2014 to July, 2014 at a university in Japan. Students in small groups engaged in collaborative learning tasks both outside of class and in class. Outside of class they collaborated online to help each other understand the course reading assignments, to conduct research activities related to the reading materials, and to create a slideshow presentation of a summary and analysis of the reading assignment. They also prepared to report the findings of their research. In class the presentations were made and discussed. The teacher monitored the students' participation in the online and in-class learning tasks and offered timely proactive and reactive problem-solving guidance and support.

A conventional EFL in-class methodology typically consists of three phases: input, intake, and output activities. Students are exposed to comprehensive input of an English text in order that they may have an opportunity to learn about a language feature that is new to them. If they understand the new feature of the language and it becomes part of their language knowledge, intake has occurred (Ishikawa, Kondo, & Smith, 2010). After engaging in learning tasks which are intended to allow intake to occur, students conduct output activities to practice, using the new language feature. At the end of the class time, the teacher usually assigns homework as an individual outside-of-class learning task to reinforce the in-class learning. The grading of the homework assignment by the teacher confirms whether the intended teaching aims have been achieved.

In the EFL flipped learning course described in this paper, in the outside-of-class component, students worked together on learning tasks in an interactive cloud-based environment, the Inkling Habitat website (<https://www.inkling.com/habitat/>), in collaboration with each other and their teacher. The teacher supported their collaborative learning by sending the students timely needs-based messages by means of a social networking system called LINE (<http://line.me/en/>). A survey conducted in June, 2013 revealed that 98% of 100 randomly chosen students at Kansai University, Japan used LINE (Sankei Express, 2013). Therefore, it was anticipated that many of the students who participated in this study had experienced the use of LINE as a

communication tool with other students, and thus, that they would be able to use the LINE system. Table 1 shows the messages sent by the teacher.

Table 1. Messages sent by the teacher

Message type	Time when the message was sent
Advice	When the students found problems related to the outside-of-class activities
Encouragement	Every day until the students started collaborative learning After the initiation of collaboration— before and after weekends

In class, after the students reflected on their outside-of-class activities, they collaborated in small groups on intake and output learning tasks which the teacher facilitated within the collaborative learning environment. Before the end of the class time, the students reflected on what they had done in class.

Figure 1 shows a conceptual diagram of the transformation of a conventional EFL in-class lesson to the EFL flipped learning methodology described in this paper.

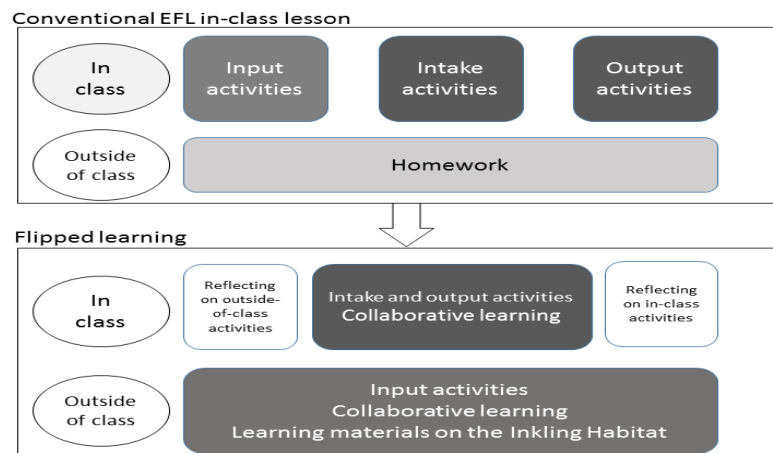


Figure 1. Conceptual diagram of the transformation of a conventional EFL in-class lesson to flipped learning

The flipped learning course consists of two-session units, one session per week. Outside of class the students read the assigned reading texts and prepared written and oral summaries of the texts. In class they used their written summaries to make oral presentations. This set of outside-of-class/in-class learning tasks comprises one learning session. In the next session of the unit, they created a slideshow outside of class, and then in class, they used the slideshow to make a presentation. After the presentations, discussions were held about the presentations. The following outline shows the flow of the learning tasks in the two sessions of one unit:

**Session 1**

**Outside-of-class learning tasks**

- 1) Students engaged in small-group collaborative learning in order to understand a reading text on the Inkling Habitat.
- 2) The teacher sent needs-based messages by means of LINE.

**In-class learning tasks**

- 1) Students reflected on what have done in the outside-of-class learning tasks.
- 2) The teacher provided the students with an achievement test such as a reading comprehension test, to make sure that the students have understood the text.
- 3) The students in small groups collaborated on a written summary of the text and prepared an oral presentation for the in-class session.
- 4) The teacher provided the students information and suggestions for the next outside-of-class learning tasks. The teacher also gave the students information about useful websites for the further research assignment.
- 5) Students reflected on the in-class learning tasks.

## Session 2

### Outside-of-class learning tasks

- 1) The students in small groups collaborated on the research questions assigned by the teacher. They prepare a group slideshow on the Inkling Habitat website for a presentation of their research findings in class.
- 2) The teacher sent needs-based messages by means of LINE during the collaboration process.

### In-class learning tasks

- 1) Students reflected on what they did in the outside-of-class learning tasks.
- 2) The students in their groups used the slideshow to present their research findings. They held discussions about the presentations.
- 3) The teacher supported the students by giving them comments and advice.
- 4) Students reflected on the in-class activities.

## 5. VALIDATION OF THE STUDY

In order to answer the two research questions, a post-course evaluation was conducted in the last class and a semi-structured interview with students was held one week later at the end of July, 2014. Five students in the Department of Global Affairs at a university in Japan participated in the study and completed the course evaluation. All of the participants owned smart phones or tablet computers, and used LINE, a social networking system, to communicate with other students. The questionnaire for the course evaluation consisted of two parts, as explained in Table 2 below.

A 4-point Likert Scale was used to measure the responses in order to adequately allow for the expression of a range of participants' beliefs and feelings about the course. The ratings of 1 and 2 respectively corresponded to strongly disagree and disagree; and the ratings of 3 and 4 respectively corresponded to agree and strongly agree.

When examining the internal consistency of scores on the questionnaire, the value for Cronbach alpha was high, .76. Tables 3 and 4 show the results of the two different parts in the participants' course evaluation. The open-ended question in Part I asked about the students' feelings about the outside-of-class activities. In Part II, three open-ended questions were asked for the students' feelings about: 1. the presentations that they made; 2. the discussions that they conducted; and 3. the support provided by the teacher (see Table 2).

Table 2. Questionnaire

Part	Question	Number of items	
		4-point Likert Scale	Open-ended
Part I	Questions about the outside-of-class learning tasks	6	1
Part II	Questions about the in-class learning tasks	8	3

As for the outside-of-class learning tasks (see Table 3), the participants said that the reading materials on the Inkling Habitat were interesting, and four out of the five students used the URLs which were provided to conduct research related to the reading texts. As for Item No. 3, two participants reported that they did not constructively collaborate with the other students on developing an understanding of the reading texts, and on creating the slideshow to report their research findings. Those two students' comments on the open-ended question show their feelings: "I was so puzzled that I had to work together with the other students to understand the texts"; and "I absolutely could not get used to working on the tasks, especially understanding the texts, in a group. I think the homework we do outside of class should be totally individual."

As for the messages sent to the students by the teacher during the outside-of-class activities (Item No. 4), all of the participants read the messages. Moreover, the participants reported that the advice was useful for understanding the reading texts, and for creating the slideshow (Item No. 5). They appreciated that the encouragement sent by the teacher kept the participants working together on the tasks (Items No. 6). Typical comments were similar to the following student's reply to the open-ended question: "The encouragement

from the teacher made me want to work on the outside-of-class tasks and kept me doing the work every week of the course, I really think so because usually I do not do my homework properly.”

Table 3. Results of Part I of the participants' course evaluation

Part	Item	Mean (SD)
Part I	1. The reading text was interesting.	3.60 (0.55)
	2. I looked for at least one related text each unit using the search engines.	3.40 (0.89)
	3. I actively worked on understanding the reading texts, and creating the slideshow with the other members of the group.	2.80 (0.45)
	4. I read the messages sent by the teacher.	4.00 (0.00)
	5. The advice sent by the teacher was useful for understanding the reading text, and for creating the slideshow.	3.40 (0.55)
	6. The encouragement sent by the teacher kept me working with the other students on understanding the reading texts, and on creating the slideshow.	4.00 (0.00)

As for the responses regarding the in-class learning tasks, reported in Table 4 below, the participants were satisfied with the tasks and they reported that they were interesting. They said that they were active participants in the collaboration with other members in the group in making summaries of the text, and in preparing and making presentations based on the summaries of the text. They also reported that they took an active part in the in-class discussions on the research findings reported in the presentations.

The participants also felt that the reflection on the outside-of-class learning tasks at the beginning of the classroom time was useful to help them collaborate on the in-class tasks. However, regarding the reflection on the in-class learning tasks held at the end of the lesson, the students felt that it was not useful support for the next outside-of-class learning tasks (see Item No. 11). The following comments from two students were typical: “I know it is important to reflect on our previous work, but I can't see the reason why I should reflect on the in-class tasks for the next outside-of-class activities. The reading text we will read next is different”; and “I cannot see a strong link between the in-class tasks and the next outside-of-class tasks.”

As for the support provided by the teacher for the following outside-of-class activities, the participants reported that it was useful (Item No. 13). Moreover, the participants believed that the teacher's support was especially useful for the class discussions on the research findings (Item No. 14). Typical comments were similar to the following student's reply to the open-ended question: “I enjoyed the in-class activities. I had never had any experience of students' work taking up the whole classroom time by making presentations and having discussions about the presentations with the teacher just supporting everything we did.”

Table 4. Results of Part II of the participants' course evaluation

Part	Item	Mean (SD)
Part II	7. The achievement test was useful for understanding the reading text.	3.00 (0.71)
	8. The presentation was interesting.	3.80 (0.48)
	9. The discussion was interesting.	4.00 (0.00)
	10. The reflection on the outside-of-class activities was useful for the following in-class activities.	3.40 (0.55)
	11. The reflection on the in-class activities was useful for the next outside-of-class activities.	2.00 (0.00)
	12. I actively worked on summarizing the text, on preparing and making presentations on the summaries of the text, and discussing the texts and the research findings.	3.40 (0.55)
	13. The support given by the teacher was useful for creating the slideshow.	4.00 (0.00)
	14. The support given by the teacher was useful for the discussions.	3.60 (0.55)



## 6. CONCLUSION

This paper reported research that showed a flipped learning approach to EFL teaching, which includes students' mobile devices as a means of communication, may encourage students to engage in collaborative learning in outside-of-class and in-class learning tasks. The support of the teacher during the performance of the online and the in-class learning tasks appeared to sustain engagement in online tasks and to provide satisfaction to students on their in-class performance.

The answers to the two research questions are as follows:

### **Research Question 1**

*Would the flipped learning approach in this study encourage students to work together on learning tasks?*

The students' post-course evaluations revealed that the students felt that the reading materials on the InKling Habitat were interesting and most of the students used the research-site URLs related to the reading materials outside of class. However, two of the five participants felt that they did not constructively collaborate on understanding the reading texts, and in creating the slideshow presentation of their research findings. Those two students believed that they should complete tasks given outside of class individually, and not in a group. This could be because of the influence of conventional EFL teaching methodology that relies on individual outside-of-class homework assignments.

The course evaluations also revealed that the students were satisfied with the in-class learning tasks. They reported that the tasks were interesting. They said that they actively collaborated on the learning tasks with the other members of their group in class.

### **Research Question 2**

*Would the flipped learning approach in this study establish interaction between students and their teacher during the in-class and outside-of-class components of the course?*

The students' post-course evaluations indicated that the students believed that the messages sent by the teacher encouraged them to collaborate on the tasks and that those messages were useful for understanding the outside-of-class activities. The students also reported that the support given in class by the teacher for the outside-of-class activities was useful. They believed that the support given by the teacher was also useful during the in-class learning tasks.

Thus, the pilot study indicated that there is justification for the development of other FL courses that are based on teacher support for student collaboration on learning tasks in small groups online and in class. An FL approach to EFL teaching which allows students to use their mobile devices such as smart phones and tablet computers to access learning materials and to engage in communication with their classmates and teachers should be investigated to discover if it improves the rates of sustained student participation in e-learning activities.

Our next task is to revise the EFL FL course design in order to effectively combine in-class and outside-of-class learning tasks so that a larger scale study can be carried out. It will be important to make the FL Collaborative Learning course class management feasible for busy teachers.

## ACKNOWLEDGEMENT

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# AN ALTERNATIVE EVALUATION: ONLINE PUZZLE AS A COURSE-END ACTIVITY

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## ABSTRACT

This study investigated the effects of the use of Online Puzzle System (OPS), an alternative learning strategy, on the learning and achievement levels of students. A pre- and post-test experimental model was used. In the study, 30 students were chosen from each of the tenth grade classes of the Department of Information Technologies of Gazi Anatolia Technical and Industrial Vocational High School in Elazığ. In total, experimental and control groups consisting of 60 students were formed. These groups were equalized based on a pre-test implemented in the 'Fundamentals of Information Technologies' course. The control group received traditional instruction; in addition to traditional instruction, the experimental group conducted puzzle activities with the OPS. Four weeks after implementation, an academic achievement test was re-applied to the groups to determine learning retention. In analysis, pre- and post-test means and standard deviation distributions were calculated, and t-test was used to determine significant difference. Moreover, the Online Puzzle Use Attitude Scale developed by the researcher measured the effects of the puzzles. It was concluded that using online puzzles increases academic achievement and retention. Moreover, it was seen that students enjoy online puzzles and think they are helpful in recalling technical terms.

## KEYWORDS

Online Puzzles, Crossword Puzzles, Interactive Learning, Academic Achievement, Retention.

## 1. INTRODUCTION

In the teaching-learning process, determining aims to be reached is of vital importance. In 1960, a pioneer in the behaviorist movement, Robert Gagné, developed the following teaching model (Gagné, 1985). This model provides a great deal of valuable information to teachers and is an excellent way to ensure an effective and systematic learning program, as it gives structure to lesson plans and a holistic view to teaching (Khadjooi, Rostami, & Ishaq, 2011). Evaluating the results of teaching-learning activities and adapting material depending on these results is crucial in terms of retention of acquired behaviors. Behaviors not repeated adequately can be forgotten, so repetition should be made at a degree to promote retention.

During the 1960s, Edgar Dale theorized that learners retain more information by what they "do" as opposed to what is "heard", "read" or "observed. Dale (1969) has stated that retention rates of information learned are closely related to the manner of instruction. According to him, learning occurs 10% by reading, 20% by listening alone, 30% by listening in combination with watching a board or projector, and 50% by watching people do something while listening. Moreover, the psychological basics of learning underline the fact that students should be at the center of study and do activities themselves. In order to relieve monotony in the classroom and arouse interest and encourage participation of students, activities such as puzzles and educational games should be used. These forms of active learning are helpful to review and practice, determine knowledge gaps, and develop new relationships among familiar concepts. Research on the specific benefits of crossword puzzles has shown that they engage thinking functions and may help prevent memory loss. In addition, crossword puzzles can help build cognitive reserve (Wilson et al., 2010). Gürdal and Arslan (2011) have suggested that using puzzles in lessons increases both attention level of students and retention of concepts. For these reasons, the crossword puzzle has been used in fields of education such as mathematics, science, biology, and medicine to improve student learning.

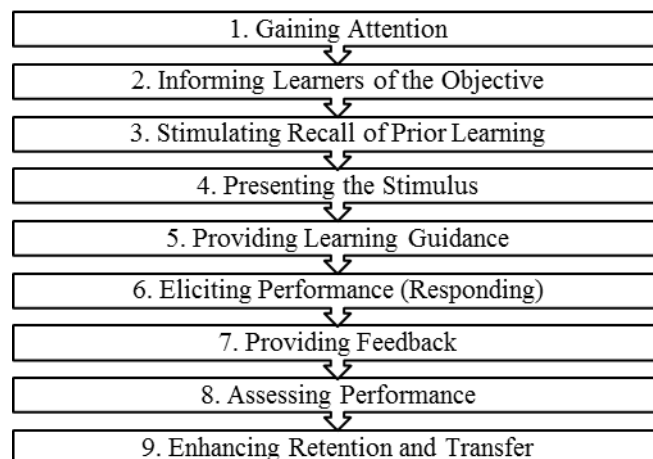


Figure 1. Steps in the Teaching Model (Adapted from Gagné, 1985).

Franklin, Peat, and Lewis (2003) found that crossword puzzles accelerate learning for first-year biology students and helps them learn terms in an entertaining environment. In a study in the field of pharmacology, it was concluded that a well-planned crossword puzzle is an appropriate method for testing high-cognitive levels when compared with other evaluation types (Sivagnanam, Rajasekaran, Jayashree, Sreepriya, & Rajakannu, 2004). In another study where crossword puzzles were used in a medical course, it was observed that using such exercise stimulated and activated the interactive learning among the students, reflected by their positive attitude and response (Manzar and Al-Khusaiby, 2004). Weisskireh (2006) stated that a well-designed crossword puzzle activity may offer students an easy and engaging way to review concepts for a test. Songur (2006) stated that puzzles and games in mathematics support retention of the lesson, improve the attitudes of students, and increase achievement scores when compared with traditional lessons. In a study where crossword puzzles were used in Psychology and Anatomy, students expressed that puzzles are attractive, entertaining, and helpful in recalling the concepts and present a varied learning experience (Kalyani, 2007). Parsons and Oja (2008) conducted a study in which they used crossword puzzles for teaching computer terms and found a significant effect on increasing students' efforts to learn. In a study where crossword puzzles were used in the instruction of electro-magnetism, it was concluded that crossword puzzles created by a computer have useful effects on learning for engineering students (Olivares et al., 2008). In a study where free software for creating crossword puzzles was used in the field of sports instruction, puzzles lessons increased the interest of the students compared to traditional instruction (Berry & Miller, 2008). Saxena, Nesbitt, Pahwa, and Mills (2009) researched the benefits of puzzles in terms of being a fast, productive way of reinforcing the learning of short words and basic terminology. In Blood Science and Pathology courses, groups of 6 and 7 students were formed to solve puzzles. It was concluded that using crossword puzzles contributes to student learning. The researchers suggested that creating logical crossword puzzles is an effective method for transferring closely related content, discussing, recalling necessary words, thinking critically, and forming small cooperative groups. In 2010, Whisenand and Dunphy (2010) concluded that the use of crossword puzzles accelerated the learning of vocabulary in an introductory management information systems (MIS) class. In a study where students created crossword puzzles in the field of finance, students found the activity attractive and helpful in learning financial terms; students thought that this activity enhanced their creativity, reasoning, written communication, and research skills (Serna & Azor, 2011). According to Gürdal and Arslan (2011), teaching Turkish to foreign students using puzzle activities increases the interest of the students and helps them learn.

Paper-based puzzles are frequently used, and there are few web-based puzzles (Seçken, 2006; Tikbaş, 2011). Despite their frequent use, preparing and evaluating paper-based puzzles can require a significant time investment; another disadvantage is the lack of immediate feedback. Based on the literature review, there is no dynamic, online puzzle system used in Turkey for educational purposes. This study uses an Online Puzzle System (OPS) by which instructors can prepare puzzle activities for students to solve online. The technical and functional properties of the OPS developed and used are beyond the scope of this study. The system presents a user-friendly interface with Turkish character support and number-writing properties.

The general purpose of this study is to determine whether the use of online puzzles in the instructional process has an effect on student achievement and learning retention. To achieve this aim, the following hypotheses were tested:

1. Using puzzle activities in lessons increases student achievement.
2. Using puzzle activities in lessons increases retention of information learned by the students.
3. Students have positive attitudes towards using puzzle activities in lessons.

## 2. METHOD

The current study seeks to determine the effects of using online puzzles on academic achievement and information retention. A pre- and post-test with control group experimental research design was implemented. Study participants were tenth grade students in the Information Technologies Department of Gazi Anatolia Technical and Industrial Vocational School in Elazığ during the 2011-2012 year. Thirty students each were chosen for the experimental and control groups, totaling 60 students. During the study, a traditional instruction method was used for the control group, while the experimental group received both traditional instruction and performed activities using the online Puzzle System. The subject Fundamentals of Networking was chosen, and the implementation period lasted 6 weeks. Four weeks after completion of the study, the achievement level of students was calculated again to test learning retention. To remove bias, while forming the control and experimental groups, students were asked whether they wanted to participate in the study, and their test grades were taken into consideration. The views of students on which group they wanted to be in can be seen in Table 1 below.

Table 1. Students preferences on group participation

Groups	Number of Students	Percentage
Experimental	46	76
Control	14	24
Total	60	100

The students mostly preferred to be in the experimental group, since they found the online applications interesting and thought that they would learn better with the extra materials. Sixteen students in the experimental group were transferred to the control group through random selection. In order to determine whether the groups were equal, pre-test results of the Fundamentals of Networking Module Achievement Test collected at the beginning and at the end of the experimental process were taken into consideration. The results of the analysis are shown in Table 2.

Table 2. Pre-test Results of the Fundamentals of Network Module Achievement Test

Groups	N	X	S	t	Significance Level
Experimental	30	25.65	4.35	.87	.21
Control	30	21.70	4.69		

\* $p < .05$

As seen in table 2, there is no significant difference between the pre-test results of the groups. Therefore, the groups were equal.

### 2.1 Online Puzzle System (OPS)

The general purpose of the OPS was to produce puzzles to enhance and make the online instructional environment more effective. Often providing instruction in this environment can be challenging, but solutions are entertaining with the help of the online system (OPS). In addition, the system was developed for providing immediate feedback to students. There are three types of profiles: administrator, instructor, and student. The students see the puzzle list developed for them. Two puzzle activities were arranged: one at the

beginning of a lesson for reviewing the previous lesson and the other at the end of a lesson for reviewing concepts just taught. The system has an immediate feedback property showing students whether each of the letters is correct by color. Wrong letters are red, and correct ones are green. The instructor determines a time limit for completion. Figure 2 shows a screen capture of OPS and Figure 3 shows a screen capture of the solution page of the OPS.

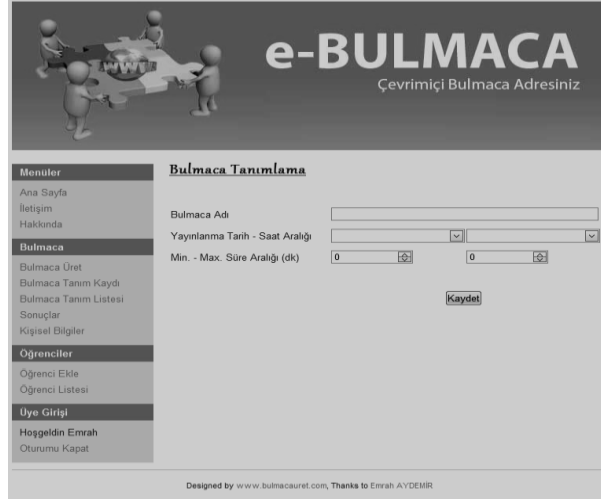


Figure 2. Screen capture of OPS

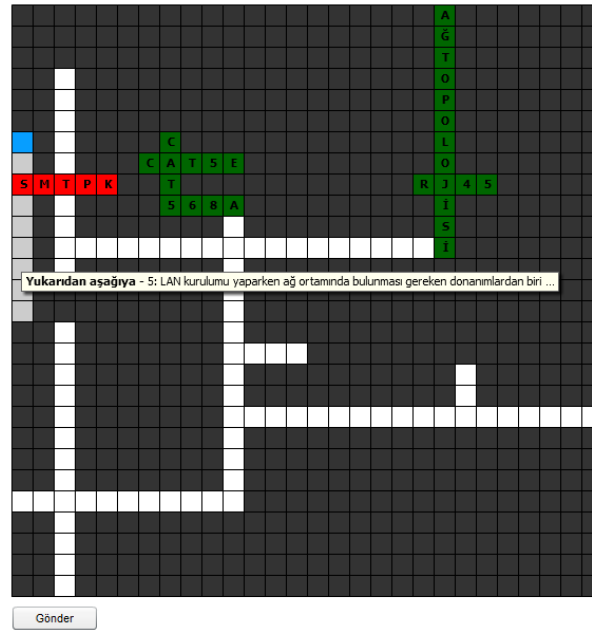


Figure 3. Screen capture of the puzzle page of OPS

## 2.2 Data Collection Tools

Two types of measurement tools were used to collect data: the Information Technologies Course: Fundamentals of Networking Module Achievement Test assessed learning and retention levels of students in the experimental and control groups and the Online Puzzle Use Attitude Scale determined student views.

**Information Technologies Course: Fundamentals of Networking Module Achievement Test:** This test consisted of 40 multiple choice items in line with program gains, developed to measure achievement and retention levels of the students. To ensure the reliability of the achievement test, KR-20 value was calculated and found to be .63, with average difficulty as .47 and average distinctiveness as .36.

**Online Puzzle Use Attitude Scale:** This scale was developed by the researcher and applied to the experimental group. It included 25 questions, which was implemented to the vocational schools as opposed to the study group. The field experts analyzed the questions and made necessary corrections. A five-point Likert Scale ranging from "strongly agree" to "strongly disagree" was used to determine the attitudes of the experimental group towards the use of online puzzles. The scale was tested on 101 students at four different schools of the same level as the schools where the research was conducted. For statistical analysis, Cronbach Alpha reliability co-efficient was calculated as .900. When the factor analysis table was analyzed, one factor showed a negative value; when one was left out, the reliability of the scale increased. Two items not suitable according to factor analysis were omitted, and Cronbach Alpha reliability co-efficient of the scale was calculated as .915.

### 3. RESULTS

#### 3.1 First Hypothesis

The first hypothesis of the study is, "Using puzzle activities in the lessons increases the achievement of the students." Differences between pre- and post-test results of students in the study were evaluated. Average scores of students on the Information Technologies Course: Fundamentals of Networking Module Achievement Test were compared, and dependent group t-test results are shown in Table 3 below.

Table 3. Dependent groups t-test results of pre- and post-tests of experimental and control Groups

Groups	N	X	SS	t	Significance Level	
Experimental	Pre-test	30	11.35	3.39	-77.6506	.000
	Post-test		38.75	3.85		
Control	Pre-test	30	12.28	3.43	-19.65	.000
	Post-test		26.97	4.77		

\*p< .05

As seen in table 3, post-test achievement scores increased for both groups. However, when post-test scores are compared, a significant difference in favor of the experimental group can be seen. According to this result, the first hypothesis was confirmed.

#### 3.2 Second Hypothesis

The second hypothesis of the study is, "Using puzzle activities in the lessons increase the retention of the information learned by the students." Four weeks after completion of the study, the achievement levels of the students were calculated again to test learning retention. An independent t-test was conducted to compare retention scores of the two groups, and the results are shown in Table 4.

Table 4. Independent groups t-test results of retention test scores of experimental and control groups

Groups	N	X	SS	t	Significance Level
Experimental	30	30.36	4.12	7.956	0.000
Control	30	22.52	3.95		

\*p<.05

In the results of the statistical analysis, a significant difference by a level of  $p < .05$  was found between the retention scores of the experimental and control groups. Therefore, the learning retention of the students in the experimental group is higher than that of the students in the control group. According to this result, the second hypothesis was confirmed.

### 3.3 Third Hypothesis

The third hypothesis of the study is, “Students have positive attitudes towards using puzzle activities in their lessons.” A 23-item 5-point Likert type Online Puzzle Use Attitude Scale was developed and tested for validity and reliability by the researcher, then implemented in the experimental group. To assess the results of this scale, frequency, percentage, mean, and standard deviation techniques were used. The means are listed in Table 5 in descending order. Gender difference was not a criterion, because the two groups consisted of only males. Moreover, students in both groups had approximately the same age and education level, so no grouping on these variables was formed in analysis. Results show that students in the experimental group had positive attitudes towards OPA. Based on these results, the third hypothesis was confirmed.

Table 5. Means of the Experimental Group Replies to Questions of the Online Puzzle Use Attitude Scale (OPA: Online Puzzle Activity)

	No	Item	X	Sd
Strongly Agree	2	I greatly enjoy the OPA process.	4.63	0.71
	5	OPA eases the understanding of the terminology in the lessons.	4.63	0.5
	17	OPA eases my learning.	4.63	0.5
	23	The points gained in OPA form a competitive environment in class.	4.63	0.71
	10	OPA helps me recall the terms and definitions.	4.5	0.73
	12	I would like to do more exercises with OPA and similar activities.	4.44	0.81
	6	OPA helps me to develop my terminology knowledge in the lessons.	4.38	0.77
	7	OPA develops my self-confidence in knowing the terms.	4.38	1.02
	14	It was fun to communicate with my friends while reviewing the material doing OPA.	4.38	0.8
	8	OPA helped my exam preparation.	4.31	1.07
	9	OPA was an entertaining activity supporting my learning of the terms in the course.	4.31	0.79
	13	OPA developed my learning.	4.31	0.94
	4	I want OPA to be used in other courses.	4.25	1
Agree	3	Doing OPA was entertaining.	4.19	1.1
	15	The time limit given for OPA was enough.	4.19	0.88
	20	The words can be put meaningfully in OPA.	4.19	1.04
	19	OPA provided more self-satisfaction.	4.13	1.02
	11	OPA was an effective tool for arranging the terms in my mind.	4.06	1.23
	1	I want to participate in an activity like OPA again.	3.88	0.79
	22	I felt as if I achieved an important thing when I completed OPA.	3.88	1.25
21	I prefer OPA to fill-in-the-blanks in sentence-type questions.	3.69	1.25	
Hesitant	16	The questions used in OPA were appropriate for the puzzles.	3.38	1.36
	18	OPA was a good method for reviewing the obscure course materials.	3.25	1.36

## 4. CONCLUSIONS AND SUGGESTIONS

The aim of this study is to determine whether the learning environment in which an online puzzle activity was used has an effect on student achievement scores. This activity was used in addition to traditional instruction based on narration. A six-week study was conducted in the department of Information Technologies of Gazi Anatolia Technical and Industrial Vocational High School in Elazığ during the 2011-2012 academic year. In the teaching of the Networking Fundamentals Module of Information Technologies Course for tenth graders, a significant difference in favor of the experimental group where online puzzle activities were used in terms of the student achievement and retention of learning was found. Therefore, it is concluded that using online puzzle activities in courses such as Information Technologies where many terms exist assists the students' retention. This finding corresponds with studies conducted by Songur (2006), Saxena et al. (2009), Whisenand and Dunphy (2010), and Gürdal and Arslan (2011). Doing online puzzle activities accelerates learning for students and helps them learn networking terms by creating an enjoyable



environment. Other studies (Franklin et al., 2003; Kalyani, 2007; Lin & Dunphy, 2012; Parsons & Oja, 2008; Whisenand & Dunphy) also support that finding.

The statements of students that they like OPA, want to learn with these activities again, and desire to see puzzles in other courses can be explained by motivation, one of the basic principles of learning. According to Yalın (2000), no one can learn without the desire. For this reason, instructors should use activities such as puzzles and games to arouse the interest and learning desire of their students. Prensky (2002) suggests that students feel comfortable and relaxed when entertainment is part of the learning process, allowing information to be absorbed easily. Moreover, immediate feedback is a necessity since it increases effectiveness. The puzzle system used in this study gives students immediate feedback through color, helping students reinforce concepts to be learned. Students in the experimental group mentioned enjoying the slightly competitive atmosphere with the points earned from the puzzles. Students also mentioned the pleasure they felt after completing a puzzle. The level of difficulty compels students to try their best, releasing feelings of excitement, fear, and enjoyment and satisfying their egos. There is a relationship between the difficulty level of the puzzles and self-efficacy perceptions of the students. When students complete an activity and move on to the next level, they feel a sense of accomplishment and pride.

From the findings of the study, it can be concluded that online puzzle activities help students understand subjects better and aid in exam preparation. Moreover, these activities are effective for students in terms of increasing understanding and retention of learned terms in and outside class, forming valuable learning experiences. Doing these online activities in class as a course-end activity can be said to be more effective in students' learning than doing them outside of class. Gomez and Scher (2005) underline this conclusion by expressing that for courses in which the content is full of word-for-word important concepts, using crossword puzzles is more effective in cooperative environments.

The recommendations related to the online puzzle system are as follows. The current study was limited to six weeks of implementation during the 2011-2012 school year at Gazi Anatolia Technical and Industrial Vocational High School in Elazığ. Similar studies could be conducted in other schools for longer periods and at different levels, so the findings can be compared with those of the current study. This study is further limited to an Information Technologies Course. Studies can be conducted with various courses using appropriate online puzzle activities. Puzzle types other than the crossword used in the online puzzle system of the current study should be developed and added. The system should also be developed by visual multimedia objects, allowing it to be more interactive. Moreover, in the development process of such an online puzzle system, educators, software designers, psychologists, and scholars from other fields should work together. Usability tests should be conducted to improve user-friendliness of the system by adding various features related to functionality and visuality.

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# LEARNING SKILLS, DIGITAL COMPETENCIES AND FLIPPED CLASS: LESSONS LEARNED

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## ABSTRACT

The paper presents lessons learned while using multimedia in form of slidecasts and screencasts in engineering education. The paper proves that Technology Enhanced Learning could be relatively inexpensive. According to Dale's Cone of Experience there is a big need of multimedia in education, also in the field of engineering. Multimedia in the form of podcasts (personal on demand broadcasting) can be very useful as a supplementary tool for lectures and software training, but they have one common drawback – they do not allow two way communication. Presented case studies, showing complete way in which multimedia can be used, are taken from two subjects – Applied Computer Sciences and Computing in Civil Engineering. They include a full set of software animations and multimedia lectures. After analysing the use of podcasts the real point of the paper is presented - a new look at streaming media in which students are asked to perform easier task at home and learn from podcasts independently. This enables to solve more difficult problems during classes. The paper presents results of survey of students' satisfaction and compares them with similar surveys from United States and Canada.

## KEYWORDS

Streaming, slidecast, screencast, flipped classroom, students' satisfaction.

## 1. INTRODUCTION

Confucius in 450 B.C. said: "tell me and I will forget, show me and I may remember, involve me and I will understand." As outlined by many researchers individuals remember much more details and information as well as for longer if they are more associated with learning process. In 1946 Dale published his famous Cone of Experience (Dale, 1946). Dale stated that the cone device can be a visual metaphor of learning experiences, where the different kinds of audio-visual materials are arranged in the order of increasing abstractness as one proceeds from direct experiences (Figure 1). One of the later extensions of this idea is common opinion, that individuals generally remember: 10% of what they read, 20% of what they see, 50% of what they see and hear, 70% of what they say and write and 90% of what they say as they perform a task. Moreover, the entire process of learning is split into two parts: passive learning and active learning.

Blooms Taxonomy proposed in 1956 (Bloom, 1984) by a panel of educators chaired by Benjamin Bloom is a categorization of learning objectives as well as activities split up into three areas: cognitive (mental skills, knowledge), affective (feelings, emotional areas and attitude) and psychomotor (manual and physical skills). The cognitive domain most significant in higher education requires mental abilities and also knowledge. Within this domain one can find six major categories outlined from the most straightforward: knowledge, comprehension, application, analysis, synthesis and finally evaluation.

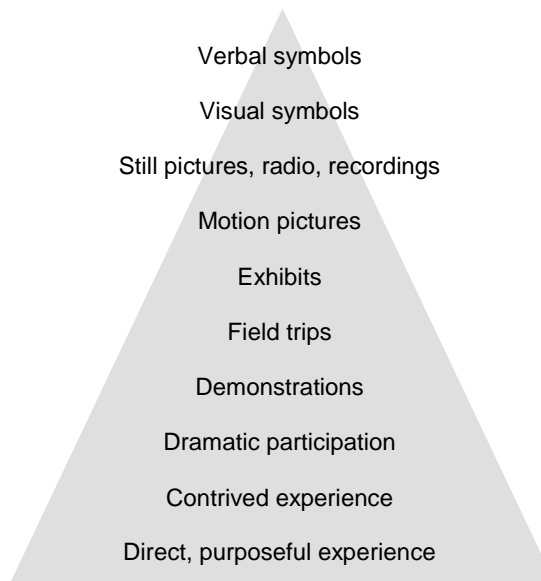


Figure 1. Dale Cone of Experience

In the middle of 1990's the cognitive domain has been modified. Titles associated with different types have been transformed from nouns to verbs. Moreover, their order has been somewhat changed. Bloom's Revised Taxonomy (Anderson et al., 2000) demonstrates to a greater extent active way of thinking and also consists of six different categories: remembering, understanding, applying, analysing, evaluating and finally creating. This taxonomy much better accounts for completely new behaviours and multimedia technology innovations (Figure 2).

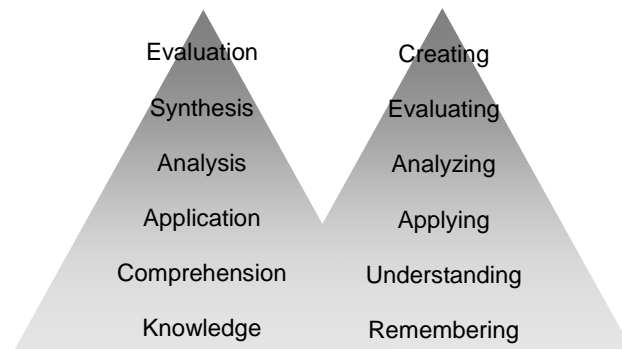


Figure 2. Bloom's Revised Taxonomy

## 2. INFORMATION TECHNOLOGIES TUTORIALS

Curricula of the subject Information Technologies (IT) taught on the first semester at Faculty of Civil Engineering is an attempt to make a reasonable combination of Information Systems (IS) and Computer Sciences (CS). Curricula of IT subject is based on compromise between the level of students' knowledge and foreseen needs of other subjects. While the first point can be easily measured by questionnaires the second one is hard to tackle with due to the conservative attitude of many teachers to the role of IS and CS in engineering (Gajewski, Wlasak, & Jaczewski, 2013).

Questionnaires and surveys about students' IT knowledge have been conducted regularly since 2011. Their results are worse than expected. Students know how to run software like a text editor or a spreadsheet but they do not know how to use it in order to solve a particular problem in an effective way. Both figure 3 and figure 4 show that the knowledge of more advanced functions in a text editor and in a spreadsheet decreases.

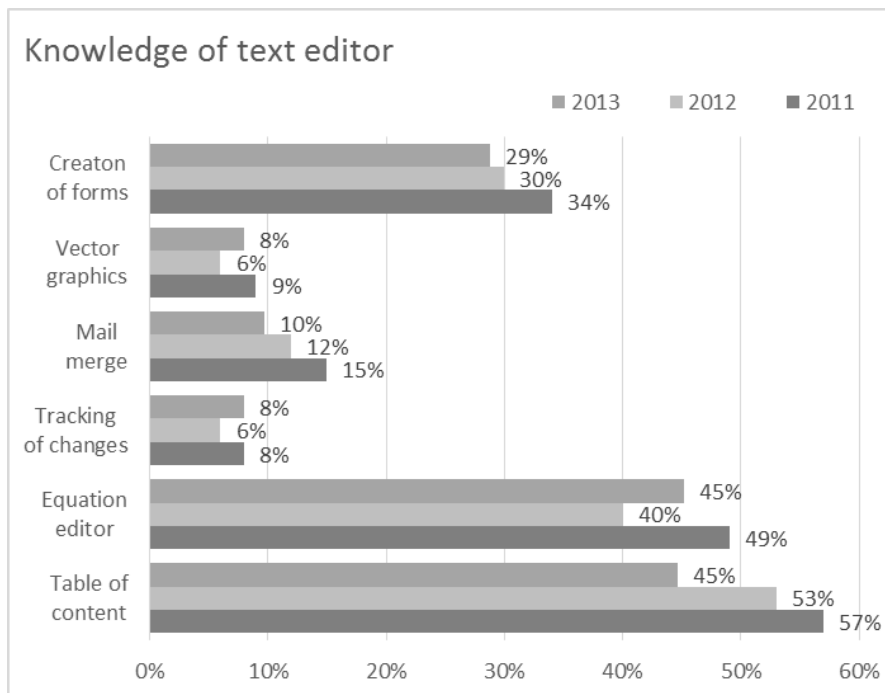


Figure 3. Knowledge of text editor

This means that material from IT on the level of European Computer Driving License (ECDL) should be still present in curricula of studies.

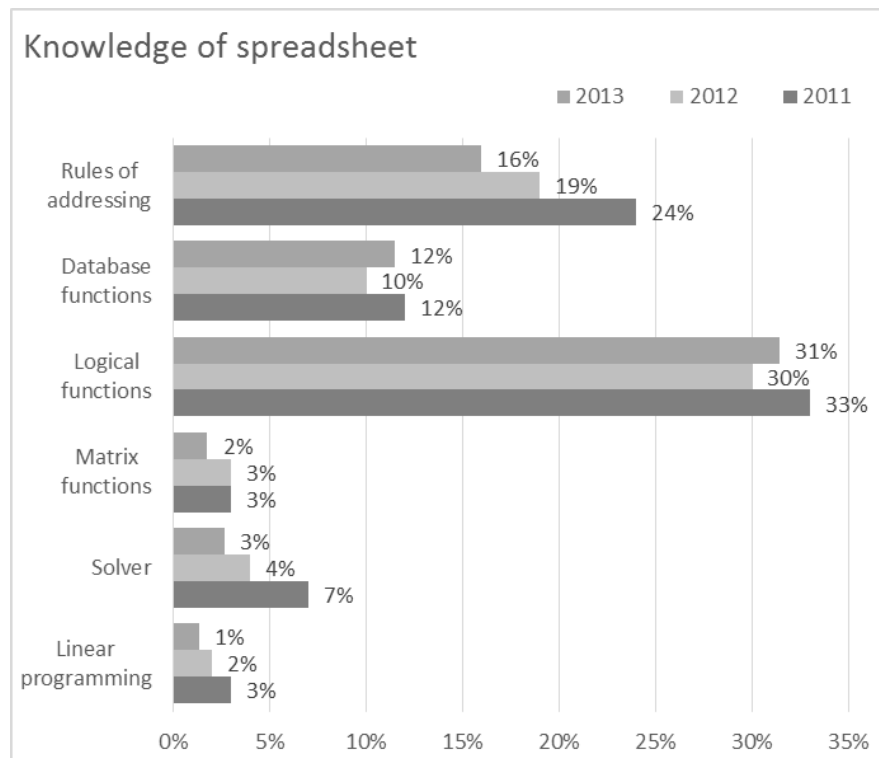


Figure 4. Knowledge of spreadsheet

### **3. MULTIMEDIA ISSUES**

Multimedia materials were prepared in the form of podcasts – personal on demand broadcasts. First podcasts prepared in the Division of Information Technologies (DoIT) had the form of screencasts – “digital recordings of computer screen output often containing audio narration”. Screencasts contain software animations helping students to learn how to use software. Second kind of podcasts are slidecasts – “audio podcasts combined with slideshow”. Slidecasts have the form of knowledge clips – short explanatory presentations of a particular problem and its solution. Last kind of multimedia materials prepared by DoIT are webcasts – “media presentations distributed over the Internet using streaming media technology to many simultaneous viewers”. In fact webcasts were lecture captures which were recorded and later distributed as podcasts. Tenth of hours of podcasts stored on an educational portal helped a lot during classes but did not have an expected impact on quality of learning process measured in terms of grades obtained by students.

Questionnaires performed in the academic year 2011/12 showed that having a full range of podcasts not all of students were fully satisfied by them. They were pleased by the quality and ease of use as well as by their availability in the mode 24/7. Moreover, they stressed positively that such an approach addressed different learning styles (Sarasin, 2006). However, in additional field of questionnaire reserved for remarks some of the students complained that especially computer laboratories were boring for them because they repeated what was recorded in screencasts. All podcasts were designed as additional, supplementary and auxiliary tool and all teaching and learning activities were conducted in a traditional way. Students were “taught” at the university how to use software and they were supposed to solve individual problems at home. In many cases solving problems was too difficult for them.

Starting from the academic year 2012-2013 in some of the groups podcasts were used in a different way. Students were asked to watch podcasts at home. During classes they should be prepared to use software without any problems and to solve particular problems using it. First results of this experiment were to some extent promising - students gained better scores in this mode, but they were not very keen to spend time at home watching podcasts. Students do prefer to “be taught” during classes. This problem can be easily solved by adding a simple point to subject regulations – students should be prepared to computer laboratories and this fact is checked by means of a test before the class. In fact, according to European Credit Transfer System (ECTS) average student should spend learning at home the same amount of time as at the university. It is much more effective to watch passive by nature screencasts at home and solve problems with a tutor in class than the other way round.

### **4. REVERTING THE SITUATION**

These observations lead to idea to revert the situation. Why not to ask students to perform easier task at home and learn from podcasts independently and why not to solve during classes more difficult problems. Such situation is with an agreement with Bloom’s Revised Taxonomy. Lower order thinking skills like remembering, understanding and applying are gained at home from podcasts which can be treated as recorded classes. Higher order thinking skills like analysing, evaluating and creating are gained at the university. Such situation requires change of the role of academic staff – from teachers to tutors.

First results from academic year 2012/13 were very positive and promising (Gajewski, 2013). Average result from tests increased by approximately 5% and the number of students who failed decreased. General students’ opinion about two subjects – Applied Computer Sciences and Computing in Civil Engineering is better than before. As it could be supposed not all students were satisfied by this change. There is a quite big group reluctant to work at home and prepare to classes by watching podcasts. The only very upsetting thing is the fact, that the idea of reverting class and home activities is not absolutely new. It is known as flipped classroom and was already discovered (Bergmann & Sams, 2012), (Gerstein, 2012).

## 5. SURVEY

The research concerning students' satisfaction with flipped classroom was conducted in academic year 2013/2014 on a group of 222 students studying in Polish (PL) and a group of 51 students studying in English (EN). From 222 PL students the questionnaire filled 211 students which makes 95%. Similar data are for students studying in English. Questionnaire was filled by 49 out of 51 students. One third of students studying in English were foreigners. Four weeks of classes, during which material covering the text editor Word and the spreadsheet Excel was discussed, were carried out in the traditional manner. In the computer laboratory equipped with 30 workstations there were two teachers. One of them demonstrated with a multimedia projector solutions of the sample problems. The second teacher assisted students.

Observations from traditional classes were rather pessimistic. More than half of the students did not follow the presentation and did not perform similar tasks to those presented by the teacher. As presented in figure 3 and figure 4 this material was rather unknown for students but they were simply not interested in learning new things. It is rather difficult to motivate digital natives to learn (Wlasak, Jaczewski, Dubilis, & Warda, 2013). This is still a very important and significant problem even there were many books written on that subject (Brophy, 2010). The answer to this question is difficult when we consider digital natives who do not care and who also think that they know everything (Mendler, 2000) in the field of subjects like Applied Computer Sciences and Computing in Civil Engineering. Mendler presents one of the existing solutions – five key processes that motivate: emphasizing effort, creating hope, respecting power, building relationships and expressing enthusiasm. But digital natives being real partners for learning (Prensky, 2010) are difficult and demanding partners.

Questionnaire used in this survey consists of fifteen closed form questions and 6 opened form questions. Due to the nature of answers all questions were divided into three groups. In order to compare results of survey with other outcomes some of the questions were based on similar surveys: first one conducted in Canada by (Johnson, 2013) and second one described in blog Flipping with Kirch conducted by Mary Kirch from the United States.

## 6. RESULTS OF SURVEY

Scale of answers for all first five questions is from “strongly agree” to “strongly disagree”. Results for Polish language and English language students were compared with surveys from Canada. First of the asked questions was about level of engagement in traditional classroom instruction in comparison to flipped classroom (Figure 5).

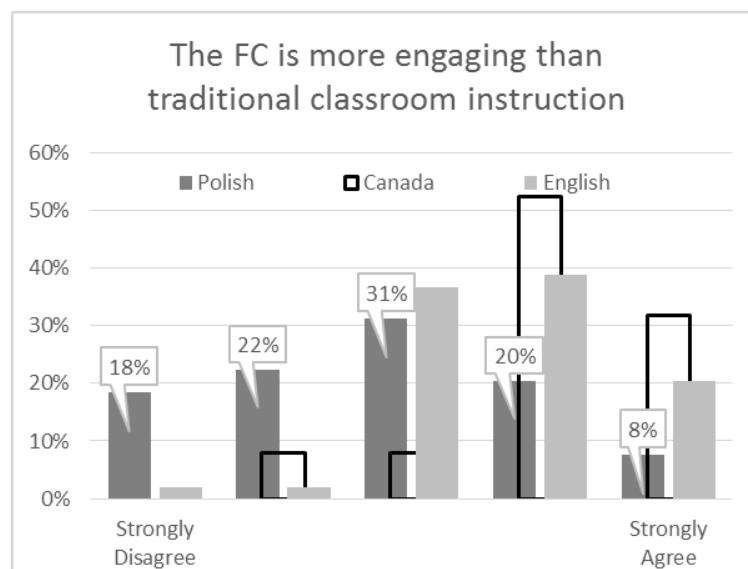


Figure 5. Comparison of answers to the question 1/1

40% of students studying in Polish language strongly disagree or disagree with the statement what is in accordance with the observation, that nearly half of the students was not interested in traditional classes. Answers of students studying in English language are closer to the answers from survey conducted in Canada.

The second question from that group was about potential recommendation of flipped classroom to a friend (Figure 6).

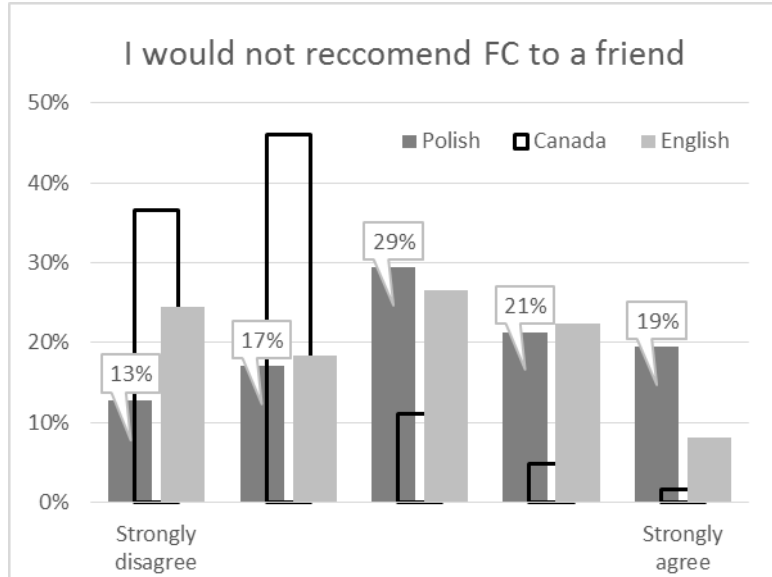


Figure 6. Comparison of answers to the question 2/1

For this question answers of students studying in Polish and English languages are similar but they definitely differ from the results of survey conducted in Canada. Nearly six times more students studying in Polish language in comparison to Canadian agree or strongly agree with the statement that they would not recommend the flipped classroom to a friend.

The next question (statement) was very simple – I like watching lessons on video (Figure 7). In this case answers for all three groups were very similar.

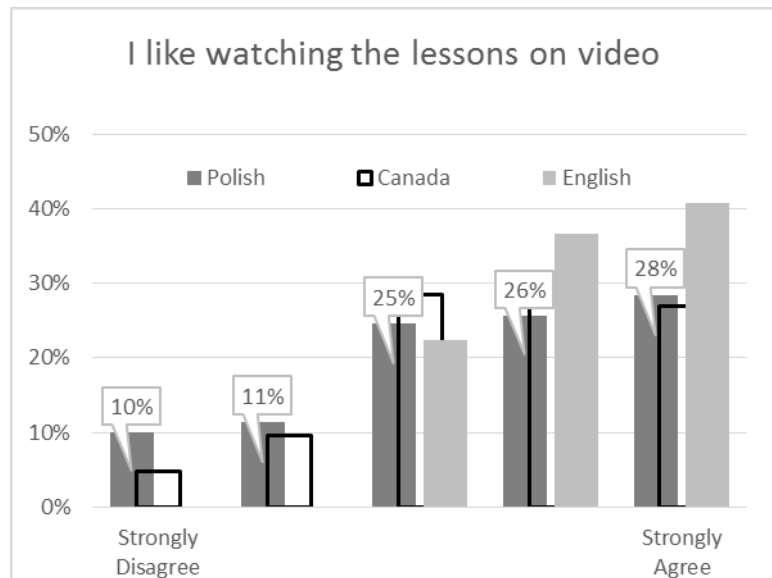


Figure 7. Comparison of answers to the question 3/1



The fourth question in this group of questions was about bigger motivation to learn in the flipped classroom mode (Figure 8).

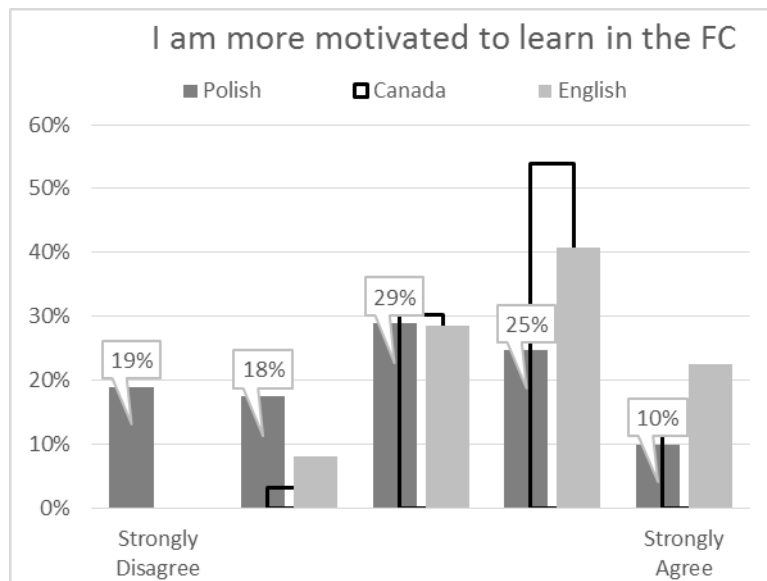


Figure 8. Comparison of answers to the question 4/1

In the case of this question answers of students studying in Polish language differ from the answers of two other groups. Nearly 40% of them strongly disagree or disagree with that statement that they are more motivated to learn in flipped classroom mode.

The last question in this group is about an improvement of learning in flipped classroom mode (Figure 9).

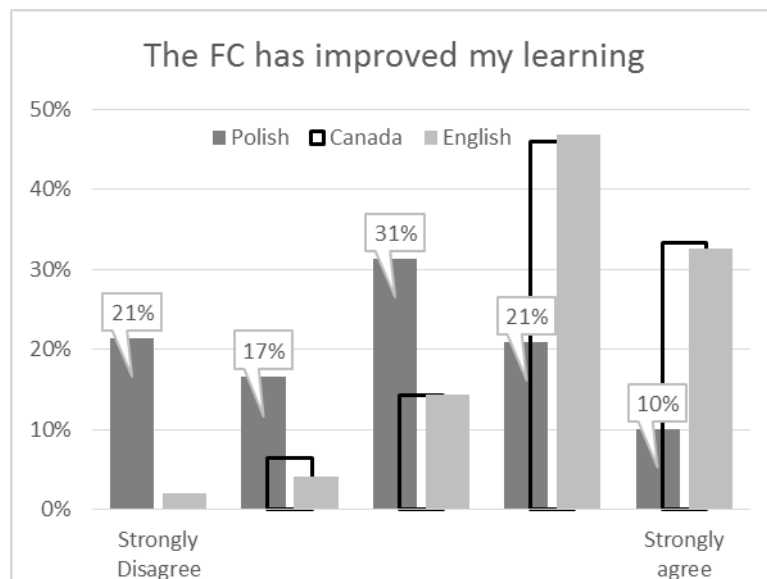


Figure 9. Comparison of answers to the question 5/1

Also in the case of this question answers obtained for students studying in Polish language are definitely different from results for two other groups. Nearly 40% of them strongly disagree or disagree with that statement. Answers for students studying in English and answers from survey in Canada are nearly the same. Nearly 80% agree or strongly agree with statement that the flipped classroom has improved learning.

## 7. FINAL REMARKS

One of the pressures on universities is the rapid development of new information and communication technologies for the provision of education and training. Wide opportunities in open and distance learning create new markets. Moreover the principle of life-long learning extends the age groups to which university can offer education. Additionally the principles of new techniques can be applied to traditional markets – regular intramural students. All Polish universities willing to use modern information and communication technologies face common opportunities, threats and constraints. A constant struggle between pressure to change and fear and resistance to change is visible in Poland. Teachers' attitudes are a major obstacle to the introduction of change. There is an internal brake on the efforts to make changes through using new technologies: resistance from people. Reference can be made to a “frozen middle” resisting attempts to change from both the top of the institutions (authorities) and from the bottom (students). Students' demands are a powerful factor forcing universities to exploit the potential of new technologies to improve learning experience. But the question “how to change the unchanging” is still open (Gajewski, 2002). Moreover one should add to this question a new one – “how to motivate digital natives to learn?” (Wlasak et al., 2013).

## ACKNOWLEDGEMENT

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# AN HCI EVALUATION OF USER EXPERIENCE IN THE MELODY SEARCH MUSIPEDIA

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## ABSTRACT

This paper evaluates the usability and user experience of a Wikipedia-type melody search engine Musipedia ([www.musipedia.org](http://www.musipedia.org)). Using Human-Computer Interaction (HCI) principles, the authors evaluate the perceptual, learning, and social and organizational aspects of the interface and test the various melody and rhythm search engines for usability and effectiveness. The Flash piano, JavaScript piano, and Contour Search prove to be the most effective tools for music information retrieval. The interface is determined to be lacking in appeal, which belies the powerful search tools provided by the site. The study recommends usability and interface improvements based on findings.

## KEYWORDS

Melody search engine, Music Search, HCI, Information Retrieval, Usability, User Experience,

## 1. INTRODUCTION

This paper evaluates the usability of the melody search engine Musipedia.org ([www.musipedia.org](http://www.musipedia.org)) based on the principles of Human-Computer Interaction (HCI). In contrast to many popular search engines that perform simple text search to find music, Musipedia makes use of melody search engines to find music and other relevant information, like artist, music sheet, video and audio renditions, and more. If the music seeker does not know any of the text associated with the music, but knows the tune and can either play it on a musical instrument or sing it, Musipedia's various melody search engines provide the facility for finding that music.

Musipedia is an "open music encyclopedia," which according to its website, uses a melody search engine to find and identify a tune. Musipedia was started by Rainer Typke in 1997 when the World Wide Web and the newly developed graphical Web browsers were just beginning to gain popularity among the general public. There is scanty information in its *About Us* page regarding its history, but there is a link to Wikipedia for a historical background of its own site. In 2004, according to Wikipedia, the site added Wikipedia-like collaboration features, which allowed editing and deleting existing entries. Typke called the music search engine "Melodyhound." From 2006 onward, the Musipedia search engine can also be used for searching the World Wide Web for MIDI files.

As an open Wikipedia-type music database (or encyclopedia), the public is allowed to contribute, edit, and maintain a large collection of music and information about music. Musipedia's search engine is unique because it utilizes sound recognition applets for conducting melody search, contour-based search, rhythm search and voice search. The user has the options of singing the tune, playing it on a Flash or JavaScript piano, whistling or tapping its rhythm, or identifying a melody's contours (up and down), in addition to being able to write the music using the special musical notation.

This study evaluates the Musipedia website from an HCI and Information Retrieval perspective. It evaluates the overall user experience and tests the usability of its interface. A recommendation for improvements is offered based on the results. Both of the authors who conducted the tests have music background but intentionally refrained from using the search engine prior to conducting the tests so as to reduce a learning bias.

## 2. LITERATURE REVIEW

The problem of storing and retrieving music as well as other media in formats other than text has been discussed as early as 1996 by Lesk, where he proposes that research is needed in the handling of images, sounds and video, as nearly all the search algorithms they had at the time were based on text and words. This was a big challenge because the storage capabilities required by media looked insurmountable in that era before the Web became popular. “In research terms, we will need to move into more serious image recognition and sound recognition research, areas which have been more promising than computational linguistics (as one might expect, given that pigeons can be trained to do image recognition, but not language understanding)” (Lesk, 1996).

Today, nearly two decades later, not much has been accomplished in the way of music search by sound recognition. A search of the term “music search” in online databases returns few results. The Library Literature & Information Science Full Text (Wilson/Ebsco) retrieves only 23 articles. None of them even makes reference to Musipedia, the subject of this study. Only four articles are relevant to this study as many of the retrieved articles are simply noise or truncations of the term *music* and *search* with other non-related terms. Of the four retrieved articles three are in fact not totally about melody search per se, but about improving text-based music search interface (Thomas, 2011), the challenges of music search engines being mostly text-based indexing (Nanopoulous et al., 2009), and search strategies in finding music materials for catalog users where at least “research into new music retrieval methods are considered” (King, 2005).

Only one article by Duggan and O’Shea (2011), entitled *Tunepal: searching a digital library of traditional music scores*, is about a melody search engine. Although this study is only specific to retrieving traditional Irish music, it describes the Tunepal system, which can facilitate “query-by-title and query-by-playing music (QBP) searches.” This system is worth a further research study because it is so far the only alternative system found that utilizes searching by sound like Musipedia. A later search of the term “*Tunepal*” in Google turns up a recently developed app for iPhone and Android by the same authors of the article in review. It also points to the website [www.tunepal.org](http://www.tunepal.org) and [www.facebook.com/tunepal](http://www.facebook.com/tunepal), its Facebook page, where more information is provided. According to the website, “tunepal.org works best with ‘legato’ style instruments such as the tin-whistle, flute, concertina, accordion [sic], pipes, fiddle.” However, it works only with traditional Irish music and only transcribes the melody into the lyrics.

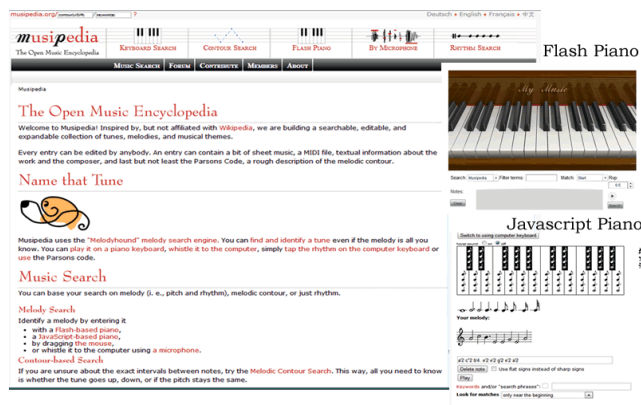


Figure 1. Musipedia homepage with insets of Flash Piano and JavaScript Piano

From the music industry, the International Index to Music Periodicals retrieves 19 articles but none that deals with searching for music. The Entertainment Industry Magazine Archive returns 85 articles that are just reviews of music industry matters and none on searching for music. The media industry’s Communication & Mass Media Complete also finds only two articles but which have nothing to do with music search. In Google Scholar, an article by Peter Knees, et al. (2007) on a music search engine built upon audio-based and web-based similarity measures is found in the ACM Proceedings of the SIGIR Conference on Research and Development in Information Retrieval. However, the search engine developed in that study is just another indexing method that uses tagging of the behavior of the notes. Of greater interest to our study, however, is that Google Scholar also finds two U.S. patents that have been awarded to inventors of melody

search engines: (1) R. Iwamura (2001) invented a search engine that retrieves music in a database by entering piano roll notes into a monitor interface or through a PC keyboard; and (2) M. Woo (2004) created an engine where the user enters a sequence of notes into the computer through either a keyboard/mouse, MIDI instrument or voice/solo instrument. The query building in both inventions is similar to the various interfaces in Musipedia, except that the former would search solely from an internally created database while Musipedia (*Figure 1*) searches the Web as well as its database that is created and maintained by the public.

Because this study concentrates on the HCI aspects of melody search engines, we identify the two usability areas for testing to be *query formation* and *result retrieval*. A study by Casey, et al. (2008) distinguished between “textual metadata” and “content-based” methods of searching for music. It concurred with Lesk that “at present, the most common method of accessing music is through textual metadata” and stated that the type of applicable algorithm to use depends greatly on user tasks and specificity (low, medium or high) of the desired results. The paper broke down the process of music information retrieval (MIR) into four components: query formation, description extraction, matching and music document retrieval. Out of these components, the first and the last ones are where HCI plays a significant role, and is used in the study to determine the usability of the interface and the various melody search engines of the Musipedia website.

### 3. THEORETICAL REFLECTIONS

The three aspects of HCI that this paper studies are: the perceptual aspect, the learning aspect, and the social/organizational aspect.

On the perceptual aspect, Rogers, Sharp and Preece (2011) state that “information needs to be represented in an appropriate form to facilitate the perception and recognition of its underlying meaning” (p. 71). Perception refers to the process of acquiring information via the sense organs – eyes, ears, fingers – and transforming it into experiences of objects, events, sounds, and tastes. While it has long been established that humans process most information through sight (Hurt, 2012), in the case of Musipedia the information contained is split between visual and audio signals. Therefore, hearing, which is only second to vision in acquiring information among human senses, is actually more important in our study.

Regarding the learning aspects of using the website, Rogers, Sharp and Preece (2011) also state that people “prefer to learn through doing” (p. 81). Good interface design should support this active learning. This study reviews the ease by which users learn to navigate and use the Musipedia website, as well as indicate whether it is possible to effectively utilize it without the need for researching an extensive set of instructions in a manual or on Help pages, if they exist.

The social and organizational aspect of the website is evaluated by how easy it is to join the membership in the registry of users. In addition to serving as a MIR system, Musipedia also has a community of volunteers “inspired by Wikipedia” that together enter and edit its collection of music documents – thus increasing “social capital” (Resnik, 2001). Members of this community are united on the basis of common ground in either occupation or hobbies (Olson & Olson, 2000), which for them is an interest in music and a desire to get information about it to become public knowledge. Musipedia has, as of the writing of this paper, over 5300 members from all over the world with 116 countries counted from the drop down list.

## 4. METHODOLOGY

### 4.1 Procedure

This study is conducted in two phases: *Phase 1* studies the overall look of the website and tests all the search tools; *Phase 2* is a more in-depth usability study of tasks that regular users are bound to undertake.

#### 4.1.1 Phase 1 – Preliminary Searches

In Phase 1, a profile of the regular users of Musipedia is described based on the characteristics of the current members. It is important that the evaluators in this study have the same or similar characteristics as the regular users of the site. This is in accordance with the principle of credibility as Shenton (2004) states, “in

addressing credibility, investigators attempt to demonstrate that a true picture of the phenomenon under scrutiny is being presented” (p. 63). It is shown in the following section that the authors fit the profile of regular users and so could act as the evaluators for both phases of the study.

In the next stage, the evaluators try all the melody and rhythm search engines found in the site. They record their impressions, comments, difficulties, and overall experience as they accomplish each task. Three tunes are chosen for this search, two are popular music and one is classical. The popular songs are entitled *A Time for Us* from the movie *Romeo and Juliet* and *Lara's Theme (Somewhere My Love)* from the movie *Dr. Zhivago*; the classical music is *The Beautiful Blue Danube* by *Strauss*. The tune, *A Time for Us*, is used for searching through all the search engines provided by the website, namely the two piano search types, the contour search, the rhythm search, and by whistling into the microphone. The top three search engines are then chosen and used for searching the two remaining songs.

The steps taken by the evaluators, the results of the searches and the user experience are all recorded and evaluated based on the User Impact specified in Chu (2011), i.e. time needed to learn the system, speed of interaction, error rate, retention of techniques, and user satisfaction.

#### **4.1.2 Phase 2 – Usability Testing**

In Phase 2, the evaluators test the site for usability. Two usability tasks are tested: a text-based task and an instrument-based task. The text-based task is to test for the ability to register for membership in the website. The success criterion for the first task is for the user to be able to actually register for membership in the website. The evaluators in this testing are the authors who are not yet registered members of the website.

The instrument-based task is to find out how easy or difficult it is to find instructions for the use of the JavaScript keyboard. The particular instrument chosen is the JavaScript keyboard, because it is an unfamiliar interface for most musicians using the site, including the evaluators in this study. The success criterion is to be able to find help or instructions on any aspect of the use of the instrument, e.g. how to correct wrong notes in the query entry, or how many notes to play on the keyboard before submitting the query, and the like. The usability test employed in this study is similar to the think-aloud protocol included in the usability experiment by Jung et al (2007). According to them, “The goal of the think-aloud protocol was to allow the participants to report their thoughts while using each system, thus giving us a more direct view of the mental processes searchers engaged in while searching” (pages 380-381). In this study, however, the evaluators are also the researchers, so instead of thinking out aloud, the evaluators take note of their thoughts and activities as they perform the assigned tasks.

##### Registering for Membership

As soon as the evaluators enter the Musipedia website, they look for the link to the membership page. They record where they first go to look for the link, the exact wording of the link, whether it is easily identifiable as a link and not just as text, and so forth. They then follow the link to the registration page and fill in the form, while noting the usability of that page as well. The evaluators clock the time it takes to complete the process from finding the link to successfully getting registered as a member.

##### Finding Instructions for the JavaScript Keyboard

Continuing from the previous task, the evaluators try to find the link to the JavaScript keyboard and note how easy or difficult it is to navigate to that page. As soon as the page is shown, they look for instructions on how to use the instrument or where to go for help. They then note the process of looking for help, including a description of their feelings while accomplishing the task. Finally, they try to formulate a query based on available information on how to use the instrument, using the first 4 notes of the popular music *A Time for Us*, and submit the query. They take note of the initial result and complete the experiment.

#### **4.2 Evaluators as Typical Users**

By studying the profile of the registered members of the website, the authors determine that the typical user would have to be able to read and play musical notes, to recognize and reproduce the movement or contour of the tone, to tap the rhythm of the tune, or to at least be able to whistle or hum the music into a microphone. The typical user is one who would be exclusively interested in matters related to musicology, like music sheets or scores, and other related formal information or materials attached to the music being searched. The

typical user will most probably *not* be interested in searching here for popular formats like MP3's, MIDI's or music CD/DVD's and videos. Those can be more easily accessed through music vendor websites, Amazon Google, or YouTube.

Although familiar with the use of musical instruments and the search tools provided by Musipedia, the typical user would not be considered an expert in the use of search engines. A typical user would be able to enter the query because it is by playing a common musical instrument. However, she would be interested only on the initial result and would not be able to further refine the query to the next level, if so required.

One characteristic that would classify the authors in the same category as the regular user described above is that they both play the piano and read musical notes. Although, as researchers the authors have extensive experience in text-based searches, they have not used this search engine before nor have they ever used any other melody search engines. They are then on the same level of expertise as any first-time user of Musipedia. They may have an advantage if the first search would need further refinement of the query, but it does not matter in this study as the objective is to evaluate only the primary search activity.

Because the authors can read musical notes and play the piano and other musical instruments, they can use all the search tools of Musipedia as a typical user. For the second phase of the study, this would be their first time using a melody search engine for usability testing, and so the process of entering the search query by sound and rhythm is still a novel experience for them. As a typical user, they expect to easily find anything they need to be able to use the website's offerings, especially as regards forming the query correctly and getting the relevant results quickly. The authors are both familiar with information retrieval and HCI concepts and one is an experienced Web designer. Important to the first task in Phase 2 is that the authors are not registered members of Musipedia.org and actually register for membership during the testing. Important to the second task of Phase 2 is that the authors have only briefly used the JavaScript-based keyboard while doing the descriptive trials in Phase 1.

## 5. RESULTS

### 5.1 Phase 1

#### First Impressions

Both evaluators report the same or similar impressions. The home page is functional but lacks aesthetic appeal. It is functional because as soon as the page opens the users immediately see what they would have come for, namely the various ways available to do a melody search. However, the layout looks obsolete and haphazard, where elements are not grouped logically together. The banner heading dominates the page. It has the name and logo of the site on the traditional upper left hand corner, and right next to it are the types of searches available on the site, like *Keyboard Search*, *Contour Search*, *Flash Piano*, *By Microphone*, and *Rhythm Search*. What is not immediately obvious to the user, as noted by both evaluators, is that they are actually hyperlink buttons; this only becomes evident when the cursor is hovered over them. The navigation bar just below the heading banner points to other information and services available on the site, including all of the musical search engines. It is located in the traditional spot for navigation and the user's eyes are drawn to it automatically.

The rest of the home page has enough background and functional information to get a user started with the various types of melody search available on the website. However, the overall design, from an aesthetic point of view, is amateurish, giving the impression that the page design has not been updated since the early days of the Web. Although it hardly detracts from a user's purpose in coming to the website, it belies the powerful and sophisticated engines running below the surface. To find some possible reason for this obsolescence in design, one of the evaluators visited the *About Us* page. This page does not give much information on its history, like when the page was created, and simply acknowledges the contributors to the system. Near the bottom of the page, however, one finds a link that says: "A bit more information can be found in the Wikipedia article about Musipedia," which indicates that 1997 may have been the date the web page was designed. While the interface may be obsolete, a look at the underlying code of the homepage reveals that it has already been updated to the latest version of the language, namely XHTML, and also incorporates other modern programming languages.

### User/Member Profile

As there is a scarcity of articles on music searching and almost none on melody searching, it is difficult to create a profile of the typical user of websites like Musipedia. For purposes of our evaluation, we look at the characteristics of its registered members, as they would be representative of the potential and current users that have not registered as members yet. As of the time of our first access in October 2013, in preparation for this study, there were 5,207 registered members who work on improving the collection of tunes and musical themes made available to the website (a more recent figure in December 2014 is over 5,600). Of the registered members, we can approximate the total number of those who are musicians, by extrapolating the figure from entries in the instruments played list. The average per instrument played is 26 members. There are 35 declared instruments and so we can safely assume that a minimum of about 20% (910) of the registered members are musicians. When we include those members who decided not to declare their musical skills but do indeed play musical instruments, and the non-members who search Musipedia that are musicians, the number may even be higher. This means that to be able to use Musipedia, one would have at least know music, to be able to read and play musical notes, to recognize and reproduce the movement or contour of the tone, to tap the rhythm of the tune, or to whistle or hum the music into a microphone. This study then evaluates Musipedia based on this group of users and their user experience.

### Flash Keyboard Search

The Flash keyboard looks like a real piano keyboard. The sound produced is that of an authentic piano note. Any user who can play the piano would be able to immediately play the tune on this keyboard.

The evaluators play the first 4 notes of the song *A Time for Us*. It is noted that each note they play appears on a textbox below the keyboard. It is however written in note letters (A, B, C, C#, etc.). One evaluator, having been formally trained to only read notes on a music *staff*, is not familiar with the style and has some trouble correcting mistakes. The other evaluator is familiar with both methods of notation and has minimal trouble inputting the tune. After entering the correct 4 notes, the evaluators press the *Search* button.

The result for both evaluators is a *No Match* with an error message that read: “Your search query is very short with its length of 4. Please enter more notes. It works best with something between 5 and 10 notes.” There are no such instructions before the evaluators press the search button. Further, there is no *Back* or *Return* button to go back to the Flash keyboard to redo the query. There is only a textbox to enter additional keywords or phrases and the button next to it that says *Refine Search*. Two hyperlinks appear at the top of the refine search textbox that said *New Search* and *Search the Web for this*. Both evaluators click the new search link as the most logical choice and are taken to another page where they are offered to search by microphone. This is not what the evaluators intend to do. Both return to the previous page using the browser’s *Back* button. One of them clicks the *search the web* link and also gets a *No Match* error message.

Finally, when both evaluators get to the Flash piano again they reenter the query using 7 or 8 notes, and this time it is a success. There are 10 retrieved tunes; the second is a perfect match. The names of the composer and lyricists are given. The first few words of the lyric corresponding to the notes and an excerpt from the sheet music are exactly the ones the evaluators entered.

Below the notes are three links: *view details* for further information about the resulting tune, *edit* to refine the search, and *delete* the entry. When the *view details* link is clicked it retrieves a page that has all sorts of information about the music, including artists’ names, lyrics, Parsons Code (to be discussed more later), and sample sheet music, midi file, and websites where one can download or purchase CDs and sheet music. As far as the evaluators’ information seeking need is concerned, it would be considered totally satisfied at this point. The result for this query is used as the standard for the others.

There are additional buttons and links to more information below it that are now redundant after this successful search, but are worth investigating for purposes of our evaluation. One link, *Search the Web for this*, shows multiple sites where Midi files can be played or downloaded. Many of the sites have identical files and there are also a number of sites that are totally unrelated or are just bad links. The button *Buy MP3* takes one to an Amazon.com page, but the music retrieved is not at the top of the list and only in 6th place. This ranking is not relevant to a regular user and it could now be considered a successful search. What is most relevant to the search is the last link, *Musicnotes.com/ Sheetmusicplus*, where one could purchase different versions of the sheet music for the song retrieved.

The last part of the retrieved music block is supposed to be a YouTube rendition of the song. It is not the song. This part of the result could be improved further by having the title or name of the retrieved song as the search query submitted to YouTube rather than the notes or tune found in the block.



### JavaScript-based Piano

The JavaScript-based keyboard looks like a plain drawing of a piano keyboard, and as such seemed crude and not aesthetically pleasing. The sound produced is that of a chime but some keys seem to be out of tune, thus giving the impression that the notes played are wrong. However, if the searcher can go past or ignore that perception there are more useful features that can be found here than in the Flash piano. For instance, while playing the melody not only the letter keys are presented like in Flash but also the actual notes on a staff complete with the beat and tempo. When the evaluators make a mistake, they can delete and replace just the wrong note and would not need to start over from the beginning (as was the difficulty with the Flash piano). There is also a Play button where one can check for the accuracy of the tune before finalizing the search. When ready, the search buttons have the option of searching the Musipedia database or the entire Web, and a choice of where to look for matches in the music piece. Both evaluators select the choice *only near the beginning*. Other choices are *only at the very beginning of the tune* and *anywhere in the piece*.

A regular user who has not yet tried the Flash piano prior to using the JavaScript keyboard would probably also try 4 notes first as the evaluators did the first time in Flash. There are also no instructions here to that effect. Unlike in Flash, however, as soon as the evaluator presses the search button, an error message in red letters immediately comes up and advises the evaluator to enter at least 5 notes. This is an exclusive feature of forms created in JavaScript because it is a client-based (browser-run) programming language, and validations can be done on the browser itself.

After entering seven notes of the song, the result is impressive. The searched song is at the top of the list. Of course the retrieved music block is exactly the same as the one presented earlier in Flash Piano. This is one case where the outstanding functionality overcomes the initial negative affect from the unattractive look and funny sound of the JavaScript keyboard.

### Dragging the Mouse

This is the worst search engine of the three so far tested. Both evaluators find difficulty in positioning the notes on the grid because it is not a standard 5-line staff. Accuracy in placing the note diminishes as the mouse moves away from the keyboard on the left. The sound is similar to the chimes in JavaScript keyboard but fainter. There is a play button for testing the tune, and changing the position of the notes could be done by dragging the note to a new location. The notes and the grid are things musicians would not be so familiar with and could quickly drop this search. When satisfied with the query sound, the evaluators press the *search Musipedia* button. None of the retrieved music is the song. The only way to refine the search is to enter text related to the music, which defeats the purpose of the melody searching function.

### Whistle it to the computer microphone.

This search function would have been the easiest to use, as it involves just the matter of plugging a microphone into a computer and recording the whistling of a tune into it. The recording can be monitored through a sound bar below the *Record* button. When the *Stop* button is pressed it is supposed to initiate a search or bring up additional buttons or chart. Instead nothing happens except for a computer-speak message “no hash given” in the area where the search results would have been presented. This search applet needs further work to make it operational as well as user-friendly.

### Contour-based Search

This is a good tool for those who are not familiar with reading or playing musical notes. Melody contour search makes use of Parson’s code, which is explained in the website as: “Each pair of consecutive notes is coded as “U” (“up”) if the second note is higher than the first note, “R” (“repeat”) if the pitches are equal, and “D” (“down”) otherwise. Rhythm is completely ignored.”

The first note is not written because it is the reference point, but may be entered as an asterisk. The contour of our search song is therefore \*UDDRUDU, which the evaluators enter into the search field and choose *Popular* as the category. As musicians, the evaluators note their initial doubt to the effectiveness of this kind of search; but they are quickly proven wrong.

Amazingly, the search is fast and accurate. The result has our music search query as the first in the set of 10 retrieved songs. The same block of information is presented for the retrieved song as found in the Flash and JavaScript search results, and the page also includes a visualization of the contour of the melody.

### Rhythm Search

Rhythm-based search, or simply rhythm search, is a method of retrieving music based on its rhythm rather than the tune. This is accomplished by tapping the rhythm of the music using any key on the keyboard. Our music search is, however, unsuccessful and our tune is not found through this method.

### External MIDI Piano

The one option that we are not testing is the external MIDI (digital) keyboard. If search can be successfully accomplished through a limited scale piano keyboard as in the Flash and JavaScript pianos, a full-scale piano keyboard should do even better. However, it would be superfluous for most melody searching needs, unless there is already a digital piano keyboard permanently attached to the computer.

### Additional Music Searches

After trying each of the music search applets in the Musipedia search engine, it is decided that only the Flash piano keyboard, the JavaScript piano keyboard, and the contour search functions should be tested further with the other two tunes. Two music pieces were chosen for this portion of the testing: *The Beautiful Blue Danube* and *Lara's Theme (Somewhere My Love)*. The results are satisfying.

The first 8 notes of the *Blue Danube* are entered into the Flash and JavaScript piano keyboards. In Flash, the result is similar to the main search above, in that the exact music is successfully retrieved but listed only as the second best match. In the JavaScript piano keyboard, again the *Blue Danube* is listed as the best match of 10 retrieved songs. In the contour search using the Parson Code of UUURURDR, the *Blue Danube* is also successfully found but positioned only at 7th place out of 10. The surprise is that the YouTube video in all three searches is an exact match with an orchestra rendition by Andre Rieu and the Strauss & Co.

The *Lara's Theme* music is a bit challenging because the first note of the song is outside the available keys on the Flash and JavaScript piano keyboards. The evaluators have to make adjustments, which is only possible because of prior formal training in music. Users, who cannot read or write notes or just have very basic knowledge of music, would not be able to use this applet for many songs. Once that was accomplished, however, the results are almost the same as for *A Time for Us* and the *Blue Danube*.

## **5.2 Phase 2 – Usability Testing**

### Registering for Membership

The information about membership and logging in are usually found on the upper right hand corner of the main page. The evaluators report looking for it there but not finding it. Next checked is the navigation bar just below the banner heading. The titles of the major sections of the site are on the bar and can be assumed as links. The word “Members” is quickly spotted, being positioned towards the right side of the bar. The process is quick and intuitive. Although the link is not found at the first glance, it is immediately spotted on the next eye movement. The navigation bar is actually the most common spot to look for links to the rest of the website when not specifically looking for the login or registration link.

At this point, the first usability task is completed but the evaluators continue through the membership registration to fully experience what a typical user would go through in the process. They both successfully complete the entire process in less than seven minutes. The forms are straightforward and easy to accomplish.

### Finding Instructions for the JavaScript Keyboard

It is not easy to find the link to the JavaScript keyboard per se. There is no obvious link to it from the banner heading or from the navigation bar. The rollover button on the navigation bar that says “Music Search” is a link to all instruments where the JavaScript keyboard is found. That, however, is not the object of this test. Across the banner at the top of the page, the names and representative images of the five major search tools are shown. These are links, but are not obvious as such, and the evaluators only find the JavaScript piano by clicking the “Keyboard Search” image next to the “Flash Piano” link. It would have been better if that had said “JavaScript Piano” to begin with. The evaluators do not find any *Help* or *FAQ* (Frequently Asked Questions) link anywhere on the page, except for a small link for how to connect a digital keyboard to the computer.

The image of the keyboard itself is daunting in that it does not resemble a regular piano keyboard and contains images (musical notes) in unusual places whose function is not quite clear. At first glance, they look like decorations placed on the keyboard by an interface designer who has no regard for, or no knowledge of, aesthetic norms. This garners a *fail* mark in our usability test. A typical user would rather opt for a tool that is more familiar and easy to use like the Flash piano. However, they would miss all the good features of this JavaScript application that render it a more efficient tool for music search than the Flash Piano.

On further fiddling around with the JavaScript application without the benefit of instructions on the page, one of the evaluators discovers that turning on the *hover sound* feature allows the user to listen to the notes first before entering it into the query. There are several other nifty features here that are not found in the Flash Piano (inset in Figure 1), but the most striking of all is the otherwise confusing images of notes superimposed on the keys. They are to specify the tempo or beat of the note, as in how long the note should be played, by clicking on one of the four symbols on the key (e.g. quarter note, half-note, etc.).

## 6. DISCUSSION AND RECOMMENDATIONS

In order to properly evaluate the user experience in the use of Musipedia for music searching, we must first consider the characteristics of the current and potential users of this search engine. It is shown earlier in the study that they would generally be people who know more about music than the average person. The user is not one who would be interested in just music CD's and MP3's that can easily be sourced from other popular search engines. The user would be one who would need more serious music-related matters, like music sheets and scores, and examples of renditions that they could probably use for their own playing of instruments, for teaching, or for some serious enjoyment and appreciation.

The authors are of about the same profile as these regular users, although with a bit more expertise in Web technology and information research. However, they do not need to resort to their extra know-how in text-based searching to use this search engine. It is from such view point that Musipedia's efficiency and effectiveness is evaluated. According to Croft et al. (2009), "Effectiveness, loosely speaking, measures the ability of the search engine to find the right information, and efficiency measures how quickly this is done." Musipedia is not just one big search engine but an integration of several search engine applets. As shown above, there are keyboard search applets, contour-based search, rhythm and microphone searching. The Flash and JavaScript keyboards and the contour search applet are highly effective and efficient in our testing. It could be further improved, however, if there were clear instructions at the start of the query building process about things like the minimum number of notes to enter. As has been shown, the search queries using these three applets find the target music on the first run and listed it at the top or close to it in the list. The process is also fast on all three modes, taking no more than 30 seconds to return the results.

The last two applets, rhythm and microphone search, are in theory great concepts that could allow non-musicians to search the Musipedia database and the Web. But the applets need further development and refinement. It will serve Musipedia better to take them off the website temporarily until improvements can be done or make them work at all. If they are keeping the applets on the website, there must be a disclaimer or warning that these may not yet work as expected. It will prevent frustrations on the part of the user, which can throw a shadow over the effectiveness and efficiency of the three other applets that work really well.

On the user impact, the factors listed by Chu (2010) as criteria are the time needed to learn the system, speed of interaction, error rate, retention of techniques, and user satisfaction. Musipedia fares well in them. The web page itself, though not really pleasing aesthetically, is easy to navigate. It is the recommendation of this study that the website be redesigned to a more current look so as to highlight its good qualities. A look at the perceptual aspect of the site shows that the graphical style selected by the Musipedia designers is ascetic: white background, with red color for headings and black color for main text. It has little graphics except for those provided by advertisers. It looks like Musipedia tries to emulate, albeit unsuccessfully, the Spartan style of Google search and Wikipedia as it tries to present itself as a similar free online information retrieval tool that specializes in music.

On the learning aspect, not much time is needed to learn the system because the process of searching and the tools provided are commonly available to the type of users of the website. The speed of interaction with the site in regard to finding a suitable applet and moving in between them is relatively quick and intuitive. There are just some minor, non-structural omissions that can easily be fixed, and the overall time for the

results to arrive after submitting the search query is also fast. There are some errors at the beginning of the search session because of inadequate instructions, but they can be quickly resolved and learned. The ineffectiveness of the rhythm and microphone search applets put a little damper on the overall positive results, but can be mitigated with the outstanding successes in the other applets.

Overall, the user satisfaction over the use of this search engine could be high, as such is the effect on the authors, in spite of their critical stance as evaluators. This supports Markey’s (2007b) findings in his survey of 25 years of end-user searching, where he concludes that “Although research findings demonstrate that end users are not conducting sophisticated online searches, the vast majority are satisfied with their searches” (p. 1128). The biggest factor is its novelty and usability, as there seems to be no other actor out there that provides the ability to find music using melody search in the scale that Musipedia does. More research is therefore recommended to improve the quality of the users experience with this search engine, and that “researchers should design experiments that capture what end users really do, not what researchers want or expect them to do” (Markey, 2007b).

From the results of Phase 2, it is shown that Musipedia’s usability in the first task of registering for membership in the website is highly positive. It is relatively easy for the typical user to register for membership in the website. Usability is part of the overall user experience, and so while it may be highly positive for just the task of registering for membership, this study again recognizes that the lack of aesthetic appeal in the design can reduce the user satisfaction on the usability as well.

The same attention should be given to the negative result of the test for the second usability task—that of finding instructions and help for the use of the JavaScript keyboard. There should be snippets of instructions written next to buttons or form objects, or if they require longer explanation, a link to a document page where instructions can be provided. Since this is a JavaScript application, a method that would not clutter the page is to employ JavaScript pop-ups or message boxes, which are relatively easy to insert into the code. They should then be incorporated into the recommended redesign of the entire website.

As it now stands, the Musipedia website is usable on aspects that relate to the standard use of a text-based search engines. Much has already been learned in this mature field of Web searching, and Musipedia reflects that when looking at any text-based features of the website. However, Musipedia is a pioneer in melody searching, and while some of its melody search tools are outstanding in efficient music retrieval, its presentation of these tools fall short of the basic usability requirements. It is therefore recommended that further studies be conducted on the usability aspects of all its music search tools with a wider variety of users and potential users, so as to determine what elements need to be included, revised, or removed, as well as what their optimal positioning on the page should be. It is further recommended that the website be redesigned not only according to the latest trends in layout and usability models, but also with view to capturing the mobile browsing market.

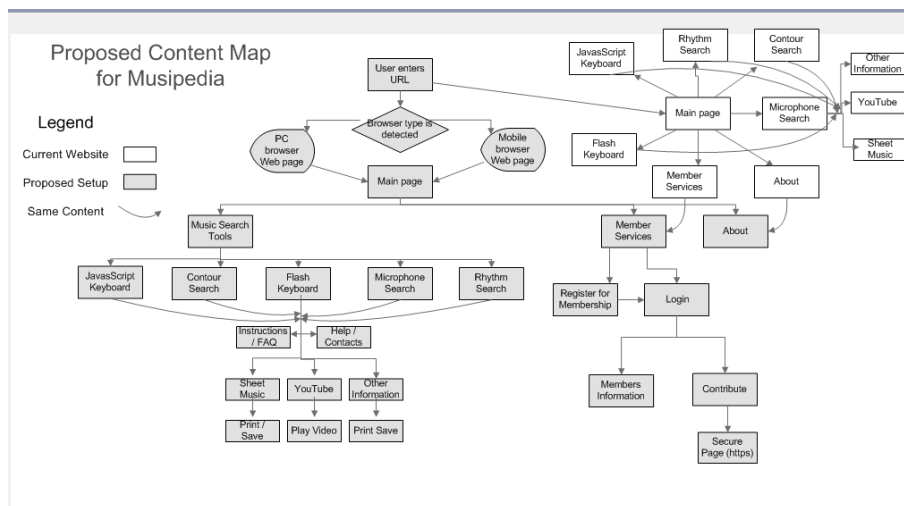


Figure 2. Proposed Content Map

While this study is limited in scope as a preliminary testing by two persons, it has garnered enough information to be able to recommend certain functional and design improvements. The proposed content map

(Figure 2) shows how the current structure could be made to be more usable and efficient. The aesthetics could then be built around the structure and made consistent across the website. The changes proposed in the content map are:

- The proposed website content is organized into three major sections: the search tools, members section, and information about the website. The new design and layout would be based on this organization, which would allow for easier updates and redesign without upsetting the structure.
- Upon user access, the type of browser being used, whether from a PC or mobile device, is detected and the user is automatically directed to the webpage appropriate for the type of browser.
- Based on the usability test of the JavaScript keyboard, instructions for the use of the tool and contact information for additional help are provided for all the search tools.
- The membership login and registration processes are reorganized as a separate section, to also include the page for making financial contributions that is encrypted and makes use of the HTTPS protocol (Secure Socket Layer).

## 7. LIMITATIONS

The limitations of this study rest mostly on the authors being also the evaluators of the usability and overall user experience. This alone could have introduced some unseen bias or subjectivity. However, their expertise in the use of the standard text-based search engines does not have a bearing on this study. The query building in Musipedia using musical instruments and music-based interface is a totally new experience for them as well. Their above-average knowledge of music is typical of the members of the website, but there would be other users who may not be represented by the characteristics of the authors.

The other limitation of the study is in having only two evaluators. Both of these limitations could be eliminated in future studies by employing more evaluators who are not the researchers or authors themselves. The think-aloud method, with somebody else recording the spoken words will tend to be more objective and fluid than when the evaluators themselves write down their thoughts as they go through the test. The usability tests are conducted on only two features of the website. In future studies it is recommended that all or most of the features of the website be tested for usability and overall user experience. A study using non-musicians could also lead to further development of a Musipedia app for mobile devices.

## 8. CONCLUSION

Although in his study on emotional design Norman (2005) proposes that “attractive things work better,” we are not recommending an outright change in the design of this website. There may be many other factors involved that the authors are not privy to. Some may even argue that there is no need to fix something that is not broken. The authors are in no way connected to Musipedia and have not contacted them before or after the study. We simply recognize the amazing contribution of this open-access search engine in the field of Information Retrieval and HCI, and we merely seek to recommend improvements to make it even more usable and efficient.

As has been said before, additional research could be done with more typical and non-typical users on the relative importance of aesthetics in the design of this search engine as compared to its functionality and effectiveness in retrieving desired results. There are many challenges encountered in conducting a search through this system, but there are also many satisfying returns. Will these challenges be more efficiently overcome by improving the design? Attractive things appeal to the emotions and as Norman explains, “Emotions, we now know, change the way the human mind solves problems—the emotional system changes how the cognitive system operates.”

Finally, there should now be a consideration for the needs of the exponentially growing number of mobile device users. Tunepal has already jumped the gun on Musipedia with their recent development of apps for iPhone and Android. While theirs is limited in scope to Irish traditional music, Musipedia has unlimited potential for melody search. Musipedia has some of the most advanced music retrieval engines in the world; its website must now reflect that level of sophistication.

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# GENERIC TECHNOLOGIES FOR SERENDIPITY: TOWARD FAR-REACHING AND EFFECTIVE PARTICIPATION IN AN E-SOCIETY

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## ABSTRACT

Information and communication technologies, doubtlessly, play a crucial role in the participatory development of democratic societies. The potential of an e-society does not only lie in the anytime and anywhere participation of the majority of related human beings. Even more importantly, there are innovative technologies bearing the potential of provoking unforeseeable thoughts, revealing unsought discoveries, establishing unprecedented communications, encouraging incredible co-operations, and leading to unexpected solutions. Those technologies lead beyond the limits of technologies by getting humans engaged in innovative ways. The origin lies in the humanities, in general, and in sociology, in particular, where serendipity has been identified as invaluable way of discovery and theory formation. But serendipity, by nature, cannot be planned. Instead, appropriate interface technologies set the stage for working and communication environments which bear the potential of provoking serendipity, an approach extended to e-society.

## KEYWORDS

Webble Technology, Web Service Integration, Information Visualization, Customization, Personalization, Serendipity.

## 1. INTRODUCTION

The term *serendipity* has been used for the first time on January 28, 1754, with reference to some Persian fairytale entitled (in English translation) “The Three Princes of Serendip”, where Serendip is a historical name of Sri Lanka (see Appendix A for more details). Nowadays, serendipity means the phenomenon of discovering something unsought. As such, it plays an important role in science, especially in the humanities (see Merton and Barber, 2004, and Campa, 2008). There are quite recent attempts to systematically introduce the serendipity idea into business processes, in general, and change management, in particular (Olma, 2013).

The recent emergence of digital humanities (Carter, 2013) is bringing with it new potentials of hypothesis creation and theory formation, but conventional tools support only conventional thoughts. There is an explicit call for unconventional technologies supporting serendipity (Schubert, 2013).

Unfolding the potential of serendipity in science is definitely an endeavor worth investment in research. But unfolding the potential of serendipity to boost the impact of human participation in an e-society is even more far reaching.

Humans connected via the web manipulate interfaces. But instead of controlling systems, they should be enabled and encouraged to deal with intellectual resources (Tanaka, 2003). Tanaka took on the challenge to make Dawkins’ ideas of *memetics* computationally feasible (see Dawkins, 1976, for the roots, and Tanaka, 2003 and 2013, for the big picture of digitalization). *Meme media* à la Tanaka are digitalized knowledge units the manipulation of which may result in expressing original opinions and representing innovative ideas.

This paper is intended to introduce and demonstrate the newest technological realization of meme media sufficiently generic to support a wide range of human participation in an e-society. The technology under investigation has been sketched for the first time in (Fujima, 2013). This approach extends earlier meme media implementations ranging from (Tanaka and Imataki, 1989) to (Kuwahara, 2013). The newest technology relies on HTML5, CSS, and JavaScript to reach over the web as many end-users as possible.

## 2. WEBBLE TECHNOLOGY TOWARD SERENDIPITY

Dawkins introduced the term *meme* to denote units of non-biological evolution (Dawkins, 1976) which may be identified in areas as diverse as animal behavior, architecture, technology, and religion (Blackmore, 1999). Tanaka developed the idea to represent memes digitally as *meme media* to allow for computer-supported knowledge evolution (Tanaka, 2003 & 2013). Early implementations were named IntelligentPad (Tanaka and Imataki, 1989). Around 2009, the term *webble* has been coined (Kuwahara and Tanaka, 2010) and was used immediately for purposes such as meme media based learning (Jantke & Fujima, 2010). The advantageous technology allows for a paradigmatic shift from direct manipulation (Shneiderman, 1982) to direct execution (see Fujima and Jantke, 2012, and Jantke, 2013).

### 2.1 Introductory Example of Meme Media Technologies

This short introductory subsection into *webble technology* is intended to provide some touch and feel of real webbles in practical applications to prepare the reader for the technicalities to come on the subsequent pages.

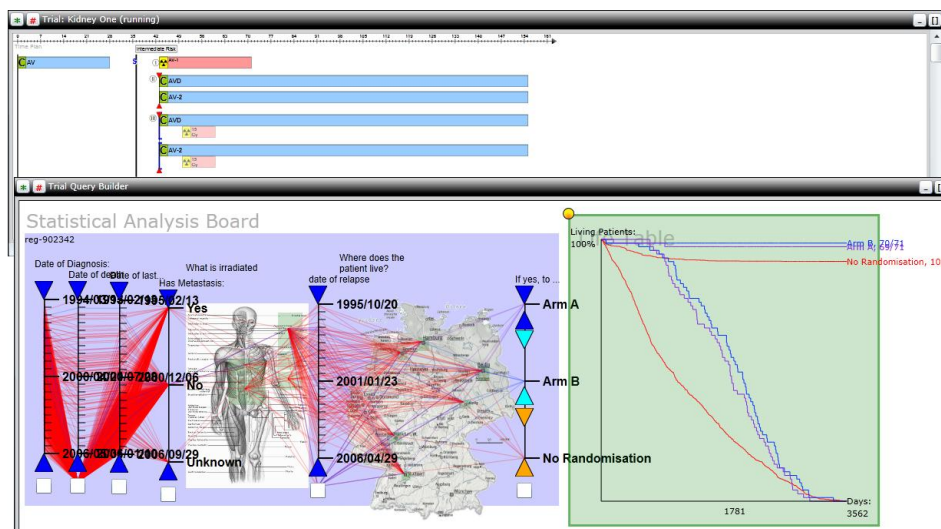


Figure 1. Screens from a Webble-Based Clinical Trial Outline Builder and Inspection Tool (Sjöbergh and Tanaka, 2013)

All objects on display in the two overlapping windows of figure 1 are webbles. There is some visualization webble in the lower right corner of the figure showing mortality statistics for three groups of patients with respect to some clinical trial. The basic population of this statistics is controlled via the dashboard on the left. The map as well as the graphic showing the human body is a webble. And so are the parallel coordinates and the triangular delimiters on the coordinates.

Webbles on top are plugged, so to speak, into the webbles below. Every plugin means to connect the webble above via some pipe, so to speak, to the webble below. There are data flowing through all the pipes up and down. Webbles receiving new data are performing computations and, if it applies, sending results through pipes to other webbles. Some, when triggered by newly incoming data, are just updating their view.

On the dashboard on display in figure 1, one can pick a triangular delimiter on a parallel coordinate (say, on the “Date of Diagnosis” coordinate webble, for instance) and shift it along the axis. In this way, the selected interval is modified. The delimiter webble represents just a single value which is sent through the pipe down to the underlying parallel coordinate webble. This webble is sending its updated interval data through the pipe to other webbles which process the data accordingly. As a result, the mortality rate display, e.g., is changing the curves on display. And on the map, the connection to some location may disappear in case there have not been any diagnosis at this place during the changed time interval.

### 2.2 Webble Technology – The New Generation of Meme Media

The present technology relies on the strategy outlined in (Fujima, 2013) and (Kuwahara and Tanaka, 2014). The new generation of meme media runs in HTML5, JavaScript, and CSS. “Webble” was coined by



Kuwahara to abbreviate “Web PEBBLE” where “PEBBLE” abbreviates the already cumbersome expression “Pad Enhanced Building Block Lifelike Entity” in which “Pad” is a reference to Tanaka’s “IntelligentPad” concept (see, e.g., (Tanaka, 2003)).

Webbles are objects—that is what Kuwahara calls a pad—which have a Model-View-Controller (MVC) structure and may be manipulated on a webble desktop. The webbles’ key touch and feel is decisive for usage. Humans may click a webble on the screen and move it to whatever place desired. When one webble is dragged over another one, there is established a slot connection (the pipe metaphor in the preceding section).

Let us have, first, some closer look into individual webbles. The webble’s view is what a user is seeing on the screen as illustrated below. The webble with the two gears has been copied. The views appear identical. Internally, there are several differences. For instance, there are view-related parameters (named the slots) such as the values of the x-coordinate and the y-coordinate. Those slot values are different. Other slots belong to the webble’s model which determines its behavior. One slot name is rpm (rotations per minute) shown in the opened connection shield in the middle. The gear webble under inspection has a transparent text webble sitting on top in the left upper corner. This text webble’s slot is connected to the rpm slot of the gear webble showing the current value. After making a copy of the gear webble, the two corresponding values, naturally, have been identical. But after dragging and dropping the slider webble over the gear webble on the left, they got connected; the lower one is named the parent and the upper one is named the child. The child’s value is flowing into the parent’s connecting slot—the value 29 shows in the text webble on top of the left gear.

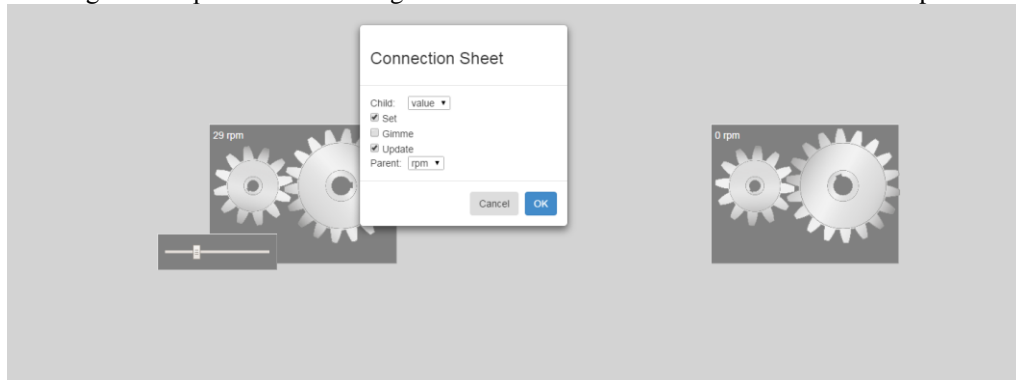


Figure 2. Exemplified Manipulation of Simple Webbles Making Copies and Plugging one Webble into the other one

The way in which this connection and the flow of data take place is predefined by each webble’s core functionality. Naturally, developers have the freedom to intervene. One may open the connection sheet of the slider webble as shown above to manipulate the data flow by hand. Turning on the gimme functionality, plugging in the slider into the gear would not change the rpm value. The reason is that there is a priority among the three features set, gimme, and update, where gimme is highest. If gimme is activated, a child webble plugged into a parent webble does, so to speak, suck up the corresponding slot value.

Apparently, different predefined settings may result in a different touch and feel of webble technology. This bears enormous potentials for tailoring webble interfaces toward the different need of varying customers. For naïve users, for instance, one may prepare webbles in such a way that they are latching when overlapping. This leads directly to the paradigm of direct execution (Fujima and Jantke, 2012); see section 2.3.3 below.

When one webble is plugged into another one as shown in figure 2, the result is some composite webble. The child is embedded into the parent webble forming a compound document. It may be moved around as it were just one webble. And as such, it may be plugged into another one for forming more complex constructs. All the mechanisms explained before apply as well.

The webble container forming the background of the screen is operating essential functionalities such as moving webbles around, copying webbles, and offering useful pull down menu features on right click.

### 2.3 Technologies for Participation, Collaboration and Serendipity

The focus of application determining this contribution is human participation in political and social processes enhanced by e-society technologies. By the society’s very nature, this involves a larger number of humans and an unforeseeable spectrum of attitudes, opinions, needs, and desires.

For the purpose of participation, governmental institutions may offer interfaces providing information to the public, allowing for human input, and providing feedback to and surveys of participation.

For effective and far-reaching impact, it is not sufficient to just provide an opinion by means of a poll, e.g. Humans must be encouraged to ponder the problems under consideration in some depth. They may want to communicate about, to access further data, and try out variants which need to be visualized for comparison. The subsequent sections 2.3.1, 2.3.2, and 2.3.3 are intended to demonstrate the usage of webble technology.

### 2.3.1 Webble Technology for Web Service Integration

There is no way to forecast what web services and what databases may play a role in a certain future human participation in an e-society. If this would be predictable, there were no opportunity left for serendipity.

Therefore, the authors have chosen some extreme combination<sup>1</sup> to illustrate webble technology for web service integration at work.

There are two composite webbles: some weather service and some digital machinery. Both are simply combined by plugging the temperature output of the weather tool into the parameter of the machinery determining rotations per minute. The one service is controlling the other.

Vice versa, one may turn the control dial of the digital machinery to tune the direction and the speed of the gears. In response, the temperature on Madeira changes accordingly. Fortunately, there is no impact on the real weather outside.

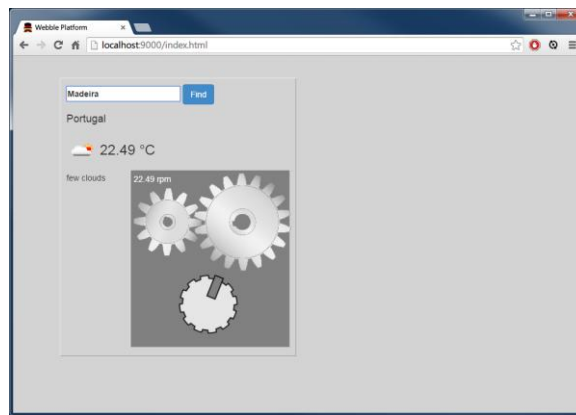


Figure 3. Integration of some Web Service and some Digital Machinery

The screenshot above, unfortunately, is static and does not change throughout the paper's present reading. Even after acceptance of this paper, it still looks the same. Imagine more advanced publishing and conference technologies which allow for the submission and publication of e-papers embedding webbles. When there is an internet connection, the weather webble in the proceedings may access the underlying web service to control the gears accordingly. When conference participants open the proceedings and click to the composite webble in section 2.3.1 of this paper, the web service is accessed and the gears turn (except the rare case that the temperature on Madeira is exactly zero centigrade). Experienced viewers may watch the turning gears to anticipate what they will feel when leaving the conference center; needless to stress that this works similarly at any other place of the world including places where the gears are forced to turn backwards.

The aim of this sample implementation delivered by the second author of the present conference paper is to demonstrate that *webble technology allows for integrating literally everything digital*.

Earlier implementations based on predecessor technologies illustrate this well (Ito and Tanaka, 2003). Interested readers are directed, for instance, to (Fujima et al., 2004) where monetary web services are integrated flexibly just by clipping, connecting, and cloning. Another leisure application demonstrated is combining (i) private preferences in an urban environment, (ii) information about the local cinema program, and (iii) a local transportation source for the purpose of interactively planning night entertainment.

### 2.3.2 Webble Technology for Communication and Collaboration

Humans active in e-society processes should not be left to their own devices just fetching data, pondering some alternatives, and making up their mind in privacy. Instead, they should be encouraged and enabled to communicate with the right agencies, on the one hand, and with their peers, on the other hand.

<sup>1</sup> The webbles on display in Figure 3 show some real demo implementation which may be found on the web page <http://www.incowia.de/webbles/>. The web service combination on display has been arranged when writing the present submission on September 23, 2014, and it has been double-checked when writing the final version on November 15, 2014.

For the time being, governmental agencies do mostly provide information on web pages to read and/or for download (Coursey and Norris, 2008), (Kabbar, 2014), but completely fail to provide enabling technologies (see (Umweltbundesamt, 2012) for some urgently relevant, but still conventional case).

Here are a few scenarios illuminating the potential of webble technology when invoked by governmental agencies who really want to establish and develop an e-society with lively public participation. The scenarios are in accordance with German legislation (EGovG, 2013) and refer, in particular, to §14 EGovG which requires geo-references in all public documents. The scenarios rely on providing webbles for download.

- A webble prepared for download may carry in its model (according to its MVC structure) some implementation parameterized by address data or by GPS coordinates, e.g. If customers download the webble and fill in their own address data, the webble works and responds location-dependently.
  - ~ For illustration, applications are large construction projects (airports, highways, tunnels, ...) which may bring with it some pollution to be considered in advance.
  - ~ Humans may fill in other location data for comparison and for communication with others.
- A webble prepared for download may be parameterized by health data such that humans may fill in their personal data in privacy instead of sending them out into some cloud not under their control.

Due to the hierarchical structure of webbles (see sections 2.1 and 2.2) which allows for peeling off any so-called child webble from its parent, humans may extract parts of some webble after they have used it as sketched above. Such a peeled off part is individualized in dependence on the data put in before (see, e.g., personalized visualizations in section 2.3.3 below). Those peeled off webbles may be used in other contexts and, for instance, may be exchanged with other humans for communication and collaboration.

### 2.3.3 Webble Technology for Visualization to Enable Comparison and Evaluation

Visualization is crucial to humans for understanding alternatives, for evaluating decisions, for anticipating effects including side-effects, and the like (Shneiderman, 1982). For this purpose, webble technology is appropriate (Fujima et al., 2012). Even further, it allows for a specification of the direct manipulation paradigm toward a new paradigm named direct execution (Fujima and Jantke, 2012), (Jantke, 2013). Direct execution means the feature of webbles to be able to run automatically whenever new data are coming in.

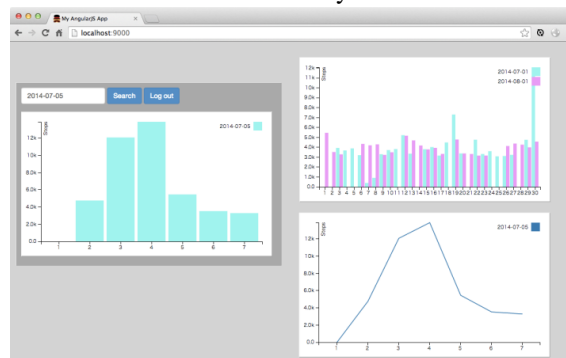


Figure 4. Fitbit® Data Fetched on the Web for Visualization

Here is some implementation developed for the purpose of demonstrating webble technology visualization and for exploration of its usefulness.

The webble on the left with dark gray background, with some data input webble left on top, and with two button webbles on top is wrapping the Fitbit® access web service.

By typing in some date such as 2014-07-06, which is on display, the webble fetches the related data from the web service and shows them on the webble sitting on top of the wrapper—the one with the white background on top of the gray. Users may drag and drop this visualization webble over another one and they combine automatically

The wrapper shown in the figure above (the darker gray box on the left) may be replaced by any other webble wrapping any web service of interest. Users may place whatever visualization webble they want next to the web service wrapper as illustrated by means of the two webbles on the right. This is setting the stage for exploratory visualization. As described in section 2.2, users can freely combine webbles. They may copy webbles and use them in different ways in parallel. In this way, the humans can see alternatives at a glance (see (Lunzer and Hornbæk, 2006) for an in-depth discussion of the usage of meme media technology for the exploration of largely varying alternatives). For illustration, bar charts as show in figure 4 on the left can be dragged over each other to fold into a single bar chart as shown on the right. Flexibility is almost unlimited.

### 3. SUMMARY & CONCLUSIONS

Most recent investigations show that even nowadays attempts to establish e-society practices fall short (Kabbar, 2014): "... e-government initiatives have fallen short of their potential to transform service delivery and improve public trust in government. The well-established technology adoption literature shows that perceptions and attitudes of potential adopters towards innovations are critical in the successful uptake of these innovations." (ibid., p. 255) The crux is, as already pointed out earlier (Coursey and Norris, 2008), "that although Web sites are commonplace, the delivery of anything but basic information is not. The only services provided by at least a majority of local governments were nontransactional." (ibid., p. 523)

Apparently, it is not particularly ingenious to digitalize already available information and put it online. "Instead, the challenge is to understand how new technologies can be used to bring a transformation in the culture and structure of government in order to provide better services to citizens." (Kabbar, 2014, p. 256)

The present contribution is offering one approach—among, perhaps, many others—to improve the current practice by means of some generic technology which bears the potential to go beyond the present limits of document visualization and downloads toward provoking and supporting active human participation.

Beyond the applications for establishing e-society practices in focus of the authors' present contribution, main application areas of webble technology in the near future will be (i) in the digital humanities, (ii) in personalized medicine and health care, (iii) in business administration, particularly, when web services are of relevance, and (iv) in technology enhanced learning as demonstrated by (Fujima and Jantke, 2012) and (Jantke, 2013). Particularly interesting is the ability to federate data from social media as exemplified in (Sjöbergh and Tanaka, 2013); see especially figures 2 and 3 of the paper under reference (ibid, pp. 121/122).

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## APPENDIX A: THE UNDERLYING PHILOSOPHY

There are always readers, especially engineers, who dislike “philosophy” in technical papers. But for the appreciation of *meme media technology*, reading Dawkins is inevitable and reading Blackmore may be inspiring to finally arrive at Tanaka. Furthermore, the concept of *serendipity* may require some elaboration.

### A.1 Serendipity

For already a century, *serendipity* is understood as “the faculty of making happy and unexpected discoveries by accident” (*The Oxford English Dictionary*, 1912-13). Columbus’ discovery of America, Fleming’s discovery of penicillin, and Nobel’s discovery of dynamite are prominent illustrations of serendipity.

There is a recent trend toward digital humanities (Carter, 2013) which is bringing with it a strong desire to use information and communication technologies in innovative ways. Digital humanities mean much more than providing every scholar and student with database access. New technologies allow for new research. Particularly important is the high potential of computerization to make unexpected findings more likely. Generating hypotheses and forming scientific theories is not what contemporary computers are expected to do. Scientific work is performed by the scientists of a discipline and, sometimes, by teams of scientists working interdisciplinarily. The higher expectations of the digital humanities is not to replace scientists by computers, but to provide technologies and tools which allow for or even provoke new forms of research and experiment. Co-occurrence search as discussed in (Schubert, 2013) is an illustrative example. It may reveal semantic relations which are neither obvious nor familiar. Conventional search tools and strategies do usually not arrive at those results (*ibid.*, p. 182).

Beyond conventional technology and innovative approaches such as, e.g., co-occurrence search, there is a desire to introduce more flexible technologies which allow for unforeseen data manipulation and investigation toward unsought syntactic results provoking unexpected semantic interpretations – serendipity.

The larger and more diverse the community of involved human beings, the larger is the likelihood of unforeseen operations and unsought results. Participation in an e-society is the ultimate place for serendipity.

### A.2 Memetics

Dawkins, the father in spirit of *memetics*, has been very much inspired by work like this of Thorpe on the evolution of birdsongs (Thorpe, 1958; see Podos and Warren, 2007, for a more recent treatment). In his seminal book (Dawkins, 1976), he develops a comprehensive theory of non-biological evolution where birdsongs are just an example of what may evolve in a Darwinian sense. Notice, seen from this perspective, the birdsongs are *living* and the birds with their environments and living conditions are just the songs’ *habitat*. Units of non-biological evolution—in the case of birdsongs, the syllables, trills, and the like—are called *memes*. Dawkins coined the term *meme* to recall the concept of a gene and, simultaneously, to refer to memory.

Blackmore discusses a quite large spectrum of fields to which Dawkins’ ideas apply (Blackmore, 1999). Those fields are, for instance, animal behavior (as mentioned above), architecture, fashion, and religion.

Those memes like, for illustration, ideas and concepts of architecture are subject to reproduction including mutation and cross-over. Therefore, memes may evolve over time and change according to their usage as well as randomly. Those memes that are fit enough may survive for a considerably long time like, e.g., the style of Gothic somehow survives in neo-Gothic. As Dawkins pointed out, “the computers in which memes live are human brains.” (Dawkins, 1976, p. 197)

Such as Dawkins has been inspired by the behavioral scientists, Tanaka has been inspired by Dawkins. He took up the challenge to carry over the evolution from memes in the human brain to the evolution of memes in digital computers (Tanaka, 2003). For this purpose, he laid the cornerstone of the technology and coined the term *meme media* to denote the units of digitalized evolution.

There has been a long series of related implementations ranging from (Tanaka and Imataki, 1989) through (Kuwahara and Tanaka, 2010) to (Fujima, 2013); see also (Tanaka, 2013) for an overview.

Relying on the newest technological basis, meme media can be made available via any browser which supports HTML5 on any terminal device. Technology is setting the stage for digitalized knowledge evolution.

# CHILDREN AND TECHNOLOGICAL ARTEFACTS: AN EXPLORATORY STUDY

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## ABSTRACT

The paper investigates the user experience of young people with video content accessed through different technological artefacts. To this purpose, an essay has been assigned to the pupils of two lower secondary school classes (mean age 12 years) to know their diverse types of usage of multimedia content in their everyday lives. These compositions have been analysed employing a plurality of text analysis tools in order to find out both the preferred artefacts and their mutual relationships. The results are here presented giving emphasis to qualitative and methodological aspects. The analysis is to be intended as a preliminary field research study mainly oriented to testing the visualization power of the selected technical tools, primarily Network Text Analysis, in the context of children exposure to video content made available by today's information and communication technologies.

## KEYWORDS

Content analysis, network text analysis, tag clouds, user experience, video content, young people

## 1. INTRODUCTION

The use of technological artefacts by children has always been one of the most important subjects in many fields: Information Science, Pedagogy, Psychology, and more generally in Social Sciences. However, before the beginning of the third millennium most of the studies on this topic were directly connected to some types of educational or developmental processes because, in most cases, children had not a constant and pervasive contact with technological tools (such as laptop computer, mobile phone, personal computer, etc.) in their daily lives. The advent of the Internet in the 90s and, starting from the third millennium, the production of many and different devices to be constantly connected to the Internet (particularly smartphone, tablet and laptop) and the development of software, apps and websites to share personal experiences and activities (e.g. social networking sites and online gaming) has profoundly changed the social contexts in which children live: family, school and social life environments.

Thanks to a relevant cultural change in the pervasive use of the web in every life moments of parents and, more generally, in family, web artefacts became more and more familiar to children and increasingly used in their daily life moments. Furthermore, thanks to the important change at a usability level, such as the passage from the mouse to the touchscreen interface (McKnigh and Cassidy, 2010, Abdul-Aziz, 2013), the use of those technological artefacts has become more and more familiar to children since it adapts to their patterns of world exploration, principally based on direct touch, due to their yet weak motor skills, and not on the mediation of some device (such as in the case of the mouse).

The pervasive use of the web and the changes determined by the ONline life on the OFFline one has been differently treated by authors that we could associate to two different currents. On the one hand, there are scholars who deal with this topic more at clinical level, trying to understand which factors determine the so called Internet Addiction (Young, 1998; Andreassen, Torsheim, Brunborg, Pallesen, 2012) or, more cautiously, a Problematic Internet Use (Caplan, 2010). On the other hand, there are those who deal with this topic from a developmental, social and cultural point of view and are more interested on the positive use of the Internet, trying to determine which factors allow a positive integration of the web artefacts in daily life activities (Ellison, Steinfield, and Lampe, 2007; Mazzoni and Iannone, 2014).

However, most of the previous studies have focused their attention on adults and emerging adults, while there are few studies on the use of technological artefacts by children. Therefore, the aim of this exploratory study is to understand which types of technological artefacts children use in their everyday lives, not only at school, but in general during all the day. In order to achieve our scope, we propose the use of Network Text Analysis, a type of analysis which is experiencing an increasing interest in many fields of inquiry and proved to be very helpful and effective to analyse the school compositions that children wrote in class on their usage of technological devices during the day. Tag clouds are also employed in this study as a preliminary representation tool.

## **2. KIDLAB MEDIA RESEARCH AND KIDLAB SCHOOL PILOT**

In the framework of Scenario Analysis and in the field of media convergence, the original methodology KidLab Media Research was developed in Fondazione Ugo Bordoni (FUB), focusing on the characterization of the use of video content on multiple platforms by the younger members of the population through experimental investigations. KidLab Media Research, which is related to Scenario Engineering (Nicolò and Sapio, 1999), can be regarded as a multidisciplinary research environment that fosters the study of the behaviour of younger generations related to new media content accessible through mobile phones, tablets, digital television and the network.

A number of studies concentrated on the effect of media over the relationship parents-children (Rideout and Hamel, 2006), whereas other studies underlined the effects of television over children (Byron, 2008; KidsHealth, 2008). And in-depth studies investigated two related aspects: the physiological side to delineate changes in kids' behaviours imputable to a heavy exposure to television and, more in general, media content (Millwood Hargrave and Livingstone, 2006) and the social side to research changes in spoken language among young people influenced by television (National Literacy Trust, 2008).

The KidLab School Pilot project is a first step towards this direction. Its main objectives are the exploration of dynamics of adoption and use, attitudes and cultural patterns, user profiles, purchase intentions and consumptions, psychological and social risks. KidLab School Pilot involves the comprehensive institute (primary and lower secondary school) “Giorgio Perlasca” in Rome (Italy) through the interaction with teachers and pupils. A set of specific tools was developed for the field research, taking into consideration the peculiar characteristics of younger audiences and of the school setting. The integration of qualitative and quantitative methods provides greater consistence to results (Giaoutzi and Sapio, 2012).

In the first phase of the field study a qualitative methodological approach was adopted in order to explore the phenomenon under consideration, while building hypotheses to understand the point of view of the young users, their behaviours, their emotions and their needs. A focus group was held, which involved the pupils of a third year class of the primary school in May 2011. Moreover, a questionnaire was prepared to analyse quantitatively the phenomenon of video consumption by children. It was administered to pupils in the classroom by their teachers. It covered general information about the children, technology preferences and usage, usage times, availability of technologies in the household and in the child's room, video content preferences, motivations, social viewing modalities, social network subscriptions, multitasking and other activities. First results of this pre-testing, from both qualitative and quantitative analysis, were presented in (Sapio et al., 2012-I). A focus group had also been held in April 2011, involving the pupils of IC (lower secondary school) and results of which can be found in (Sapio et al., 2012-II). Also the already mentioned questionnaire was administered to the pupils of this class: the results built the first annual data set of a three-year longitudinal study.

The second year dataset for this study was collected in 2012, administering the same questionnaire to the same pupils (class IIC), within the larger KidLab School Pilot campaign carried out in the same year in the “Giorgio Perlasca” Institute, which involved 135 children ranging from 6 to 13 years old. The quantitative analysis relevant to this larger field research were shown in (Mazzolini et al., 2013).

The third year dataset for the above mentioned longitudinal study was gathered in June 2013 by administering the same questionnaire to the pupils of the IIIC, that is, again, to the same pupils a year later. The overall results of this study can be found in (Nicolò et al., 2014).



### 3. AN EXPLORATORY STUDY

In May 2014 an essay was assigned to the students of two lower secondary school classes of the “Giorgio Perlasca” Institute: IB (9 males and 4 females) and IC (10 males and 9 females), i.e. two first year classes of the lower secondary school. The mean age of these 32 pupils was approximately 12 years. Class IC was a “class 2.0” due to its larger use of new technologies for education purposes (mainly interactive multimedia boards): this peculiarity might explain some of the differences between classes highlighted in the following.

The extended title of this composition, whose analysis is the object of the present paper, was: “I write about my videotecnological day: from morning when you wake up until night when you go to sleep, describe the moments when you use video communication and video game equipment, such as television, computer and mobile phones. Needs, expectations, difficulties, joys and disappointments.” Some tips that could help the students write their essays were available too, that is: “Describe what video equipment you use, how much you like them, how much time you spend to watch videos via the different technologies and in what hours of the day this happens. Say what video technologies are present in your home and which of them are in your room and tell the people with whom you watch videos. Explain also what video content and programmes you prefer. Furthermore, you may explain for what reasons you like to watch videos. If you want, please tell your user experience about the technologies which are present in your classroom, such as the interactive multimedia board (IWB). Eventually, say if you sometimes go to the cinema.”.

#### 3.1 Tag Clouds

A first visual representation of the textual content of children's compositions is provided by tag clouds. They are a text-based visual depiction of tags (or words), typically used to display the relative tag frequency, popularity, or importance by font size (Lee, Riche, Karlson, Carpendale, 2010). In our study tag clouds are used as a visualization tool to extract macro information, before proceeding with more sophisticated analysis.

Figure 1 presents a global tag cloud considering all of the children's compositions, whereas figure 2 highlights the most repeated words by boys and girls.

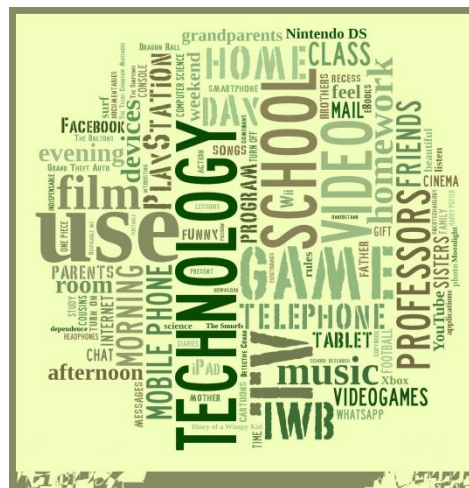


Figure 1. Tag clouds with words in all compositions.

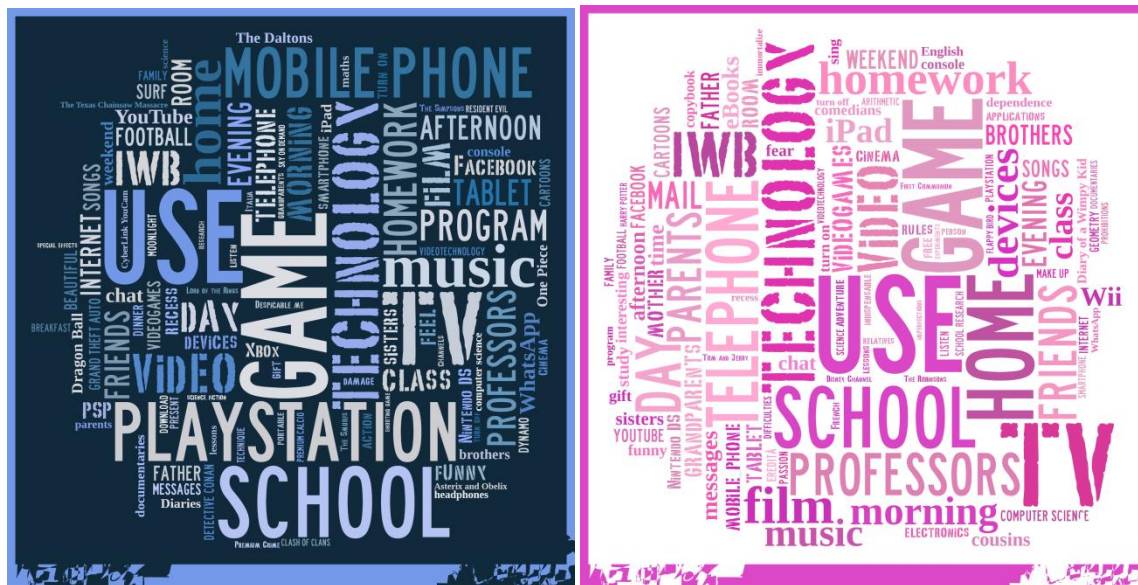


Figure 2. Tag clouds with words in compositions by boys (left) and girls (right).

### 3.2 From Content Analysis to Network Text Analysis

As data is represented by the words written by children in a class school composition, we decided to analyse this qualitative data by integrating two types of analysis: content analysis (CA) and social network analysis (SNA). There are already several examples of an integration between CA and SNA, especially as regards the study of ontology (Hoser, Hotho, Jäschke, Schmitz, & Stumme, 2006) and the semantic aspect of a network (Gaggioli, Riva, Milani, Mazzoni, 2013). Network Text Analysis (NTA), i.e. the SNA applied to qualitative data such as those collected in this study, focuses the attention on the relations between the lemmas (keywords) derived by the content analysis applied to the children. The purpose of this methodology is to explore the nature of the relationships between words to have a different and deeper understanding that goes beyond the simple numerical data of SNA. In particular, NTA focuses on the ability to understand what are the central and peripheral arguments of a speech, the strengths and weaknesses of a message or conversation, which arguments are more or less central in real or virtual conversations about a topic, etc.

To analyze our data, we proceeded as follows. First, we have taken together all the essays of pupils of the same class and divided them by gender. Therefore, we have 4 different datasets: the females of a first class, the males of the same class, the females of a second class and the males of the same class. By means of T-LAB software, we have carried on a content analysis on each dataset to take over the keywords (lemmas), i.e. the words more frequently written by children in their school compositions.

After this step, we have focused our attention on the co-occurrence matrix of the keywords, i.e. a square matrix (lemmas\*lemmas) that shows keywords that are more likely to appear together in the children's sentences (Riva, Gaggioli, Mazzoni, Milani, 2013).

The co-occurrence matrix is similar to the adjacency matrix normally used to represent numerically the data of SNA and it is therefore very simple to save this matrix and open it by a SNA software such as NetMiner (the software we use in this study).

### 3.3 Network Text Analysis Applied to Children School Compositions

Now, for the explorative proposal of this study, we will present and describe the analysis made on each of the two classes (IB and IC), by separating boys from girls. So we will analyze if, concerning the technological use during the day,

- there are some differences between the two classes, maybe determined by a class culture suggested by teachers,
- there are some differences between girls and boys in the type of technology used.

The SNA analyses that we will present are:

- the graph of neighborhood analysis representing the network of relations between the selected keywords, in which the centrality of each word (that is its relevance in the children's essays) is visualized.
- the graph of the eigenvector centrality representing the most central (relevant) words in the children's essays, i.e. the more a keyword is co-occurred with keywords characterized by high relevance the more it becomes relevant. Weighted scores are assigned to nodes based on connections to all other nodes.

We start with the description of the girls of the class IB (figure 3).

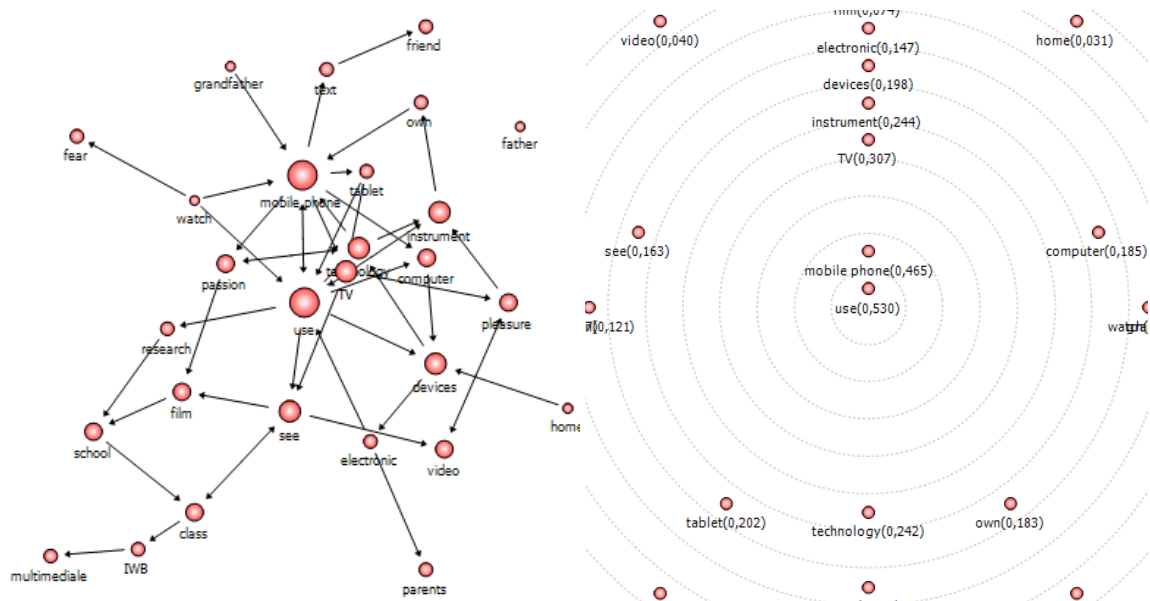


Figure 3. Neighborhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the girls of the IB.

The graph on the left represents the network of co-occurrences between words where the dimensions of keywords represent their frequencies (centrality or relevance). To select the most relevant keywords, we have defined a co-occurrence baseline of three, i.e. that only keywords with at least 3 co-occurrences have been selected. The arrows between words represent the sense of the co-occurrence, i.e. which keyword appears before the other. The graph on the right (figure 3) represents the most central (relevant) keywords. By looking at the graph on the left, we can see that the core of the girls' compositions of class IB is focused on seven most relevant keywords: use, mobile phone, see, TV, technology, instrument, devices (the order is based on the degree centrality index, i.e. the frequency of co-occurrence in terms of the number of links incident upon a node).

At a more deeper level, by looking at the eigenvector centrality (right) we can observe that the most relevant aspect of the technological use for girls of the IB during a day is the mobile phone use.

The score near each keyword represents its centrality (between 0 to 1, this last representing the highest of centrality) i.e. its relevance with respect to the other keywords.

Differently from the previous class, the compositions of the girls of the IC (figure 4) are focalized on four keywords: watch, computer, use, TV (left). However, the eigenvector centrality (right) shows that the most relevant technological use of the girls in this class is "watch TV".

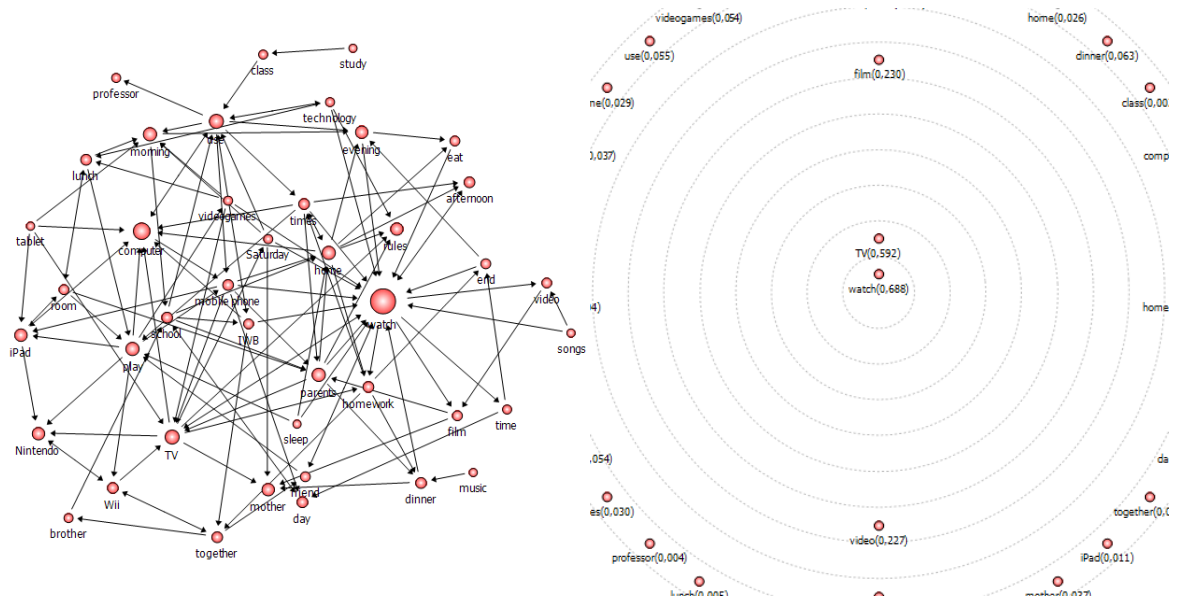


Figure 4. Neighborhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the girls of the IC.

Now we can analyze the boys of the IB (figure 5).

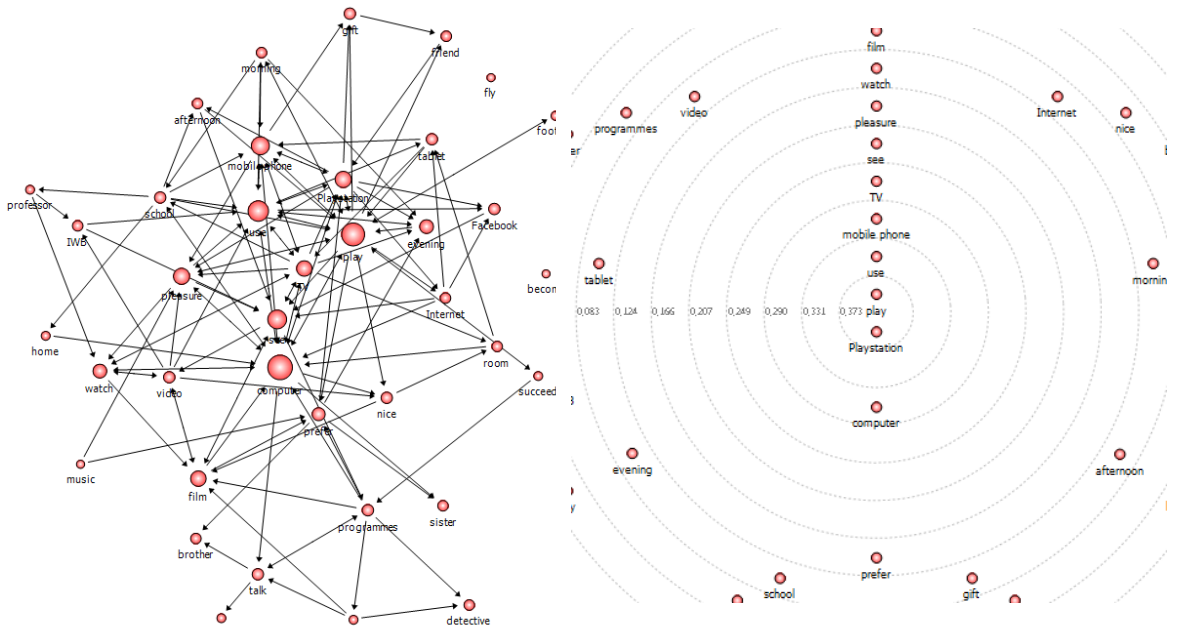


Figure 5. Neighborhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the boys of the IB.

For them, the most relevant keywords resulting from text compositions are, in order, computer, play, use, see, mobile phone, Playstation.

It is clear that, compared with what has been seen for girls, for boys the use of technology to play becomes more relevant and that is confirmed by the eigenvector centrality in which play and Playstation are the most central keywords.

Finally, the group characterized by the boys of the IC (figure 6) shows three very central keywords (watch, use, computer) followed by other seven but less important (TV, technology, school, play, homework, mobile phone, home).

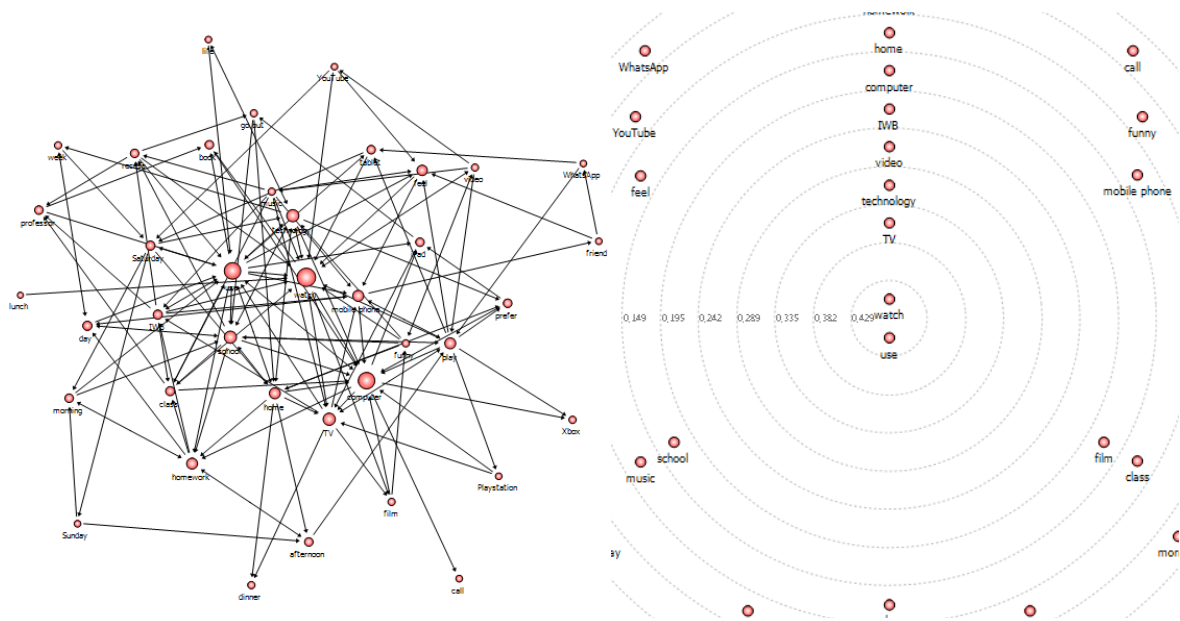


Figure 6. Neighborhood graph (left) and eigenvector centrality graph (right) of the keywords derived by the compositions of the boys of the IC.

The eigenvector centrality shows that for this group the most relevant action is using technology to watch TV and film.

#### 4. CONCLUSIONS

This exploratory study has shown which types of technological artefacts are used by the children of two school classes in Rome (Italy) in their everyday lives, not only at school, but during all the day. In order to achieve this scope, both tag cloud analysis and Network Text Analysis have been applied, by analysing the school essays that the pupils wrote in class about their usage of technological devices during the day.

The results obtained, distinguishing between the two classes and between males and females, show some differences in both the types of technological artefacts used and the intensity of usage (in terms of relevance) by the students. Due to the limited size of the considered sample, only a qualitative illustration of the main outcomes achieved has been presented. As a matter of fact, the study was intended to be a preliminary exploration, i.e. a pilot research project whose main interest resides in the test of the methodological tools employed.

In this sense, Network Text Analysis has revealed its strength, thanks to its synoptic diagrams, which also offer an effective visualization of the socio-technological phenomena under consideration.

As already said in section 2, further studies, based on wider field research campaigns and on the use of NTA and other methodological tools, both qualitative and quantitative, could allow the study of dynamics of adoption and use, attitudes and cultural patterns, user profiles, consumptions, psychological and social risks.



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# DIGITAL POSTCOLONIALISM

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## ABSTRACT

This paper explores theoretical and practical opportunities for describing human expansion into the digital worlds – the so-called ‘information revolution’ – using the wide body of theories and approaches under the common name of postcolonial science and technology studies (PSTC). In order to employ digital postcolonialism as a feasible research methodology, it explores three dialectically related themes: opportunities for creating a new geography of the digital and creating conceptual bridges between geospatial migrations of the past and digital migrations of the present, the relationships between the digital territories and the digital settlers, and situating the current stage of (post)colonialist developments into a wider historical context. On that basis, it shows that digital postcolonialism might provide a fresh insight into human relationships with information and communication technologies, and explores the main methodological challenges. Finally, it warns that the material base of digital postcolonialism is much more elusive than material base of geographical migration, and points towards further research directions.

## KEYWORDS

Postcolonial science and technology studies, digital postcolonialism, critical geography, technology as ideology.

## 1. INTRODUCTION

Social impacts of information and communication technologies are often discussed using familiar colonial discourse. Founding fathers such as Bill Gates and late Steve Jobs have created brave new *virtual worlds* populated by *digital immigrants* – few decades after, the logic of historical development has created the new *digital natives* (Prensky, 2001). This list of references could be expanded almost indefinitely. Once our attention has been set in an appropriate direction, we have started to notice traces of colonial thinking about information and communication technologies in diverse places from everyday language to prestigious artistic talks and academic journals. Inspired by such traces, this paper explores opportunities for describing human expansion into the digital worlds – the so-called ‘information revolution’ – using the wide body of theories and approaches under the common name of postcolonial science and technology studies.

Technology and colonialism are dialectically intertwined – one cannot be thought of without the other. However, their relationship can be understood in various ways. According to Itty Abraham, “‘postcolonial techno-science’ as a way of doing science studies may not be commensurable with ‘postcolonial techno-science’ as a way of thinking about alternative and local knowledges” (2006: 211). In order to build our theory from ground up, we will try and develop digital postcolonialism as a way of doing science. However, digital postcolonialism could also be used as a way of exploring alternatives to mainstream information and communication technologies, and will do our best to explore that line of reasoning in our future research. Similarly, Warwick Anderson asserts that

[t]oo often the ‘postcolonial’ seems to imply yet another global theory, or simply a celebration of the end of colonialism. But it may also be viewed as a signpost pointing to contemporary phenomena in need of new modes of analysis and requiring new critiques. (...) The term ‘postcolonial’ thus refers both to new configurations of technoscience and to the critical modes of analysis that identify them. (2002: 643)

Deeply immersed in the field of critical theory, this research implies its active role within the society. Digital worlds created by the internet are definitely amongst the most important developments of our times – it goes without saying that they require new research approaches and new critiques. Borrowing one more

sentence from Warwick Anderson, therefore, we can say that our take on digital postcolonialism is an attempt to develop “a means of writing a 'history of the present', of coming to terms with the turbulence and uncertainty of contemporary global flows of knowledge and practice” (ibid: 644).

## 2. GEOGRAPHY OF THE DIGITAL

In *Culture and Imperialism* Edward Said leaves no trace of doubt that geography is the very heart and soul of imperialism.

Underlying social space are territories, lands, geographical domains, the actual geographical underpinnings of the imperial, and also the cultural contest. To think about distant places, to colonize them, to populate or depopulate them: all of this occurs on, about, or because of land. The actual geographical possession of land is what empire in the final analysis is all about. (...) The geographical sense makes projections – imaginative, cartographic, military, economic, historical, or in a general sense cultural. It also makes possible the construction of various kinds of knowledge, all of them in one way or another dependent upon the perceived character and destiny of a particular geography. (Said, 1993: 78)

Following Said’s argument, it is appropriate to start analysis of digital postcolonialism from inquiry into opportunities for geographical thinking in the digital worlds. In 1974, Henri Lefebvre published the highly influential book *The production of space* (1991). He claims that every society produces own spaces, and that such production is prerequisite for (re)production of social relationships. The contemporary society has produced the digital worlds that consist of two main components: the material space of the internet and the non-material space of the World Wide Web. Gradually, their dialectical mix in the form of digital worlds has become essential for maintenance and (re)production of the contemporary network society. Mechanisms of social reproduction are deeply rooted in human nature. Therefore, the (re)production of the new digital spaces is undertaken by the dominating classes as a tool for (re)production of the existing hegemonic social relationships. In this sense, digital worlds are true Lefebvre’s social spaces as described in the following oft-used quotation: “(social) space is a (social) product (...) the space thus produced also serves as a tool of thought and of action (...) in addition to being a means of production it is also a means of control, and hence of domination, of power” (1991: 20).

Obviously, the digital spaces are not physical in the same sense as Madeira. Digital grass cannot be felt on bare feet, digital potatoes will never feed people, and – most importantly – digital artefacts cannot (re)produce life. In spite of being intangible, however, this article on our screens is just as real as coffee mugs placed next to our keyboards. Its production requires intellectual and physical effort. During the process of (re)production, it utilizes physical resources such as plastic, silicon and electricity. Its transport through the network requires energy, and its acceptance by the research community will contribute to tenure appointments of its authors. While the nature of the digital is clearly different from the nature of the physical, those differences do not impede opportunities for spatial thinking in the digital worlds – at least on the abstract level required by digital postcolonialism. In words of David Harvey, “different concepts of space may be appropriate for different theoretical purposes. It may be realistic to regard the concept of space, therefore, as a ‘multidimensional’ concept in the sense that the concept has a different meaning according to cultural background, perceptual ability, and scientific purpose” (Harvey, 1973: 197). Based on Lefebvre’s concept of production of space, therefore, digital worlds can be considered as fully developed physical, social, economic, cultural and linguistic territories.

The task of science is to survey and map the new territories. In general, the territory is an entity that is being described; the map is a description which represents human knowledge of the territory. The map covers the same space as the territory, but in less detail. Therefore, the map forever remains representation of the territory and never reaches the full accuracy. In this way, map-making is inextricably linked to epistemology. In order to build maps smaller than territories, map-makers must inevitably exclude and simplify – political maps are focused to physical borders between countries, while meteorological maps are focused to the dynamics of water and air. Furthermore, map-makers are always at least indirectly immersed in the mapped territories: it is hard to find a truly apolitical geographer, or a meteorologist who does not care about accuracy of own forecasts. Therefore, maps are never objective or neutral, and the act of map-making is always



political. This understanding gives rise to the field of critical geography. Based in the dialectic between theory and practice, action and reflection, critical geography assumes that “maps are active; they actively construct knowledge, they exercise power and they can be a powerful means of promoting social change” (Crampton and Krygier, 2006: 15).

In the field of postcolonial studies, “the scholarly trend in recent decades has been to view scientific activities such as surveying and mapmaking as two cogs in an imperial machine – a ‘scopic regime’ – grinding across far-flung colonies and distant landscapes” (Craib, 2009: 481). In this context, cartography is dialectically intertwined with discourses of power as the technology of plunder and control. Imperialist cartography always excludes indigenous knowledges, languages and worldviews. In order to challenge the imperial routines, however, it is not enough to include bits and pieces of indigenous knowledge in the current maps. Instead, we need to “more fully historicize the practices, categories and narratives themselves by not artificially bounding – geographically or socially – the subjects of study in the first place” (ibid). In cyberspace, subjects of study cannot be easily bounded according to any particular criterion – more often than not, it is next to impossible to know who is on the other end of the network. Therefore, Craib’s conclusion that “the history of cartographic practice needs to take a social, not solely cultural, turn” (ibid: 487) gains particular relevance in the context of digital postcolonialism.

According to McKenzie Wark, subjectivity may be “formed within two sets of exterior relations, both external to individual subjects and their “consciousness”, both equally real. Those two relationships are the map and the territory upon which people locate themselves and form their sense of place.” (1994: 62) In this context, the nature of digital territories raises at least two important consequences for critical geography of the digital. First, as Jaron Lanier clearly shows in his analyses of virtual reality, digital worlds provide us with the powerful illusion of detachment from their physical origins (2011). Therefore, mapping the digital is even more susceptible to politics – and requires even more grounding in critical theory. Second, geography of the digital directly influences human decisions about the physical (the internet) and the logical (the World Wide Web) structure of the described territories. Therefore, the map of the digital is just as real as the physical optical fibre that enables its virtual existence.

### 3. THE DIGITAL SETTLER AND THE PRE-DIGITAL SAVAGE

Digital worlds created by the internet arrive into existence only through interaction with human beings. Therefore, further inquiry into colonization of the digital should be conducted in dialectical relation with the settler. In his analyses of traditional colonial conquests, Frantz Fanon describes this relationship as follows:

The settler makes history and is conscious of making it. And because he constantly refers to the history of his mother country, he clearly indicates that he himself is the extension of that mother country. Thus the history which he writes is not the history of the country which he plunders but the history of his own nation in regard to all that she skins off, all that she violates and starves. (Fanon, 2001: 40)

Digital colonialism transfers the existing social relationships into another territory, and the very act of settlement irreversibly changes the emitting and the receiving territories and their inhabitants. Certainly, the digital worlds cannot be ‘plundered’, ‘skinned off’, ‘violated’ and ‘starved’ in any traditional sense. Therefore, differences between geography of Earthly territories and geography of digital territories cause profound differences in the dynamics of settlement. Geographical structure of Earthly territories is given: as powerful as they were, the British could never cause snow in Mumbai. Faced with staggering heat, therefore, the best thing they could do was adapt: re-organise activities in order to avoid the warmest periods of the day, install air-conditioning, eat low-fat foods. This kind of attitude, known as environmental determinism, reflects the view that “environmental features directly determine aspects of human behavior and society” (Encyclopedia Britannica, 2014). Faced with familiar problems, people often instinctively resort to familiar solutions: in the digital worlds, environmental determinism transforms into technological determinism.

However, information and communication technologies are not ‘natural’ in the same sense as the weather. The structure of the internet – or any other human creation, as Ivan Illich has clearly shown in *Tools for conviviality* (1973) – results from negotiation of various influences that contribute to its design and development. The British in India had the power to conquer territories and introduce new customs. However,

Tim Berners Lee and the creators of the internet had the power to design new territories and customs from the scratch. Naturally, their designs were taken from what Frantz Fanon calls their ‘mother country’ or the existing social relationships in their environments. However, the digital settlers have much more power over the new territories than their traditional counterparts – therefore, digital postcolonialism rejects technological determinism and replaces it by more nuanced approaches to human agency thus corresponding to theoretical achievements of the third generation of Frankfurt School theorists (Kellner, 2003; Feenberg, 2002).

In early 2000s, Marc Prensky’s article *Digital natives, digital immigrants* has become “a commonly-accepted trope within higher education and its broader cultural contexts, as a way of mapping and understanding the rapid technological changes which are re-forming our learning spaces, and ourselves as subjects in the digital age” (Bayne and Ross, 2011: 159). While this trope has recently been heavily contested (ibid), it does not take much to realize its potentials for explorations of digital colonialism. Transferred into the new digital territories, however, the concepts of native and immigrant require a bit of good old-fashioned conceptual analysis. For Edward Said, Frantz Fanon and other postcolonial authors, the first immigrants – known by various names such as colonizers and conquistadores – are curious adventurers, mighty soldiers, zealous missionaries, cold-blooded mercenaries, heartless murderers, savage rapists, true oppressors, male, white machistas who plunder the colonized territories and extract their riches for the benefit of themselves and their crowns. During colonization of the digital, however, the likes of Christopher Columbus, Vasco da Gama and Amerigo Vespucci have been replaced by people such as Tim Berners Lee, Steve Jobs and Mark Elliot Zuckerberg.

So what are the digital colonists like? Without any doubt, they are also curious, adventurous, brave, bold, organized, white, middle class, and male; many amongst this colorful lot made even larger fortunes than their ancient counterparts. However, their strategies of domination are very different from those employed in the age of geographic discoveries, as historical forms of legalized crime such as murder and rape have been replaced by the global system that consistently turns a blind eye to unhuman conditions in factories throughout the global South. Conceptually and geographically, new forms of oppression closely follow geographic, racial, economic and other lines of traditional colonial relationships. This interesting parallel requires more fundamental research which lies out of scope of this paper. For the purpose of the presented argument, it is enough to recognize that – while digital colonists cannot be literally paired with their ancient counterparts – Fanon’s concept of colonists as creators of the colonized territories is even truer in the context of the digital. Prior to arrival of the digital settlers, the digital worlds were lifeless, empty, non-existent – it is only through their creative interaction with physical infrastructure, that the digital worlds came into the current form of being.

Speaking of natives, things are obviously different. In the context of traditional colonialism, natives are the original inhabitants of the colonized territories, recipients of other nations’ colonial ambitions, sufferers of territorial conquest, slaves to colonial masters, infidels who dearly hold on to their backward religions, lazy savages who need to be put into service of civilized peoples. As Syed Hussein Alatas masterfully explains in *The myth of the lazy native* (1997), this image is a social construction designed and developed by colonial masters in order to serve their political and economic interests. Following a similar pattern, digital conquistadores have also created own class of savages. Obviously, empty digital worlds which arrive into existence only through interaction with the settlers do not have own pre-existing natives. Instead, the new savages are sought for and created elsewhere – from the population that did not follow digital conquistadores into the digital worlds, or people residing on the non-privileged side of the digital divide. In this way, the age-old principle of creating the savage has merely shifted direction: instead of creating the savage from peoples found in the new territories, digital colonialism has modelled the savage from peoples who are left behind in the old territories. Simultaneously, digital colonialism has created own class of digital natives – people who were born into the world of information and communication technologies, their most able users, the true citizens of the network society. The concept of the digital native does not have an exact counterpart in traditional postcolonial theory. However, their main features are roughly the opposite from traditional colonial natives. In order to remain within postcolonial discourse and avoid terminological confusion, therefore, we paired traditional natives with digital savages. While this linguistic acrobatics adequately serves requirements of this article, further developments in digital postcolonialism will inevitably have to develop a more nuanced jargon.

In order to (re)produce superiority, the settler needs the inferior other, the primitive, the savage. While critical theory clearly recognizes that ‘inferior’ features of savage peoples result from objective conditions in their surroundings, traditional colonialism had to create the savage (Harding, 2011). Similarly, the supposed superiority of the digital arrives into existence only through juxtaposition with the pre-digital. Up to very recently, there was nothing wrong with traditional face to face communication, education or business. It is only through introduction of information and communication technologies that traditional activities have been digitalized and ‘improved’, while their prior versions have been proclaimed ‘primitive’. As soon as the command of information and communication technologies has become necessary for full participation in the society, digital colonialism has evoked the familiar discourse of personal responsibility for structural inequalities. In ancient times, the savage was guilty of being poor, dirty and ill; contemporary pre-digital savage (at least in good part) is guilty of being unable to use computers. Thus, digital postcolonialism has created own version of ‘the myth of the lazy [pre-digital] native’ (Hussein Alatas, 1997) that needs to be saved from ignorance, poverty and the sin of failing to catch up with the ‘inevitable’ logic of technological development. In spite of all advances brought by information and communication technologies, the relationship between the digital settler and the pre-digital savage has remained one of exploitation, violation, and oppression.

#### 4. DIGITAL POSTCOLONIALISM

When first sailors embarked on new lands, their large ships and fair skin impressed the savages. They made peace and traded: knives for food, mirrors for gold, glass pearls for ebony. In the early days of colonization this exchange was conducted on more or less equal grounds, because the sailors were still mere visitors – received and treated just like any other foreigners. Soon after, however, the sailors had been followed by the settlers, and it became clear that the white man was here to stay. The settlers brought their ways of living, working and organizing daily affairs, and the traditional ways of functioning slowly but surely became out of date. The settler economy was blooming, and vast open pastures that once belonged to savages gave way to organized plantations, mines and manufacture. Naturally, the savage did not let go easily – however, the logic of techno-social development has inevitably pushed once free hunters, gatherers, shamans and many other occupations into one or another form of slavery. Centuries later, the most stubborn savages have exiled into reservation sites, where they still trade their ‘original way of life’ for a modest living in the modern society.

When first people embarked into the digital worlds, chess-playing machines and immersive worlds of virtual reality impressed the pre-digital savages. They lived in peace and traded: algorithms for scholarships, network protocols for PhDs, computer programs for wages. In the early days of digital technologies this exchange was conducted on more or less equal grounds, because computers were still just tools – handled and developed just like any other machinery. Soon after, however, more people settled into the digital worlds. Digital technologies entered homes, offices and factories, and the traditional ways of functioning slowly but surely became out of date. The settler economy was blooming, and vast open pastures that once belonged to pre-digital savages had been narrowed down to sporadic niche jobs and hobbies. Naturally, the savage did not let go easily – however, the logic of techno-social development has inevitably transformed professors, tradespeople, artists and many other occupations into operators of various digital machines. Decades later, the most stubborn savages have exiled into the small niche of manual occupations, where they still trade their ‘pre-digital way of life’ for a modest living in the modern society.

The dynamics of early settlement is obviously very different from the dynamics of late colonialism and/or postcolonialism. Early settlers plunder using brute weaponry and strong colonial administration; postcolonialism exploits through politics of knowledge, representation and cultural perception of the colonizer and the colonized, human relationships within the colonial nations, and ideology. Therefore, the current dynamics of human settlement into the digital should be placed into an appropriate historical context. During the past few decades, the digital worlds had been created and conquered. Their founding fathers such as late Steve Jobs are slowly but surely entering history. Recent critiques of Prensky’s digital natives and digital immigrants “argue against the reduction of our understanding of these issues to a simplistic binary” (Bayne and Ross, 2011: 169). Recent research of the digital divide is oriented towards alternative formulations “which take into account the hybrid, scattered, ordered and individualized nature of cyberspaces” (Graham, 2011). Important social changes such as the development of the global class-in-the-

making, the precariat, reflect a multiplicity of tensions between the global North and the global South, the industry and the environment, the digital and the pre-digital (Standing, 2011). Profound global impacts of digital colonialism have reached all the way to worldwide acceptance of evolution from the mass society to the network society (van Dijk, 1999; Castells, 2001).

Temporal aspects of this evolution are obvious – we are witnessing the period of fastest technological development in human history. However, it is (again) the geographical aspects that are particularly relevant for the current dynamics of settlement into the digital. At the end of 2013, 34.3% of world population was online. This percent vastly varies amongst countries: from 92.9% in the Netherlands, 83% in Germany and 78,1% in the USA to 1.1% in Ethiopia and 1.2%, in Congo (Internetworldstats, 2014). In order to analyze the current stage of colonization of the internet, we shall draw a brief comparison with its geographical counterpart. In 2014, the global North has a decent network of roads and railways (internet infrastructure) as well as legal institutions (data protection laws, international treaties, technical standards). Slavery had recently been abolished (internet access has transformed from commodity into social category), but the unequal social relationships resulting from colonialism cannot be stronger (the digital divide still strictly follows the poverty line) (van Dijk and Hacker, 2003). In the global North, therefore, digital colonialism has already transformed into early stages of digital postcolonialism. The global South, however, still anticipates the sweeping wave of digital colonialism. Its internet infrastructure is yet to be built, its technology-related laws are yet to be adopted, and pre-digital slavery is still the stark reality. Naturally, it is hard to expect that the global South will re-invent digital technologies from the scratch. Instead, it is likely to buy Northern technologies, re-write Northern laws, and adopt Northern social inclusion policies – and it is even more likely to pay for these services by exporting natural goods in various forms from oil and minerals to human labour. Powered by globalization, uneven development is dialectically intertwined with usage, design and production of information and communication technologies (Smith and Harvey, 2008: 147).

Using its upper hand in the fields of science and technology, the global North utilizes (its knowledge of) information and communication technologies to maintain its borders and inculcate superiority. In this way, we arrive directly to Michel Foucault's concept of power-knowledge (1980) and to the notion of technology as ideology. Few centuries ago, colonists set out to 'civilize' the savage by introducing Christian missionary schools that taught basic skills such as reading, writing and calculus – all soaked up in the Holy Scriptures. In this way they inculcated knowledge, values, representations, and ideology of the colonial powers, only occasionally allowing minor cosmetic adjustments such the Black Madonna. They preached that every government is divine, and that only the meek will inherit the Kingdom of God, thus employing religion directly into the political and economic service of colonialism. Throughout the twentieth century, Frankfurt School theorists have repeatedly shown that modern technology has become the new (colonial) ideology – information and communication technologies are considered as humanity's inevitable destiny, and only their meek adopters will inherit the network society.

Evidence of the colonial nature of information and communication technologies is all around us. For instance, two short sentences in the back panels of our smartphones – 'Designed by XXX in California. Produced in China' – say conceptually the same thing as our complex analyses. Global IT companies will happily map Nigerian streets for those who can afford their geographic information systems. During the process, Nigerian precariat will spend long hours driving smart cars designed in California and produced in China for a meagre wage and no social security. Powered by information and communication technologies, traditional colonial relationships have gained new wind in their sails. For instance, our Nigerian precarious workers might 'subjectivate' (Foucault, 1980) their 'inferiority' to the Western 'digital masters', and be proud to work in the lowest ranks of a successful global corporation. Their Californian employers might evoke the myth of the lazy pre-digital savage and complain about bad performance of digital immigrant workers. Opportunities for drawing such analogies are numerous, and we are strongly convinced that they might significantly contribute to our understanding of the network society. In this way, digital postcolonialism might graduate from a mere description of the contemporary reality to the powerful tool for scientific inquiry.

## 5. DISCUSSION

This paper establishes opportunities for using postcolonial thinking for analyzing the relationships between information and communication technologies and the society. Digital postcolonialism reveals economic and social relationships between the users and the non-users of information and communication technologies, between the global North and the global South, between the rich and the poor, between the oppressor and the oppressed. Once again, missionaries from ‘civilized’ countries bring ‘enlightenment’ to the ‘savage’ – this time, in the form of creating material and educational preconditions for ‘informatization’. At the one hand, the return to the familiar terrain of economic, cultural and military domination gives some confidence in accuracy of digital postcolonialism. For instance, its elegant explanation of technological determinism can be interpreted as a powerful confirmation of the developed theories. At the other hand, however, it still remains to be answered whether digital postcolonialism is a mere coincidence – a curious, but unimportant consequence of universality of human nature – or it can be used as a research methodology. In the worst case scenario, this paper will represent just another description of the current reality. In the best case scenario, it will start a new, exciting research adventure.

Cyberspace was born and raised in fully artificial laboratory conditions. With the advent of participatory web, however, digital colonists have quickly built up own communities, customs and even vernaculars, while research methods such as internet ethnography have quickly gained popularity. Local knowledges and languages are rising in importance, and researching contemporary phenomena on the World Wide Web strongly resembles the phase of epistemic primitive accumulation (Hess, 2011: 429). ‘Hard’ sciences such as physics and electronics have created the digital worlds of the internet – in turn, our experiences from these worlds have started to question the primacy of ‘hard’ sciences. This inversion is an essential feature of postcolonial science and technology studies, and might be used as another argument in favor of developing digital postcolonialism. However, the developed perspective is burdened with profound methodological challenges. Digital postcolonialism is based on the idea of human expansion into new digital territories. While our analyses introduce some theoretical opportunity for geographical thinking in cyberspace, such expansion is clearly metaphoric. Therefore, theoretical opportunities for digital postcolonialism are deeply rooted in fundamental, unanswered questions about the nature of relationships between the analog and the digital.

Last but not least, the rise of the network society cannot be further from the smooth curve of technology development envisioned by technological determinists – instead, it is a battlefield of various world-views, cultures, interests and social forces. Certainly, we could try and align digital postcolonialism with traditional anthropological approaches. Moving towards postmodernism, we might also follow Edward Said and examine the impacts of digital postcolonialism through the lens of Michel Foucault’s discourse. In a recent paper, however, Warwick Anderson has clearly showed that the mentioned approaches do not provide the best fit for postcolonial science and technology studies (2002: 646-650). Looking into the existing body of research, it is fairly obvious which theories should not be used to place digital postcolonialism into a historical perspective. However, there will be a lot of water under the bridge before digital postcolonialism manages to develop a theory that would situate its ‘history of the present’ (ibid: 644) in the context of past and future.

## 6. CONCLUSION

Faced with numerous opportunities offered by information and communication technologies we dream, hope, fear and anticipate. Sometimes, such as in the embarrassing case of the Millennium Bug, we develop unjustified collective fears. Other times, such as in the unfulfilled vision of the paperless office, we expect too much from technologies. Some people try and replace real-life relationships with online social networking, while ‘cyborgs’ go as far as replacing physical parts of their bodies. To each their own – our expectations often say more about us than they say about our technologies. However, it cannot be denied that we live in exciting times. Immersed in the spirit of the moment, it is often hard to see wood from trees. In order to achieve a balanced view of our present relationships with information and communication technologies, therefore, they need to be placed in relation with the past and the future.

Digital postcolonialism is an attempt to create a historical framework for our understanding of human relationships to information and communication technologies. It starts from the deep human need to migrate from one space to another, and ends in the vast open fields of postmodernism. Based in the research framework of postcolonial science and technology studies, digital colonialism might absorb wide bodies of research in various fields including but not limited to technologies, postcolonial studies, philosophy, education, economy and arts. Therefore, it could contribute to diverse debates from global trade to citizenship. However, it should be remembered that the material base of digital postcolonialism is much more elusive than the material base of geographical migration. After all, digital postcolonialism is merely another lens for viewing our reality, and it is only with great caution that it might be transformed into a research methodology. At the current state of development, digital postcolonialism is just another attempt in the ancient quest for scientific unification – and the one in serious need of deeper evaluation.

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# CRITICAL SUCCESS FACTORS FOR ADOPTING STATE AND LOCAL E-GOVERNMENT – POLISH INSIGHTS

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## ABSTRACT

Although governments can gain many benefits from e-government, there are high failure rates in successful adoption of e-government. Therefore, a better understanding of e-government adoption success is critical. One of the best known approaches used to define and measure e-government adoption success has been the critical success factors approach. The purpose of this research is to investigate critical success factors for e-government at the local and state levels in Poland. The factors are identified holistically. They are reflected as economic, socio-cultural, technological and organizational issues. Moreover, the factors are considered at three stages: e-government access – reflecting technical and economic accessibilities, e-government competences – reflecting competences and awareness related to the use of e-government, and e-government use – reflecting actual usage of e-government by stakeholders. The factors are evaluated and statistical analyses are conducted. The study concludes with a discussion of the findings, limitations, implications, and avenues for further research. The research contributes to the extant research by identifying success factors for adopting e-government in the contexts of the Central and Eastern European countries and local and state governments. It provides governments with the factors that most likely have an impact on the adoption of e-government and will help them to make better plans for the adoption of their e-government.

## KEYWORDS

e-government, critical success factors, CSF, e-government adoption, Poland, Central and Eastern Europe

## 1. INTRODUCTION

Electronic government (e-government) suggests the use of information and communication technology (ICT) to provide efficient and quality government services to employees, government units at the state and local levels, and to citizens and businesses. According to the literature, e-government includes (Anttiroiko, 2008; Gil-Garcia and Helbig, 2007; Ziemia et al., 2013):

- improving government processes by using ICT and government process management (e-administration);
- providing government services electronically for citizens, businesses and employees, (e-government services);
- improving transparency and democratic decision making as well as citizens' participation (e-democracy);
- developing cooperation, networking and partnerships between government units, citizens and business (e-governance).

E-government successful adoption can benefit governments in many ways. E-government has the potential to bring about higher quality and cost effective government services, and better relationships between government units at the state and local levels as well as between government units and their clients, like citizens and businesses (Angelopoulos et al., 2010; Carter and Belanger, 2005). E-government improves efficiency, transparency, and accountability in government units. Moreover, it helps build trust between governments and citizens and businesses. It is possible to achieve significant cost reductions derived from improving government processes, introducing electronic-based document processes and service-oriented procedures, reducing transaction times and removing redundant layers of bureaucracy (Sultan et al., 2007). The full benefit of e-government will only be gained with successful implementation of ICT in state and local governments, and e-government successful usage by all government stakeholders, e.g., government employees, citizens and enterprises.

Studies and empirical activities aimed at e-government have been conducted since 2000 (Heeks and Bailur, 2007). Despite these studies and experiences, adoption of e-government is not straightforward. It is considered very costly and it often requires disruptive technological, organizational, social, economic and political changes to implement (Beynon-Davies, 2007; Pina et al., 2009). It also requires the coordination of many activities of government units and a close cooperation of employees, managers, IT specialists as well as citizens and businesses.

In short, research has revealed that e-government adoption can achieve many benefits for governments or it can lead to catastrophic results for governments that fail to manage the adoption process (AlAwadhi and Morris, 2009; Ebrahim and Irani, 2005; Kunstelj et al., 2007). Therefore, a better understanding of e-government adoption success is one of the key issues which many studies have investigated. One of the best known methods used to define and measure e-government adoption success has been the critical success factors (CSFs) method. Many researchers applied the CSFs method to analyze e-government adoption (Almarabeh and AbuAli, 2010; Kachwamba and Hussein, 2009; Oyomno, 2004). These researchers applied different labels to the categories they proposed for their list of CSFs, but studies on CSFs for e-government success from the holistic approach embracing economic, social-cultural, technological and organizational issues and reflecting e-government access, e-government competences and awareness, e-government use, have been very limited. In addition, there is a lack of literature and experience in the adoption of e-government in the countries of Central and Eastern Europe. The adoption of e-government in these countries is generally not considered as successful as in their counterparts in the developed countries. The countries face serious challenges in making ICTs work over time and institutionalizing them within the government units at the state and local levels (Harindranath, 2008; Ifinedo and Singh, 2011; Nurdin et al., 2012).

Thus, this research is designed to fill this gap in studies. The focus of this research is to examine the key factors influencing successful adoption of state and local e-government in Poland. This article is structured as follows. First, it discusses the concept of critical success factors and reviews the literature on CSFs for e-government. Second, the success factors for adopting state and local e-government in Poland are identified. Third, the differences between these factors are examined. The article concludes with a discussion of the findings, limitations, implications, and avenues for further research.

## **2. THEORETICAL UNDERPINNINGS**

### **2.1 Critical Success Factors and their Utilization**

Critical success factors refer to “the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organization” (Rockart, 1979). Rockart and Bullen (1981) defined the critical success factors as the restricted number of fields in which positive outcome would result in “successful competitive performance” for an employee, an organizational unit and an organization as a whole. Leidecker and Bruno (1984) describe CSFs as a set of characteristics, conditions and variables which should be adequately sustained, maintained, or managed in order to affect success factors of an organization competing in a specific industry. Overall, CSFs provide a clear, explicit, and shared understanding of the organization's areas of performance, business environment and the actions which are necessary for the organization to accomplish its mission.

In the late 1970s, CSFs concept was moved into the information systems area. Rockart (1979) popularized CSFs for information systems implementation. According to Ramaprasad and Williams (1998), CSFs should be used in three crucial areas: including project management, information systems implementation, and requirements. Other examples include CSFs that affect the implementation of Enterprise Resource Planning (ERP) systems in organizations (Ngai et al., 2008; Soja, 2006) and Business Intelligent systems (Yeoh and Koronios, 2010).



## 2.2 Critical Success Factors for e-government Adoption

The successful adoption of e-government is highly context-dependent. It can be formulated on the basis of various criteria, e.g., time, cost, quality (Atkinson, 1999), satisfaction of e-government stakeholders (Xu et al., 2010), and the fulfillment of functional requirements (Joosten et al., 2011). The level of success depends on technical, managerial, organizational and cultural factors; stakeholder's expectations; and functional requirements. The U.N. lists macro factors as determinants of e-government (Kachwamba and Hussein, 2009) such as social, political and economic conditions. In Oyomno's approach (2004), ICT infrastructure development, human resources capability, leadership and management at the organizational level determine e-government successful adoption. Other factors are also cited, e.g. ICT infrastructure development, law and public policy, digital divide, e-literacy, accessibility, trust, privacy, security, transparency, interoperability, records management, permanent availability and preservation, education and marketing, public/private competition/collaboration, workforce issues, cost structures and benchmarking (Almarabeh and AbuAli, 2010). Other authors have classified possible threat sources to e-government into five groups: organizational, technological, human, natural, and environmental factors (Sultan et al., 2007).

Studies on CSFs for e-government adoption are rarely conducted in the countries of Central and Eastern Europe. Moreover, these studies are dispersed and fragmentary; they are focused on the surface level of e-government phenomena. For example, Ifinedo and Singh (2011) addressed the possible determinants of e-government maturity in the economies of Central and Eastern Europe. They showed that higher levels of human capital resources, greater human capabilities and knowledge, rule of law, the availability of ICT infrastructure and more ICT amenities have positive effects on e-government. Laszlo (2008) presented the actions related to the implementation of e-government services in Hungary reflecting on the EU funding. In Hungary another study analyzed the experience of the Hungarian adult population with e-government services (Krisztina and Aniko, 2007). In the Czech Republic, researchers focused on the accessibility of local e-government websites and the success of the e-government websites (Kopackova et al., 2007). The participants of International Congress in Bratislava (ITAPA, 2013) indicated seven main obstacles in the successful accomplishment of ICT projects in Slovakia which included public procurement, constant changes in project teams or insufficient legislative. In Poland, studies on e-government have examined enterprise architecture for public administration (Sobczak, 2008), the role and applications of ICT for e-government development (Papińska-Kacperek, 2013; Ziemia and Papaj, 2013), and ERP systems implementation in government units (Ziemia and Obłąk, 2013).

In sum, while there are several studies on the factors for successful adoption e-government in developed countries, there are only a few scattered ones in developing and emerging countries. Moreover, there is a lack of depth in such studies in the countries of Central and Eastern Europe. Therefore, we develop a model in a systematic and scientific fashion which incorporates critical factors contributing to the success of e-government adoption in the economies of Central and Eastern Europe.

## 3. RESEARCH METHODOLOGY

This study seeks to examine the critical factors for successful e-government adoption at state and local levels. The following research questions were posed:

1. What are the CSFs for state e-government in Poland?
2. What are the CSFs for local e-government in Poland?
3. Are there the significant differences in the ranking of CSFs for local and state e-government?

Research methods included a critical review of literature, the Delphi technique, brainstorming, collaboration, and statistical analysis. The following steps were taken:

- The first step. A review of the literature was conducted to identify existing CSFs for the e-government adoption. It began with five bibliographic databases: Ebsco, ProQuest, Emerald Management Plus, ISI Web of Knowledge, and Scopus. The search was conducted using a relevant set of keywords and phrases such as “critical success factors,” “CSFs,” “e-government,” “electronic government,” “success factors,” “success,” in all possible permutations and combinations. In addition, some dedicated journals in e-government, such as *Government Information Quarterly (GIQ)*, *Transforming Government: People, Process, and Policy (TGPPP)*, *Electronic Government: an International Journal (EGIJ)*, *Journal of*

*Global Information Technology Management (JGITM)*, *The Electronic Journal of e-Government (EJEG)* were also reviewed. Even open access papers and empirical studies were examined.

- The second step. CSFs for e-government adoption in the Silesian Voivodeship (a southern province in Poland) were developed on the basis of practical collaboration among the authors in conjunction with the Silesian Centre of Information Society (SCSI) that is responsible for e-government in the Silesian Voivodeship.
- The third step. After careful evaluation of the literature findings, practical experiences and brainstorming, CSFs for e-government was further refined and a CSFs framework was proposed. In the framework, the CSFs were considered holistically as economic, socio-cultural, technological and organizational aspects (i.e. four dimensions). Moreover, the CSFs were reflected in the three stages: e-government access, e-government competences, and e-government use.
- The fourth step. Using the Delphi method, the CSFs framework was evaluated and further developed. Twenty two experts participated in the Delphi study. Experts were selected to represent the knowledge and experience of scholars, researchers and practitioners. They included: (a) 16 managers in the local and state government, responsible for e-government adoption in Poland; and (b) 6 professors of Polish universities, who conduct studies and empirical research on e-government. The Delphi process was conducted as a series of rounds. In the early rounds, four experts participated, in the last round all 22 experts participated. In each round, each expert filled out a questionnaire which was delivered to a researcher who organized the results and gave back to every expert a summary account of the whole group and the expert's own opinions. In the last round, the experts evaluated the strength of the influence of particular factors on e-government adoption. The experts had to answer the question: *On a scale of 1 – 5 state to what extent do you agree that the following factors influence e-government adoption?* A five-point Likert scale was used, as follows: 1 – disagree strongly, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, and 5 – agree strongly.
- The fifth step. The data was analyzed statistically in order to verify and evaluate the CSF framework. The following techniques for data analysis were employed: min, max, mean, median, standard deviation, and coefficient of variation. To conduct reliability analysis, Cronbach's coefficient alpha was used. The conducted statistical analyses could be performed on the small sample size. The statistical and qualitative analyses allowed us to correct the framework of CSFs, also in confusing or incomprehensible statements.
- The sixth step. The survey questionnaire was worked out and a five-point Likert scale, described at the fourth step, was used. Applying the CAWI (Computer-Assisted Web Interview) method and employing the Survey Monkey platform, the survey questionnaire was uploaded to the website.
- The seventh step. The sample group was defined. It consisted of internal stakeholders of e-government, that is government employees working in the government units at the state and the local level of government. The actual research sample was composed of 2,711 government units, comprising 2,268 local government units and 443 state government units, which respectively referred to 81 % of the whole local government and 82 % of purposive sampling of government units at the state level.
- The eighth step. The data was collected between the 22nd of December 2013 and 15th of April 2014. We obtained a set of 636 correct and complete responses (response rate – 23.45%). 542 of the responses were collected from the local government (response rate – 23.89%) and 94 of them were from state government (response rate – 21.21%).
- The ninth step. Firstly, the reliability was calculated to examine the internal consistency among items on a scale. The Cronbach's alpha values for all the items, research dimensions and stages have values no lower than 0.800. It shows a strong internal consistency and reliability. Secondly, based on the statistics such as as min, max, mean ( $\bar{x}$ ), median (Med), standard deviation ( $\sigma$ ), and coefficient of variation (CV), the CSFs for local and state government were identified. In order to identify dependencies between CSFs and the levels of government, the Spearman's rank correlation coefficient and the Mann-Whitney rank sum test were used.

## 4. RESEARCH FINDINGS

### 4.1 Critical Success Factors for Adopting State e-government

The final CSFs framework for public administration includes 55 factors in various dimensions and stages (is deleted for the review process). The four dimensions of CSFs were indicated: economic (E), socio-cultural (S), technological (T) and organizational (O). Moreover, the factors are considered in three stages: e-government access (a) – reflecting technical and economic accessibilities, e-government competences (c) – reflecting competences and awareness related to the use of e-government, and e-government use (u) – reflecting actual usage of e-government by stakeholders.

By conducting statistical analyses, ten CSFs with the highest means and medians for state e-government were identified. The results are summarized in Table 1.

Table 1. Ranking of CSFs for adopting state e-government

No.	Critical success factor	Dim./ Stage	N	$\bar{x}$	Med	Min	Max	$\sigma$	CV in %
X1	Public subsidies on hardware, networks and telecommunications	E/a	93	4.63	5	3	5	0.57	12.23
X29	Integration of front-office and back-office information systems	T/u	94	4.56	5	3	5	0.58	12.67
X52	Electronic communication between government units	O/u	93	4.53	5	1	5	0.72	15.82
X13	ICTs awareness of managerial workers in government units	S/a	94	4.50	5	2	5	0.77	17.17
X5	Financial situation of government units	E/a	93	4.47	5	2	5	0.77	17.31
X48	Top management support	O/u	94	4.47	5	1	5	0.77	17.27
X28	ICT competences of government employees	T/c	94	4.45	5	3	5	0.60	13.44
X32	Information security in government units	T/u	94	4.43	5	2	5	0.70	15.71
X30	Interoperability of information systems in government units	T/u	94	4.37	5	2	5	0.72	16.43
X20	Information culture in government units conducive to the use of ICT	S/u	94	4.36	4	3	5	0.70	16.07

### 4.2 Critical Success Factors for Adopting Local e-government

Table 2 shows ten CSFs for local e-government in Poland. The eight CSFs, i.e. X1, X5, X13, X28, X29, X32, X48, X52 (bold numbers of factors in Tables 1 and 2) are the same for local and state e-government. The four CSFs are various, i.e. for state e-government – X20, X30, and for local e-government – X31, X45. However, those factors were identified amongst the first fifteen factors for local and state e-government. The mean, median, standard deviation and coefficient of variation of those four factors are slightly inferior compared to the values of the CSFs listed in Tables 1 and 2.

### 4.3 Differences between Government Levels and Critical Success Factors

In order to answer the research question about the significant differences in the ranking of CSFs for local and state e-government, the Spearman rank correlation coefficient was used. Its value is 0.9248 ( $p= 6.63E-24$ ). This indicates a strong positive relationship between the ranked means of CSFs for state and local e-government.

Additionally, the Mann-Whitney rank sum test was used to determine if there was a statistically significant difference between distributions of scores measured on the Likert scale for CSFs of state and local e-government. The results presented in Table 3 do not show any significant difference between the underlying distributions (except for factors X13, X30, and X52).

Table 2. Ranking of CSFs for adopting local e-government

No.	Critical success factor	Dim./Stage	N	$\bar{x}$	Med	Min	Max	$\sigma$	CV in %
X5	Financial situation of government units	E/a	541	4.54	5	2	5	0.71	15.64
X1	Public subsidies on hardware. networks and telecommunications	E/a	542	4.49	5	1	5	0.72	15.94
X29	Integration of front-office and back-office information systems	T/u	539	4.43	5	2	5	0.69	15.63
X52	Electronic communication between government units	O/u	535	4.38	4	2	5	0.70	15.99
X48	Top management support	O/u	539	4.37	5	1	5	0.77	17.58
X28	ICT competences of government employees	T/c	539	4.37	4	2	5	0.68	15.58
X45	State standardization of solutions for e-government	O/a	540	4.36	5	1	5	0.81	18.49
X32	Information security in government units	T/u	540	4.33	4	1	5	0.80	18.48
X31	Quality of e-government services	T/u	540	4.26	4	1	5	0.79	18.52
X13	ICTs awareness of managerial workers in government units	S/c	540	4.22	4	1	5	0.88	20.85

Table 3. The Mann-Whitney test results

CSF	X1	X5	X13	X20	X28	X29	X30	X31	X32	X45	X48	X52
Z	1.359	-0.674	2.848	1.939	0.764	1.319	1.991	0.835	0.799	-0.405	1.200	1.973
p value	0.174	0.500	0.004	0.052	0.445	0.187	0.046	0.404	0.424	0.686	0.230	0.049

## 5. CONCLUSION

The adoption of e-government involves a variety of economic, socio-cultural, technological and organizational changes and transformations connected with accessibilities of ICTs, competences and awareness of ICTs adoption and ICTs usage by government units. The concept of CSFs gives a good basis for stating which determinants should be followed and which barriers removed during the implementation of e-government projects and e-government successful adoption. CSFs show the limited number of areas in which satisfactory results will ensure successful e-government. Government units and government authorities could find answers to important contemporary questions, in particular: Which areas and operations of government units should be primarily focused on in order to achieve the most satisfying results of transition from a government to e-government?

This work contributes to the extant e-government research by identifying and examining CSFs for adopting state and local e-government in Poland. The CSFs for state e-government are no significantly different from the CSFs for local e-government, and they are:

- public subsidies on hardware. networks and telecommunications;
- financial situation of government units;
- ICT awareness of managerial workers in government units;
- ICT competences of government employees;
- integration of front-office and back-office information systems;
- information security in government units;
- top management support;
- electronic communication between government units;
- information culture in government units conducive to the use of ICT;
- interoperability of information systems in government units;
- quality of e-government services; and
- state standardization of solutions for e-government.

Although the identified CSFs are generic and comprehensive, there is a limitation of this study. It lies in the fact that this study only examines the data of Polish government units.

The replication of this study in emerging and developing countries will be useful to improve their knowledge related to the factors impacting on e-government adoption (or lack thereof) in such contexts. In particular, this research can be useful for the Central and Eastern European countries. This is because the countries are similar. Their similarity concerns their analogous geopolitical situation, their joint history, traditions, culture, and values. In addition, the similarity reflects in building democratic state structures and a free-market economy, participating in the European integration process, the quality of ICT infrastructure and also the maturity levels of e-government. Moreover, they have to resolve the same problems and overcome the same political, economic, social, technological obstacles in their transition from a government to an e-government. In this research government units and government authorities could find answers to important contemporary questions, in particular: Which areas and operations of government units should be primarily focused on in order to achieve the most satisfying results of transition from a government to e-government? Thus the knowledge about these CSFs would help the governments of these countries in developing sound e-government plans, receiving funding from the European Union, and ultimately reaping benefits from these initiatives. Moreover, our other studies are related to CSFs for successful adopting ICTs (including e-government) by people and enterprises. Finally, findings of the three studies will give a full picture of the CSFs for e-government adoption.

This paper attempts to provide a new line of thinking and further scope for researchers in areas of CSFs for e-government. Researchers may use this methodology and do similar analyses with different sample groups in other countries and many comparisons between different countries can be made. Moreover, the methodology constitutes a very comprehensive basis for identifying CSFs for e-government adoption, but researchers may develop, verify and improve this methodology and its implementation.

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# INVESTIGATING FACTORS INFLUENCING THE ACCEPTANCE AND UTILIZATION OF GOVERNMENT MOBILE CROWDSOURCING APPLICATIONS CASE STUDY: CITYGUARD APPLICATION IN ABU DHABI CITY

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## ABSTRACT

In an era where cities are facing rapidly growing urban challenges, it became inevitable that new strategies should be implemented. Crowdsourcing has emerged in the last couple of years as a growing phenomenon that provides feasible framework to solve urban problems facing smart cities. A widely implemented form of crowdsourcing in an urban context is geocentric crowdsourcing applications. These applications enable citizens to report urban-related issues to the local authorities using their mobile devices. CityGuard is an example of a geocentric mobile crowdsourcing application in Abu Dhabi. This study sets forth to investigate the significant factors influencing the acceptance and utilization of CityGuard application among Abu Dhabi residence and visitors. In order to do so, a model was conceptualized after studying the literature. It has been found that there are four factors significantly influence the intention to use CityGuard application whereas three factors influence the actual usage of the application.

## KEYWORDS

Crowdsourcing, Mobile Application, UTAUT Model, Acceptance, Utilization, Smart City

## 1. INTRODUCTION

Throughout history, cities have been expanding both geographically and demographically due to technological, economic, and social changes (Schuurman et al. 2012). According to the United Nations Population Fund, It is estimated that by 2030 approximately five billion people will be living in cities (UNFPA 2007). This swelling urbanization rate is creating more challenges for policy makers to consider more sustainable strategies to mitigate urban problems (Nam and Pardo 2011). One of these emerging strategies is a smart city (Chourabi et al. 2012).

A city is considered “smart” when it monitors and integrates all of its critical infrastructures to better optimize resources, plan maintenance activities, monitor security, and maximize services to its citizens (Hall 2000). The aim of this integration is to solve urban problems by creating more sustainable environments and capitalize on the economic opportunities and social benefits of the city (Washburn and Sindhu 2010; Nam and Pardo 2011).

The smart city initiative emphasizes the importance of coupling ICTs with collective human capital in order to create innovative urban environments where all city stakeholders, including citizens, can interact in and contribute to the city’s smartness (Schuurman et al. 2012). The level of citizens’ engagement can determine the success of the smart city initiative (Chourabi et al. 2012). This is because humans can provide deep, qualitative knowledge that digital systems cannot (Erickson 2010). Under the smart city umbrella, crowdsourcing has emerged as an efficient framework that facilitates the completion of large scale tasks (Yan et al. 2009). Policy makers in many parts of the world agree that citizens’ engagement in the form of crowdsourcing can promote greater innovation and sustainability for the city and therefore create successful smart cities (Schuurman et al. 2012).

Crowdsourcing applications are acknowledged to potentially have the power to change how societies are organized (O'Neill 2012). The increasing adoption of mobile crowdsourcing applications especially by governments, demands more insights into users' acceptance and utilization of these applications. Technology acceptance can be defined as the act of adopting a technology; that is to make the initial decision whether to use it or not (Agarwal 2000). The mere presence of crowdsourcing applications will not guarantee the crowd's participation. Therefore, it is necessary to understand exactly what could influence the crowd to accept and use these applications especially in a government context. This paper aims to answer the following question: *What are significant factors influencing the acceptance and utilization of CityGuard application?*

This paper is organized as follows: first, crowdsourcing concept is introduced with its application in the mobile devices' context and government context. Second, acceptance and utilization factors found in the literature are discussed. Then, the proposed model for the case study is introduced, followed by the results of the study. Finally, the paper concludes with some recommendations for further research.

## **2. CROWDSOURCING**

Crowdsourcing has gained scholarly attention in the recent years as a model that promotes collaboration in businesses, governments, and research alike (Sowmya and Pyarali 2013). It was first coined by Jeff Howe, who defines crowdsourcing as a model in which an organization outsources certain tasks traditionally performed by its employees to the crowd (Howe 2006). The term combines two words; "crowd" that refers to a large undefined group of individuals and "sourcing" which is combining the resources of the crowd such as knowledge, time, and skills (Howe 2006; Geiger et al. 2011; Thuan et al. 2013). The existing literature provides different definitions for crowdsourcing. (Brabham 2009; Rouse 2010; Chatzimilioudis et al. 2012). Erickson (2011, p. 1) provides a precise definition of crowdsourcing that is to tap "the perceptual, cognitive or enactive abilities of many people to achieve a well-defined result such as solving a problem, classifying a data set, or producing a decision".

Although crowdsourcing is relatively a new terminology, the concept has been in practice for so many years. One of the early examples of crowdsourcing is dated back to 1714 when the British government offered a monetary reward for finding a precise way to determine ships' longitude in an act known as the "Longitude Prize" (Chilton 2009). Since then, crowdsourcing initiatives took different forms in many contexts (Yan et al. 2009; See et al. 2013).

### **2.1 Mobile Crowdsourcing**

The increasing uptake of mobile devices coupled with the continuous development in mobile technologies made these devices embedded in almost every aspect of life (Al Thunibat et al. 2014). They have opened new channels to communicate between citizens and governments, and increase the civic participation in urban governance (Höffken and Streich 2013). Utilizing mobile devices in crowdsourcing can reveal its full potential as a problem solving model (Chatzimilioudis et al. 2012). This is due to the multi-sensing capabilities embedded in mobile devices that make these devices efficient for data collection and sharing in a scalable manner (Shahabi 2013). An example of deploying sensing capabilities in crowdsourcing is "Participatory Crowdsourcing". This form of crowdsourcing enables the crowd to voluntarily collect and share data using the sensors available on their mobile devices (Dua et al. 2009). Another form of mobile crowdsourcing is "Opportunistic Crowdsourcing" which automatically uses the device's sensors to generate and collect raw data (Poblet et al. 2014). The joint effort of participatory and opportunistic crowdsourcing will be the driving force for developing applications that can solve more complicated problems in the future (Chatzimilioudis et al. 2012).

### **2.2 Government Crowdsourcing**

Crowdsourcing has succeeded in drawing the attention of governments worldwide as an enabler of civic participation in the public planning projects (Brabham 2009). It is considered as an extremely useful model for governments to promote collaboration, increase transparency, harness the collective knowledge of



citizens, and reduce transactional costs (Warner 2011). The ability of crowdsourcing to integrate different types of data and communication channels made it a dominant tool for live mapping initiatives in which geospatial data is tracked and analyzed via satellite imagery and maps (Bott and Young 2012). FixMyStreet is an example of a crowdsourcing initiative that deploys live mapping (King and Brown 2007). This crowdsourcing application, which was launched in 2007, enables citizens in the UK to report streets-related problems to their local council (Foth et al. 2011). SeeClickFix is another example of a crowdsourcing application. SeeClickFix is an interactive platform that allows citizens in the US to report to the local government any non-emergency issues related to their cities (Mergel 2012). The application was launched in September 2008 and now covers more than 25,000 towns and 8,000 neighborhoods in the US and abroad (Sowmya and Pyarali 2013).

The aforementioned initiatives are examples of deploying crowdsourcing in an urban context. According to Erickson (2010), "Geocentric crowdsourcing" is using crowdsourcing applications to enable the crowd to effectively address issues related to infrastructure and governance using GPS enabled devices. In this type of crowdsourcing, the crowd has the ability to collect and disseminate information related to a certain geographic area easily.

Adopting crowdsourcing initiatives in urban environments can empower citizens and allow them to take the role of distributed sensors in discovering and reporting issues related to their neighborhoods (Sowmya and Pyarali 2013). These initiatives raise the voice of the people which was once considered a secondary concern to government officials (King and Brown 2007). Thus, crowdsourcing has the potential to offer a new mechanism to deal with highly complex and global governance challenges (Bott et al. 2014).

### **3. ABU DHABI CITY**

The United Arab Emirates (UAE) is a federation that consists of seven Emirates. Abu Dhabi, the Capital of the UAE, has the biggest local government with more than 50 entities and departments (National Media Council 2013). Abu Dhabi is divided into three main geographic regions; one of which is Abu Dhabi city which is the focus of this study. According to the Statistics Center in Abu Dhabi, the Emirate has one of the highest population growth rates in the world of 7.5% annually. As of mid of 2013, the Emirate's population exceeded 2.4 million whom more than 1.4 million live in Abu Dhabi city. Mobile-cellular subscriptions in Abu Dhabi Emirate reached 197% with the network covering 100% of the Emirate's population (Statistics Center 2014).

#### **3.1 Case Study: CityGuard Application**

Under the slogan "Your City, Your Community, Your App" Abu Dhabi government has launched CityGuard application in 2013 as an instant channel to communicate with the government. This initiative leverages rich media and location-based services by allowing users to submit their complaints to the government 24/7. By downloading the application to their smartphones, Abu Dhabi residents and visitors can report incidents and send their feedback regarding any non-emergency issues directly to the government. The application has an interactive map that can be used to exactly locate where the problem is. In addition to the map, users can report incidents in three different ways; pictures, videos, or voice notes.

According to Abu Dhabi government, as of February 2015, the application was downloaded 80,080 times and 19,173 cases were reported which 95% of the reported cases were resolved completely. The reported cases are classified into 33 categories ranging from Expired Food Products, Damaged Roads & Sidewalks, Public Property Damage, and Sewerage (CityGuard Application 2014). Once the case is submitted, it will be automatically channeled to Abu Dhabi Government Contact Center, which will send it to the appropriate government entity to resolve it.

The aim of CityGuard application is to increase civic participation and social inclusiveness in Abu Dhabi. This collaboration between the public and the government will improve government services and ultimately enhance the welfare of the city. According to Abu Dhabi government, there are several advantages of CityGuard application. First, it helps in closing services' gaps in underserved Abu Dhabi communities. Second, CityGuard helps in achieving fairness and equality in service offering by providing equal development of infrastructural services to all citizens across the Emirate. Third, it improves communities'

welfare by improving the overall services and infrastructure. Fourth, CityGuard application allows the government to plan proactive measures to address the root cause of the reported problems in order to mitigate these problems in the future. CityGuard application allows all residents to have a say and a stake in the continuous development of their communities (CityGuard Application 2014).

## 4. ACCEPTANCE AND UTILIZATION FACTORS

A long-standing research question in the information systems domain is how to accurately explain the factors influencing the acceptance and utilization of new technologies (DeLone and McLean 1992). This area of research is considered one of the most mature streams of information systems research (Venkatesh et al. 2003). Different models were developed to explain and predict the acceptance and utilization of different technologies in different contexts. This section discusses the UTAUT model and other acceptance and utilization factors mentioned in the literature.

### 4.1 UTAUT Model

The Unified Theory of Acceptance and Use of Technology (UTAUT) model which was developed by Venkatesh et al. (2003) has synthesized the factors of eight different theories into a one unified model. This model as illustrated in figure 1 suggests that there are four significant constructs that directly determine users' acceptance and utilization of a technology which are Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. In addition to these constructs, they are four moderators; age, gender, experience, and voluntarism. Venkatesh et al. (2003) defined the model's construct as follows: *Performance Expectancy* is the degree to which an individual believes that using the technology will help attain gains in job performance. This construct is the strongest predictor of intention in the model. *Effort Expectancy* is the degree of easiness associated with using the technology. *Social Influence* is the individual's perception that important others think he or she should use the system. *Facilitating Conditions* refers to an individual's belief that existing organizational and technical infrastructure will support using the technology. As opposite to the other constructs in the model, the empirical study showed that facilitating conditions has a direct effect on the use behavioral rather than the behavioral intention (Venkatesh, Morris, Davis, & Davis, 2003). Another construct directly affecting the technology use is the *Behavioral Intention*. This construct is the key predictor of actual technology usage. Intentions indicate the effort an individual is willing to exert in order to perform the intended behavior; the stronger the individual's intention, the more likely he/she will perform the behavior under study (Ajzen 1991).

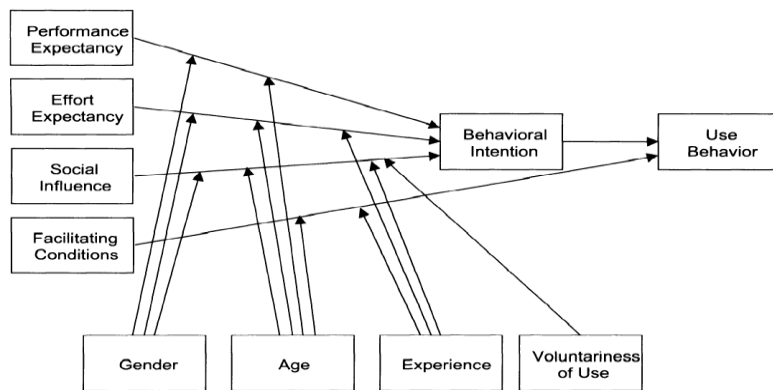


Figure 1. UTAUT model (Venkatesh et al. 2003)

## 4.2 Other Acceptance and Utilization Factors

The limited literature investigating acceptance predictors of mobile crowdsourcing applications in a government context, made it necessary to expand the literature to include the acceptance and utilization factors for m-government, e-government, mobile phones, and crowdsourcing in general. This is because government crowdsourcing applications such as CityGuard have three dimensions; government, mobile phones, and crowdsourcing. The sections below discuss the acceptance and utilization factors found in the literature that are applicable to the case study of this paper.

### 4.2.1 Cultural Values Construct

Cultural values are considered an influential factor in determining the behavioral intention toward new technologies in any society (Yaseen 2014). By applying Hofstede's Cultural Framework (1980) in the context of this study, there are three important cultural dimensions to investigate in any society; Collectivism, Masculinity, and Uncertainty Avoidance. Cultures which are ranked high in collectivism, and uncertainty avoidance and low in masculinity are more reluctant to participate in online crowdsourcing applications (Yassen 2014). According to Hofstede's framework, the UAE culture is 75% collectivist, 50% masculine, and 80% avoids uncertainty (see <http://geert-hofstede.com/>). Therefore, cultural norms related to sharing opinions and expressing feedback using mobile applications are important to be investigated in the context of this study.

### 4.2.2 Trust Constructs

In a technology context, trust can encourage users to give personal information and reduce perceptions of uncertainty and risk associated with the technology (Gatara 2012). Thus, it plays a critical role in determining the intention to use and ultimately the success of a crowdsourcing initiative (Gatara 2012; Shahabi 2013). It was found that trust in technology is perceived as one of the most important factors that positively affect the intention to use mobile services (Gao et al. 2012). However, Users' trust does not come only from trusting the technology, but from accepting and trusting the provider of the technology (Alzahrani & Goodwin, 2012). In a government crowdsourcing context, trust in government is the most critical success factor for any government crowdsourcing initiative (Warner 2011). Trust in government comes from participants' belief that their contributions and efforts are being considered by the government and that the government is capable of delivering effective services without jeopardizing citizens' security (Warner 2011; Akram and Malik 2012). Therefore, perceived trust in technology and perceived trust in government are two constructs that are applicable in this study. Both of these constructs will be investigated separately.

### 4.2.3 Attitude toward Technology Construct

Attitude can be explained as the overall individual's reaction toward using a technology (Venkatesh et al. 2003). This construct measures the general liking or disliking of the behavior in question (Agarwal 2000). Researches argue that attitude is one of the determinants of behavioral intention to use a technology (Ajzen 1991). This construct was found to have a significant effect on the intention to use m-government services (Althunibat et al. 2011). In a theoretical ground, the attitude toward using a technology is a better predictor of the intention to use that technology (Zhang 2008). Therefore, investigating the attitude toward government mobile crowdsourcing applications is necessary in the context of this study.

## 4.3 The Proposed Model

In order to investigate the significant factors influencing the acceptance and utilization of CityGuard application, it was necessary to develop a model that is adapted from the literature. Figure 2 illustrates the proposed model. The UTAUT model has been used as a foundation to develop this model because the UTAUT model explains 70% of technology acceptance while the other models explain only 40% of technology acceptance (Venkatesh et al. 2003). This confirmed the viability, validity, and stability of the UTAUT model in explaining technology adoption in different contexts (Alzahrani and Goodwin 2012).

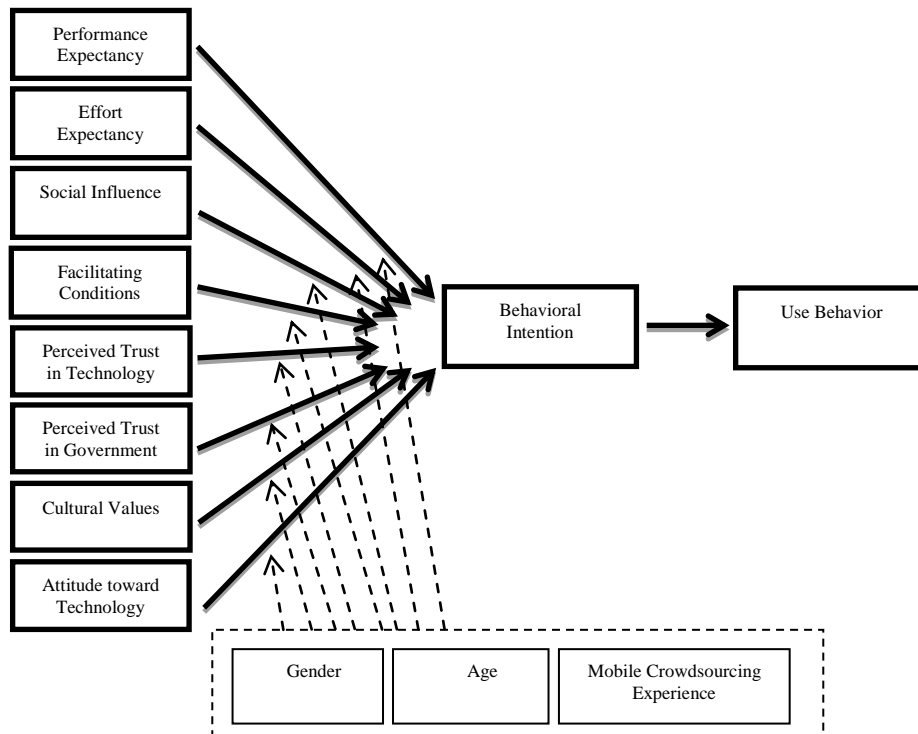


Figure 2. The proposed model for acceptance and utilization of government mobile crowdsourcing applications

In the proposed model, facilitating conditions is suggested to predict the behavioral intention not the use behavior as concluded by the UTAUT model. This is supported by the literature in which facilitating conditions found to have a positive effect on behavioral intention to use e-government services (Alshehri et al. 2012). In addition to the four constructs suggested by the UTAUT model, the proposed model integrates four other factors. *Perceived Trust in Technology* is especially applicable in CityGuard application because users have to submit their personal information along the case. This feature could jeopardize the acceptance of CityGuard application among potential users who wish to remain anonymous. *Perceived Trust in Government* reflects the trust of potential users that their contributions are valuable and important to the government. In addition, perceived trust in government measures if people trust the technologies developed by the government. The third factor is *Cultural Values*. This factor aims to understand the mindset of potential users in regard to their sense of belonging to their community, sharing opinions openly, and using mobile applications to express their opinions. Finally, *Attitude toward Technology* measures the general feeling over CityGuard application. The Voluntarism moderator was removed from the model because participating in CityGuard is completely voluntary.

## 5. METHODOLOGY

In order to investigate the acceptance and utilization factors of CityGuard application, the qualitative approach was followed. An online survey was distributed in which participants were asked to answer fifteen questions distributed in six webpages. In order to increase the sample size, snowball sampling was followed. Snowball sampling is asking the participants to nominate other participants to be part of the study (Goodman 1961). This resulted in 576 participants. The respondents' answers were analyzed using the Statistical Package for the Social Science (SPSS). A regression analysis was conducted to investigate which factors have significant influence on behavioral intention and use behavior in the model. The moderators' influence on the significant factors was analyzed using ROCESS macro which is a computational tool used to generate moderation analysis in SPSS software.

## 6. RESULTS

A total of 576 responses were collected in a period of ten days. Out of the 576 responses, 384 were complete with a response rate of 66.6%. Prior to any analysis, a reliability test was performed. The reliability test is a measure used to ensure consistency of the scale used in the survey (Israel and Tiwari 2011). For a questionnaire to be reliable, the Cronbach's Alpha should exceed 0.7. The coefficient Cronbach's Alpha for the research questionnaire is 0.868 which indicates that the questionnaire is reliable.

Then, regression analyses were performed to determine the significant factors. The regression analyses results are illustrated in table 1 and 2. Factors with p-values equal or less than 0.05 are considered statistically significant. Table 1 shows that Performance Expectancy (PE), Perceived Trust in Technology (PTT), Cultural Values (CV), and Attitude toward Technology (ATT) have significant influence on the intention to use CityGuard application. Table 2 shows that Social Influence (SI), Attitude toward Technology (ATT), and Behavioral Intention (BI) significantly affect using CityGuard application.

Table 1. Regression analysis for factors influencing the behavioral intention

Model		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
1	(Constant)	-.219	.226		.334
	PE	.118	.054	.102	.031
	EE	-.087	.059	-.069	.139
	SI	-.010	.029	-.011	.728
	FC	-.072	.057	-.049	.205
	PTT	.160	.052	.144	.002
	PTG	.046	.059	.042	.436
	CV	.401	.072	.293	.000
	ATT	.479	.064	.412	.000

Table 2. Regression analysis for factors influencing the use behavior

Model		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
1	(Constant)	2.034	.093		.000
	PE	.035	.022	.117	.123
	EE	-.012-	.024	-.037-	.623
	SI	.024	.012	.105	.045
	FC	-.009-	.023	-.023-	.701
	PTT	.034	.022	.121	.113
	PTG	-.014-	.024	-.050-	.565
	CV	-.024-	.031	-.069-	.433
	ATT	-.097-	.028	-.326-	.001
	BI	.046	.021	.178	.031

As for the moderators, it is notable that the moderators have no significant effect on the Behavioral Intention. Only two moderators (age and previous experience in mobile crowdsourcing applications) have a significant influence on the usage of the application under study. Age has a significant moderating effect on the relationship between Social Influence (SI) and Use Behavior (UB). Younger people are more influenced by the social pressure to use CityGurad application than older people. People with high experience in mobile crowdsourcing applications are less subject to social pressure to use the application. In addition, those people

have a positive attitude toward using CityGuard application more than people with minimum experience in crowdsourcing applications. Figure 3 illustrates the proposed model with the significant factors and moderators.

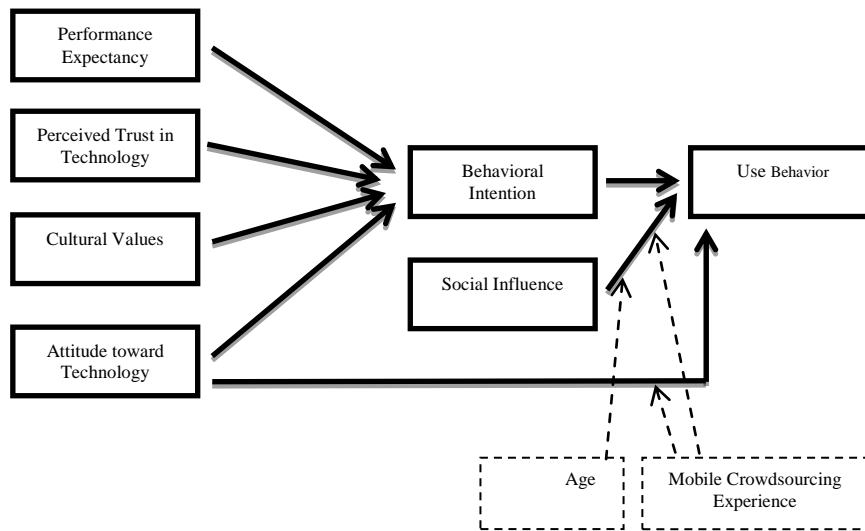


Figure 3. The significant acceptance and utilization factors of CityGuard application

## 7. CONCLUSION AND FURTHER RESEARCH

Crowdsourcing is a mechanism that taps into the power of the collective knowledge of a large and open number of people (Geiger et al. 2011). Applying crowdsourcing in an urban context can empower citizens to take a role in solving the problems facing their cities. However, providing the service does not mean that people will use it automatically. That is why it is necessary to investigate what factors influence the adoption of government mobile crowdsourcing applications. In order to increase the level of acceptance and participation in such applications, several factors should be taken into consideration; Performance Expectancy, Perceived Trust in Technology, Cultural Values, and Attitude toward Technology. In addition, there are three significant factors that influence the utilization of CityGuard application which are Social Influence, Attitude toward Technology and Behavioral Intention. Experience and age showed to have a moderating effect on Social Influence whereas experience alone has a moderating effect on Attitude toward Technology. Considering the effect of these factors on the government mobile crowdsourcing applications is vital to the success of these applications. There are two main limitations in this study; first, the proposed model is not inclusive. There might be other significant factors that are not included in the model. Second, the results of this study are captured through respondents' self-reporting mechanism. Thus, bias and inaccurate answers are inevitable. The extent of these limitations on this study cannot be quantified. Therefore, it is important to treat the findings of this research as strong outcomes in a specific context rather than conclusive results.

For the best of the researcher's knowledge, this is the first study that aims to investigate the acceptance and utilization of government mobile crowdsourcing applications, specifically in the Arab countries. This study contributes to the practice by identifying the significant factors the government should consider prior to developing and launching its crowdsourcing applications. Governments can use the findings of this research as a starting point to enhance their crowdsourcing applications and encourage wider crowd participation. This research opens new avenues for more researches in the field of government mobile crowdsourcing applications. Future researchers have great opportunities to approach this area of research from different perspectives. For example, replication of this study can be done for different applications in different contexts to investigate the validation of the proposed model. In addition, further research can be conducted to compare the acceptance and utilization of mobile crowdsourcing applications in a government context and business context.

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# FACTORS INFLUENCING M-GOVERNMENT ADOPTION IN THE UAE

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## ABSTRACT

Mobile government initiative has taken its first steps in the United Arab Emirates, as almost all of the government entities have released their first mobile applications. The success of mobile government in any country is based on government support, along with the people's acceptance of mobile government applications. The purpose of this research is to find out the attitudes and perceptions of Abu Dhabi locals regarding mobile government in the UAE.

Diffusion and adoption of the M-Government applications is subject to a number of factors as is the case with the diffusion or adoption of any new or innovative technology. Previous researches have determined the factors which influenced the adoption of mobile government in some countries by using the Unified Theory of Acceptance and Use of Technology model (UTAUT). This study adopts some of these common factors and to find out which factors will influence the adoption of mobile government in the UAE.

The factors used are demographic factors, social influence factors, technology awareness factors, face-to-face interaction factors and trust factors. At the end of this study, the researchers make some recommendations for successfully adopting mobile government in the UAE.

## KEYWORDS

Mobile Government, M-Government, E-Government, UTAUT, UAE

## 1. INTRODUCTION

The Prime Minister of the UAE, H.H Al Sheikh Mohamed Bin Rashid, announced in May 2013 that the government would begin an initiative called Mobile-Government, or M-Government, to develop smartphone applications for government services.

The M-Government initiative scheduled for completion on May 2015 Newcombe (2014) achieved impressive results by announcing a number of applications, such as the application of the Ministry of the Interior, through which the client can end all traffic and licensing procedures.

As many researchers Carter and Belanger (2005), Abdelghaffar and Magdy (2012) and Al-Awadhi and Morris (2009) have used a Unified Theory of Acceptance and Use of Technology model (UTAUT) model to extract common factors that influence the adoption of mobile government in some countries such as Egypt, Kuwait and Taiwan using. The UTAUT is a model that was presented by (Venkatesh, V. et al., 2003). This model extracts the critical factors and contingencies related to the prediction of behavioral intention to use a technology and technology used primarily in organizational contexts. (Venkatesh et al., 2012).

This paper will discuss the research problem, questions and delimitations. Further, there will be a review of literature related to reach domain. The methodology and the results of this research is discussed and presented to the reader. The paper is completed with conclusion and recommendation.

### 1.1 Research Problem

Launching the mobile government initiative without a clear list of the factors that could influence the acceptance of a mobile government could lead to citizens' reluctance to use mobile government applications.

This research paper studies and demonstrates the most important factors that influence the adoption of mobile government in the UAE and clarify them so that they can be resolved and applied by the government before the formal launch of the mobile government initiative.

## 1.2 Research Questions

The main research questions are:

1. Do demographic factors influence the adoption of M-Government in the UAE?
2. Do social factors influence the adoption of M-Government in the UAE?
3. Do face-to-face interaction factors influence the adoption of M-Government in the UAE?
4. Do trust (security and privacy) factors influence the adoption of M-Government in the UAE?

## 2. LITERATURE REVIEW

According to the International Communication Union (ITU) the mobile phone penetration average in the UAE reached 134 percent in a total population of 8.2 million, which means that mobile phones subscribers exceed the population of the country see ITU (2012). UAE is considered one of the most ready countries to initiate mobile government due to the widespread utilization of advanced technology among its citizens and its advanced technological infrastructure, as well as its high rate of mobile phone subscriptions. ITU (2012) puts the UAE as a major mobile phone user when it comes to GSM subscriptions.

In addition, 77 million internet users are classified as heavy users in the Middle East as in Al-Khouri (2012). UAE has the highest internet penetration, with around 88 percent of the population as published by Internet World Stats (2013).

To support the M-government initiative, the government of the UAE has initiated a UAE government applications market in both the Android market and the Apple store; however, some of these applications are still informational prior to the formal unveiling of UAE's M-Government in May 2015.

M-Government is a subset of e-government. e-Government is the use of information and communication technologies (ICT) to improve the services provided by public sector institutions utilizing Internet technology. Most advanced ICTs is used by m-government utilizes mobile devices such as smart phones, phablets and tablets technologies based on wireless networks and GSM. M-Government makes it possible to receive government services "anytime, anywhere" where e-government not necessarily anywhere as in Lallana (2008) and Heeks (2008).

In addition, Abdelghaffar and Magdy (2012) found that many researchers considered other factors which influence mobile government adoption, that are base of the Unified Theory of Acceptance and Use of Technology (UTAUT) model. UTAUT integrates the social influence and cultural factors and consists of several independent factors: Usefulness, Ease of Use, performance expectancy, effort expectancy, social influence, awareness, Personal connections, Trust, Internet Experience, Face-to-face interactions and facilitating conditions significantly contribute to the prediction of the intention to use M-government in Egypt.

The UAE government established its guideline for Mobile Government through its Telecommunications Regulatory Authority (TRA) as documented in TRA (2013).

Al-Khouri (2012) states, "through a strong authentication and easy to use application security feature, the user can feel safe each time he activates any of M-Government services on his smartphone".

Hung, S. et al., (2012) conducted a study of user acceptance of mobile government services in Taiwan. They selected nine common factors, which are perceived usefulness, perceived ease of use, trust, interactivity, external influence, interpersonal influence, self-efficacy, and facilitating conditions, from previous studies in e-government service acceptance to support their research and to develop their web-based survey.

Al-khamayseh, S., et al. (2006) targeted the experts and researchers in both e-government and M-Government to support their research and to filter the significant factors, which affect mobile government. From preliminary survey results, the authors have identified seven factors considered core success factors in interactive mobile government.

After reviewing the aforementioned studies, as well as a number of literature reviews regarding the topic (factors influencing mobile government adoption), it has been found that the majority of the studies used the UTAUT to determine the factors which influence the adoption of mobile government. This includes demographic factors, ease of use factors, usefulness factors, social influence factors, technology awareness factors, face-to-face interaction factors, and trust factors.

### 3. METHODOLOGIES AND APPROACH

The primary data was collected from survey questionnaires that gave information about participants such as educational level, mobile technology literacy, and demographic details, as well as answers of open and closed-ended questions that cover the research questions and sub questions.

This research was conducted by collecting secondary data about M-Government from academic journals, research papers, books and websites as a secondary data then the researcher processed this data to extract meaningful information to support the literature review section and research study in general.

The survey was distributed to government and semi government organizations such as the Ministry of the Interior (Abu Dhabi Headquarters), ADNOC, the Abu Dhabi Education Council, public people along with a letter insuring the confidentiality of the data collection.

### 4. RESEARCH RESULTS

As shown in Figure 1, among all of these 352 respondents, 57.67% (203 respondents) are between 21 and 35 years old, followed by respondents from 36 to 50 years with 25.85% (91 respondents). The third place was respondents who were 20 years and below with 10.51% (37 respondents). Figure 2 shows that gender distribution is balanced; 50.85% (179 respondents) were female, while 49.15% (173 respondents) were male.

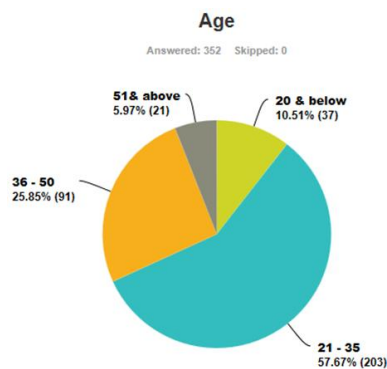


Figure 1. Age Groups of Respondents

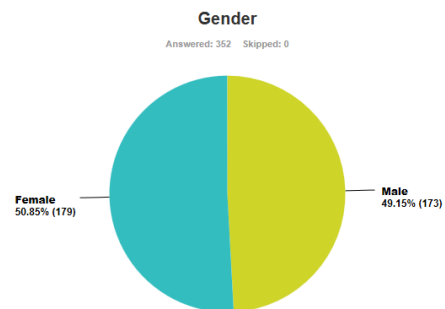


Figure 2. Respondents' Gender

As is shown in Figure 3 and Figure 4, the majority of Abu Dhabi locals are subscribed to 3G and 4G networks, and use their mobile phones not just for voice calls but as an alternative for computers and laptops.

In addition, 94.89% (334 respondents) use their smartphones to surf the internet and use email and social networking sites; however, only 5.11% (18 respondents) use their phones to make voice calls only.

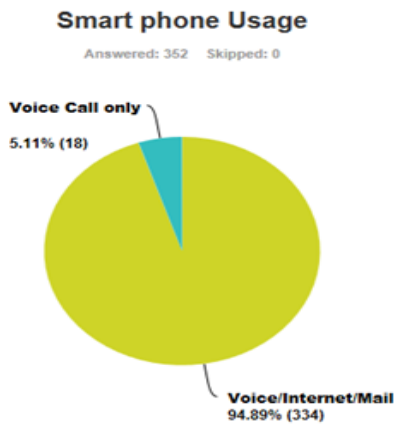


Figure 3. Respondents' Online Connectivity

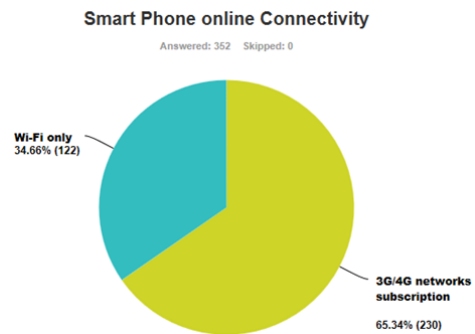


Figure 4. Respondents' Phone Usage

As shown in Figure 5, 44.60% (157 respondents) and 34.09% (120 respondents) are strongly agree or agree that M-Government implements the latest standards to provide security and privacy. 17.61% (62 respondents) doubt whether M-Government implements the latest standards to provide security and privacy. The rest, 3.69% (13 respondents), disagreed or completely disagreed that mobile government uses the latest standards to provide security and privacy.

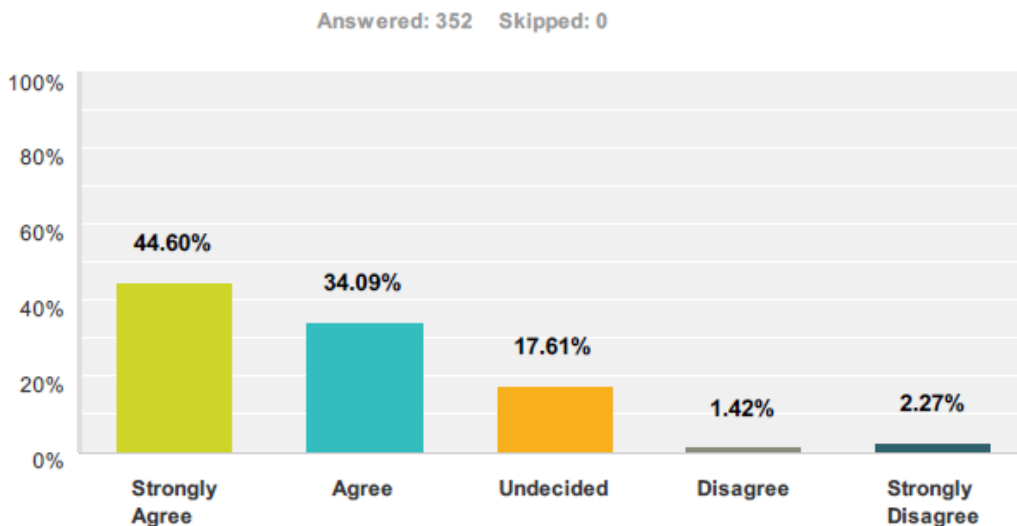


Figure 5. M-Gov Implements the Latest Security and Privacy

As per Figure 6 below, almost all the participants (83.53% or 294 respondents) strongly agree or agree that mobile government apps will work on their smartphones without any problems, so this is a great indicator that the people are willing to test and use government apps. Measuring people's awareness regarding mobile government applications' reliability and stability for their smartphones will give an idea about the extent to which people are willing to download mobile government apps.

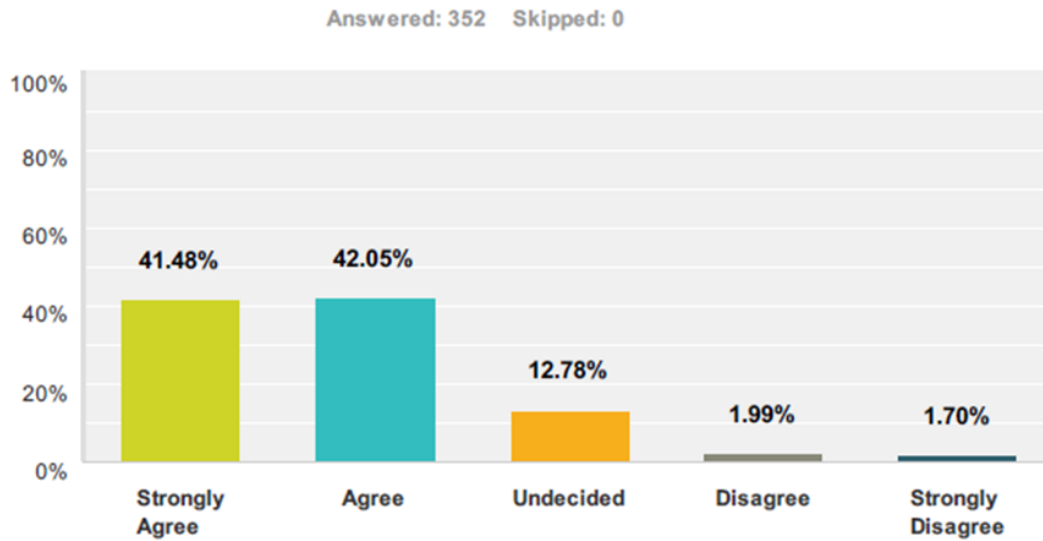


Figure 6. Gov Apps Will Work on Smartphones Properly

As illustrated in Figure 7, 69.61% (245 respondents) strongly agree or agree that their colleagues encouraged them to start to use mobile government apps.

Figure 8 shows that almost three quarters of participants (65.06% or 229 respondents) agree that their peers influence them to use mobile government apps. 26.42% (93 respondents) don't think that their friends encouraged them to use mobile government apps, 3.97% (14 respondents) disagree or strongly disagree that their friends tell them to use those apps. 26.99% (95 respondents) don't are undecided on whether someone influenced them to use mobile government apps and 7.95% (28 respondents) think that no one influenced them to use mobile government apps. Abu Dhabi citizens are helping mobile government apps to be deployed to a large number of locals through word of mouth.

People I know think that I should use the M-Government app's

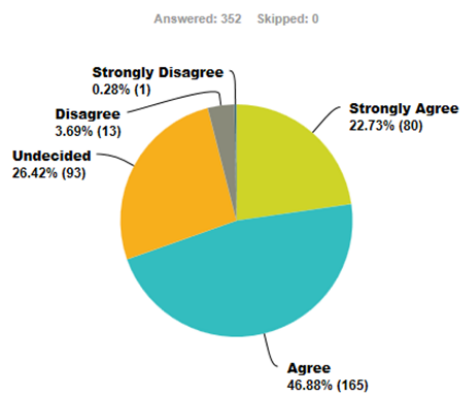


Figure 7. People Think I Should Use M-Gov Apps

My peers influence me to try out the M-Government app's

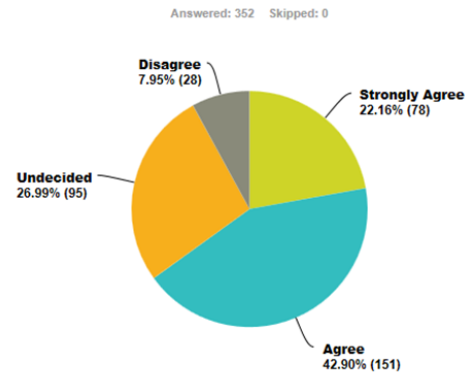


Figure 8. Peers' Influence pn Trying M-Gov Apps

Figure 9 reflects that 51.42% (181 respondents) find that using M-Government applications are better than visiting the physical government offices. They preferred using M-Government apps over going to government physical service offices. However, 34.09% (120 respondents) prefer going to physical government service offices and communicating face-to-face with employees.

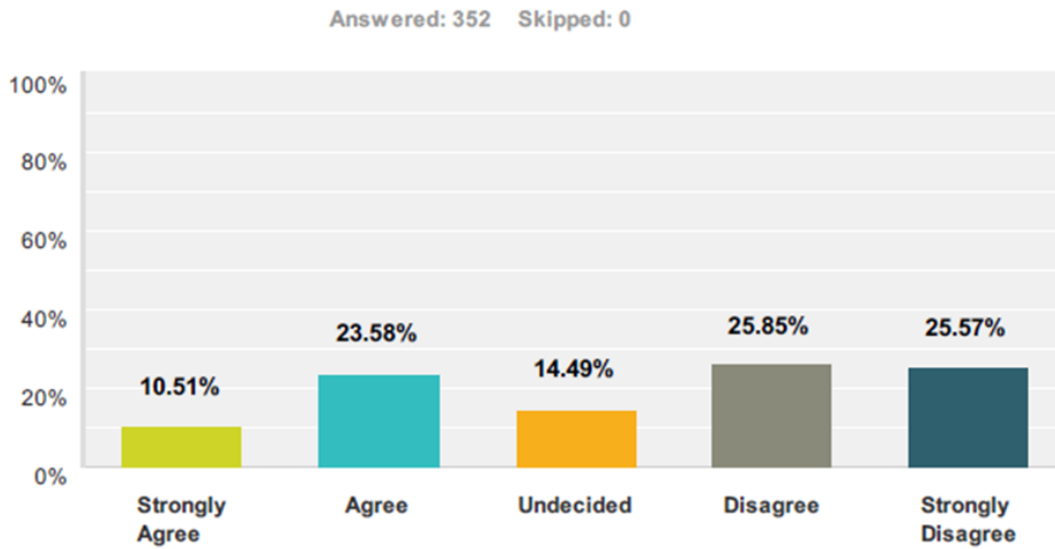


Figure 9. Are Government Service Offices Better than M-Gov Apps?

As shown in Figure 10, 85.23% (299 respondents) believe that M-Government apps will give people an equal chance to carry out their government transactions far from nepotism, whereas 9.94% (35 respondents) have doubt and 4.38% (18 respondents) disagree that M-Government apps are capable of providing an equal chance for all people to carry out their government transactions far from nepotism.

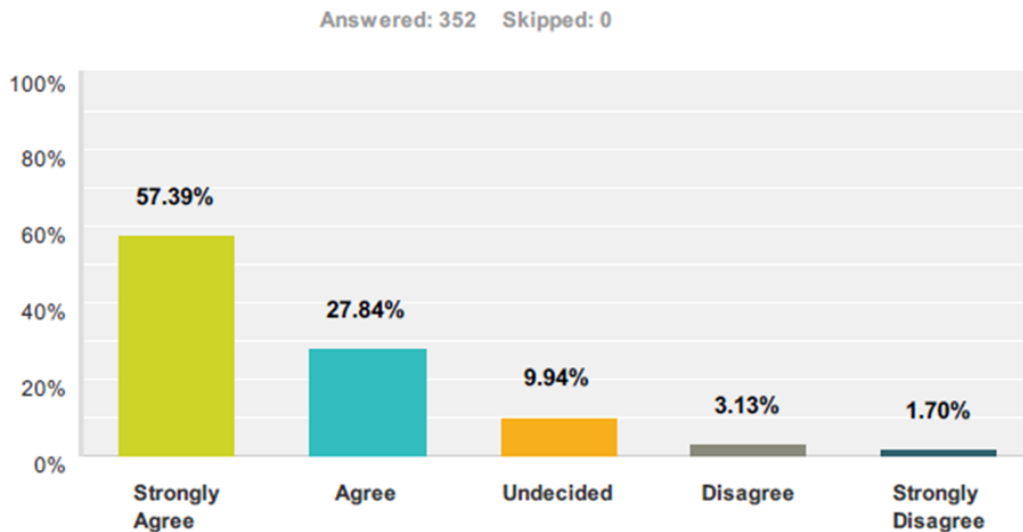


Figure 10. M-Government vs. Nepotism

As is shown in the bar chart (Figure 11), 32.1% (113 respondents) either strongly agree or agree that mobile government apps will not reduce their data privacy. However, the overwhelming majority of participants 58.53% (206 respondents) believe that using mobile government applications will compromise their personal information and affect data privacy negatively, and 9.38% (33 respondents) uncertain whether or not mobile government apps will not compromise their data privacy.

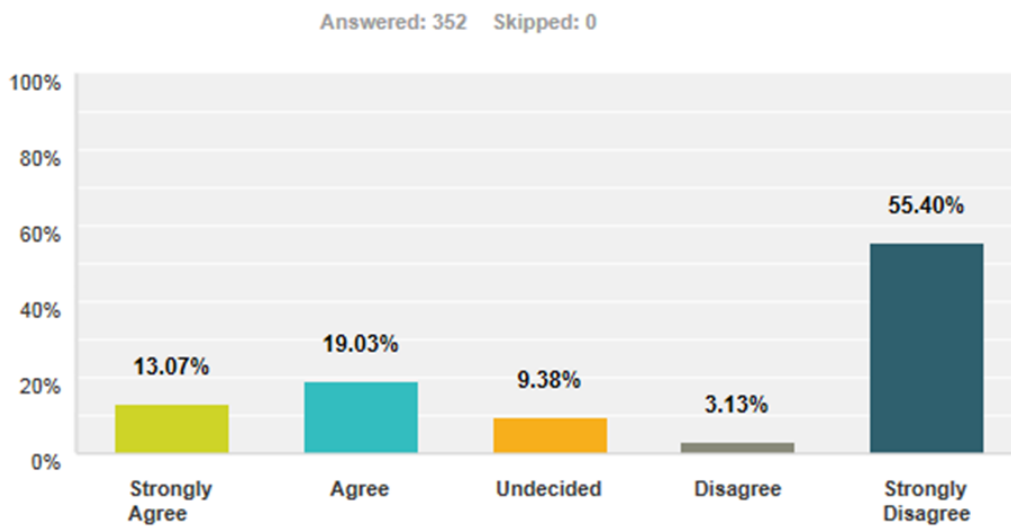


Figure 11. M-Gov vs. privacy

Furthermore, respondents gave additional comments and recommendations that are summarized as followed: privacy is a main concern for a large number of participants. They believe that government applications can gather personal information about smartphone owners. One respondent proclaims, "the main thing which prevent me to using government application is the danger of breaching my personal information." Finally, some of participants state that media campaign of mobile government in the UAE is very low.

The respondents argue that most government departments outsource the development of their applications; however, they believe that those applications should be developed and managed by local people who are entrusted with sensitive information. In addition, a common answer is that some of the existing government apps do not work properly and that respondents would like these applications to be updated and want professional, reliable, and high-availability applications. The résumé of the answers is that almost all the respondents praise the initiative of mobile government in the UAE and believe that government apps will save their time and money, as well as increase their productivity. They believe that people must be informed, educated and motivated to utilize mobile government apps through comprehensive advertising campaigns.

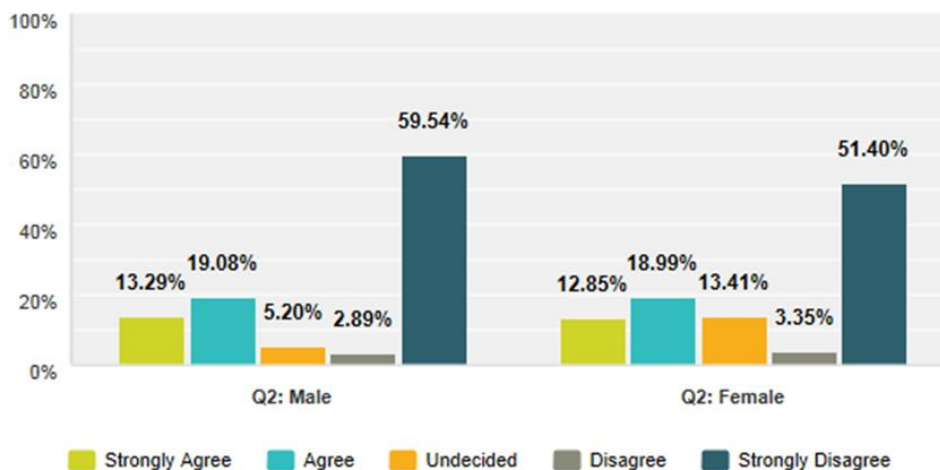


Figure 12. Gender and Distrust in M-Government

It is shown in Figure 12 a high percentage of both males and females believe that mobile government apps would compromise their privacy and personal information. 62% of the total males and 53% of the total females believe that M-Government application will compromise their privacy, which reflects how this phenomenon is widely spread in the UAE community.

As a further investigating the distrust of UAE local for M-Government applications, Figure 13 shows us that all the age groups of UAE locals are distrusting M-Government applications. More than half of the respondents of every age groups believe that M-Government will compromise their privacy so it clearly sees that distrusting in M-Government applications among the locals is general problem and it has to be taken seriously by the government in order to adopt M-Government services seamlessly.

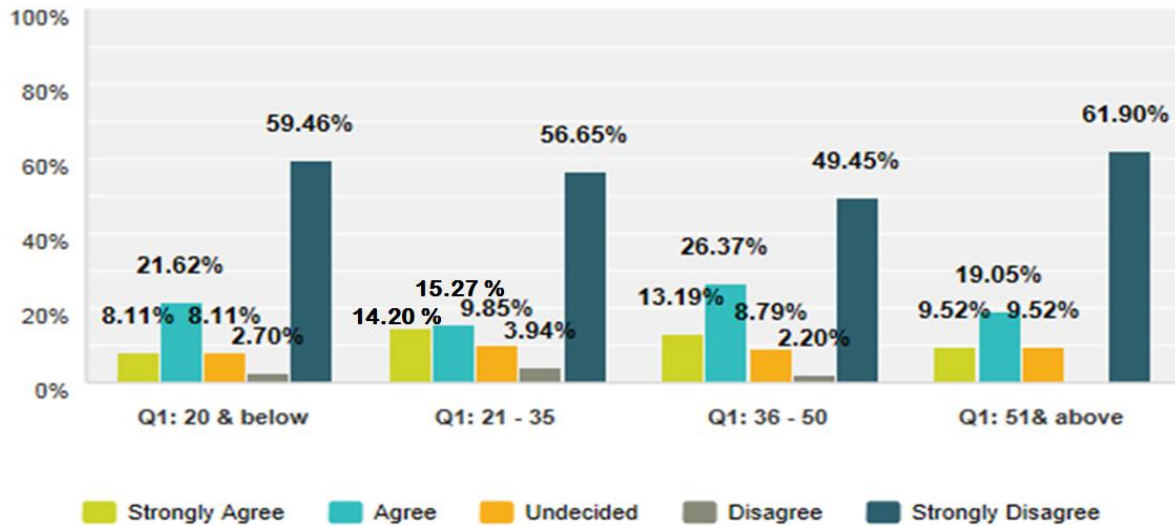


Figure 13. Age Groups and Distrust in M-Government

## 5. RECOMMENDATIONS

The researchers recommend the following points in order to successfully adopt the mobile government applications in the UAE.

1. The government needs to provide mobile applications that allow receiving the entire service without the need to visit the government physical office to finalize the transaction.
2. All online applications should be easy and user-friendly.
3. The government should promote its mobile applications by employing well-known people in the UAE as ambassador for mobile government applications.
4. The government needs to insure the population that the data privacy and security will be maintained.
5. The government should provide Wi-Fi connectivity throughout the city of Abu Dhabi to involve those who do not have the ability or willing to subscribe to 3G network data plans.

## 6. CONCLUSION

After analyzing the results of the survey questionnaire and reading the views and comments of the citizens in the emirate of Abu Dhabi, it is clear that the significant factors influencing mobile government adoption in the UAE are slightly different than the factors studied in a number of previous studies in Egypt, Kuwait, Qatar and Taiwan as in the papers of Abdelghaffar and Magdy (2012), AlAwadhi and Morris (2009) and (Hung, S. et al., 2013). However, lack of user awareness, lack of free public Wi-Fi spots, face-to-face interaction, and trust significantly influence mobile government adoption among the UAE's citizens.



The main beneficiaries from this research are government entities who are participating in the initiative of mobile government the influencing factors should be reviewed and the M-Government initiative in the UAE may consider the recommendations given in order to be seamlessly adopted and accepted by the citizens.

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# A DIMENSION-ORIENTED TAXONOMY OF DATA QUALITY PROBLEMS IN ELECTRONIC HEALTH RECORDS

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## ABSTRACT

The provision of high quality data is of considerable importance within the health sector. Healthcare is a domain in which the timely provision of accurate, current and complete patient data is a prime objective and the quality of Electronic Health Record (EHR) data concerns health professionals and researchers for secondary usage. To ensure high quality data in the sector, health-related organizations need to have appropriate methodologies and measurement processes to assess and analyse it, yet little attention has been paid to existing problems (dirty data) in health-related research. In practice, detection of anomalies and cleansing is time-consuming and labour-intensive, which makes it unrealistic for most health-related organizations. This paper proposes a dimension-oriented taxonomy of data quality problems. The mechanism of the data quality assessment relates the business impacts to the dimensions of data quality.

## KEYWORDS

Data Quality, Information Quality, Quality Problem, Dirty Data, Data Quality Dimensions Electronic Health Record (EHR).

## 1. INTRODUCTION

Data quality in health information systems is attracting researchers' attention. Data quality plays an important role in all applications of information systems. The private and public sectors have recognized the importance of data quality, and many initiatives such as the Data Quality Initiative Framework by the Welsh government, passed in 2004, and the Data Quality Act by the United States government, passed in 2002, have been launched to improve the quality of data in those countries (Batini et al., 2009).

Electronic Health Records (EHRs) are a digital form of patient medical records that surpass many existing registries and repositories. An EHR is defined as a repository of patient data in digital form that is stored and exchanged securely and is accessible by different levels of authorized users (Häyrinen et al., 2008). Many studies (Thakkar & Davis, 2006; Yoon-Flannery et al., 2008) have highlighted how such systems could improve the efficiency and effectiveness of healthcare and support its sustainability.

In the area of health information systems, issues and challenges have arisen that affect widespread adoption of EHRs. Data quality assurance is a common challenge for many institutions (Botsis et al., 2010), as the key barrier to optimal use of data in EHRs is the increasing quantity of data and their poor quality. The definition used in this study for the quality of data is their 'fitness for use'. This definition raises a concern beyond traditional concerns with data accuracy: that they will lead to many dimensions of data quality, making data quality a multi-dimensional concept.

The healthcare field is known as information-intensive, since massive data information is generated on a daily basis. An estimated 30 per cent of the health budget usually goes to issues related to information handling (Health Information and Quality Authority, 2011). Sound, accurate and reliable health information plays an important role in providing safe and reliable healthcare. Similarly, this high quality of information helps decision makers in their healthcare planning.

In this paper, a new classification of dimension-oriented data quality problems is proposed and discussed with EHR stakeholders and IT. This harnesses end-users' involvement to capture their requirements and needs. The remainder of this paper is as follows. In section 2, a review of data quality issues is presented.

Section 3 presents the taxonomy of dimension-oriented data quality problems. Confirmation of the new taxonomy in the context of EHR is presented in section 4. In section 5, the findings and results are discussed. Finally, the paper is concluded in section 6.

## 2. DATA QUALITY ISSUE

The importance of high quality health information for healthcare decisions is widely recognised by many health-related bodies through their initiatives (Batini et al., 2009). The Canadian Institute for Health Information (CIHI) defines data quality in the context of users; that is, if data satisfy users' needs, then they are fit for use (Canadian Institute for Health Information, 2009).

### 2.1 Data Quality Dimensions

The quality of data may be determined by assessment against a set of dimensions. The clinical research community has failed to develop a consistent taxonomy of data quality as there is an overlap of terms between existing dimensions, as reported by Weiskopf and Weng (2013). These authors reviewed clinical research literature for the data quality dimensions in the context of EHR to identify five dimensions, which are completeness, correctness, concordance, plausibility and currency. These findings support widely used dimensions in the literature of data quality, which are accuracy, consistency, completeness and timeliness (Batini et al. 2009; Liaw et al. 2012). These represent the basic set of dimensions for data quality and are broadly accepted.

In the literature there are different classifications of quality dimensions with a number of discrepancies in the definitions of most (Batini et al., 2009). The definition of a dimension may vary from one framework to another – see the example given by Wand and Wang (1996) in their definition of accuracy. The concept of data quality depends on the actual use of the data. Thus, it depends on the application: what is considered high quality data in one application may not be sufficient in another (Wand & Wang, 1996). Wand and Wang (1996) also emphasize the importance of providing a design-oriented definition of data quality that will reflect the nature of information systems. Thus, this paper adopts the basic set of dimensions due to its being widely accepted. Besides, Ge and Helfert (2008) provide a model in which they group data quality dimensions (Wang & Strong, 1996) into two categories based on assessment type. Accordingly, accuracy, consistency, completeness and timeliness are classified as objective assessments.

The definitions of these dimensions were discussed with IT experts and health professionals, concluding with the following definitions (Almutiry et al. 2013):

**Accuracy:** The extent to which registered data conforms to their actual value.

**Consistency:** Representation of data value remains the same in multiple data items in multiple locations.

**Completeness:** The extent to which data are of sufficient breadth, depth, and scope for the task in hand.

**Timeliness:** The state in which data are up to date and their availability is on time.

### 2.2 Data Quality Problems and Dirty Data

Organizations and enterprises tend not to pay enough attention to the existence of 'dirty data' in their repositories, although this compromises the quality of their data and produces unreliable information. The reasons could be due to resources, time and a lack of appreciation. In the literature many proposals of 'dirty data' taxonomies are proposed that tackle a wide variety of data quality problems.

In the work of Müller and Freytag (2005) data anomalies are roughly classified into syntactical, semantic and coverage. Syntactical anomalies concern representation-related dirty data. This type includes lexical error, domain format errors and irregularities. Semantic anomalies affect the comprehensiveness of data collection as well as non-redundant representation, whilst coverage anomalies cause missing values and missing tuples. They include integrity constraint violations, contradictions and duplicates of invalid tuples.

Rahm and Do (2000) provide a two-level classification of data quality problems associated with databases. In the first hierarchical model, problems are categorized as single-source and multi-source. In each, the data quality problems are classified as schema-level and instance-level problems. With regard to the single-source category, schema-specific problems occur due to the limitations of model and application-specific integrity constraints, as the data quality of a source mainly depends on its data being governed by schema and integrity constraints. On the other hand, in the multi-source category the heterogeneity of data models from different sources results in many ‘dirty data’ such as duplicates and instances of naming conflict.

Kim et al. (2003) take another pattern of classification of ‘dirty data’. They look at dirty data as either missing data, wrong data or non-standard representations of the same data. This leads them into a hierarchically structured taxonomy: missing data; not missing but wrong; and neither missing nor wrong but unusable data.

Researchers Oliveira and Rodrigues (2005) present a comprehensive taxonomy of data quality problems through reviewing previous work (Kim et al. 2003; Rahm & Do 2000; Müller & Freytag 2005), using a bottom-up approach, from the lowest level where data quality can appear to the highest level where these problems occur. This approach results in six levels of granularity ranging from problems in single attribute value (lowest level) to problems in multi-sources (highest level).

### **2.3 Data Quality and Dirty Data Taxonomies**

In the literature, the terms data quality problems and ‘dirty data’ are frequently used interchangeably, addressing all issues and problems that lead to poor quality of data and, consequently, produce unreliable data. Müller and Freytag (2005) instead use the term ‘data anomaly’ and classify these anomalies into lexical errors, domain format errors, irregularities, integrity constraint violations, duplicates, invalid tuples, missing values and missing tuples. By contrast, Rahm and Do (2000), Kim et al. (2003) and Oliveira and Rodrigues (2005) consider data quality problems on the basis of source. Rahm and Do group their findings into multi-source and single-source problems, and their classification has been the most widely cited in the context of data cleansing. Kim et al. (2003) produced a comprehensive hierarchal taxonomy that captures 33 types of ‘dirty data’, both single and multi-source. In their approach they rely on the fact that ‘dirty data’ are either missing, wrong or unusable. The most recent proposal is from Oliveira and Rodrigues (2005), who adopt a bottom-up approach to generate 35 types of ‘dirty data’.

## **3. DIMENSIONS-ORIENTED TAXONOMY OF DATA QUALITY PROBLEMS**

As discussed earlier, data quality is multi-dimensional concept. It is widely defined as ‘fitness for use’, emphasizing the importance of a data consumer’s perspective of quality. Researchers since the early 1990s have identified many dimensions that capture different facets of data quality, and some of these works were empirically proven (Wang & Strong 1996). Rationally, data quality problems should fall under the dimensions proposed in the literature, however there is no taxonomy of ‘dirty data’ that groups quality problems based on their relation to dimension measurement. In this section, a dimension-oriented taxonomy of data quality problems is proposed that would help organizations to assess each dimension of quality and to prioritize them.

Figure 1 illustrates how the taxonomy proposed by Rahm and Do (2000) was adopted as an initial collection of data quality problems. Subsequently, other types of ‘dirty data’ found in other studies were thoroughly analysed and filtered to identify those not included in that initial collection.

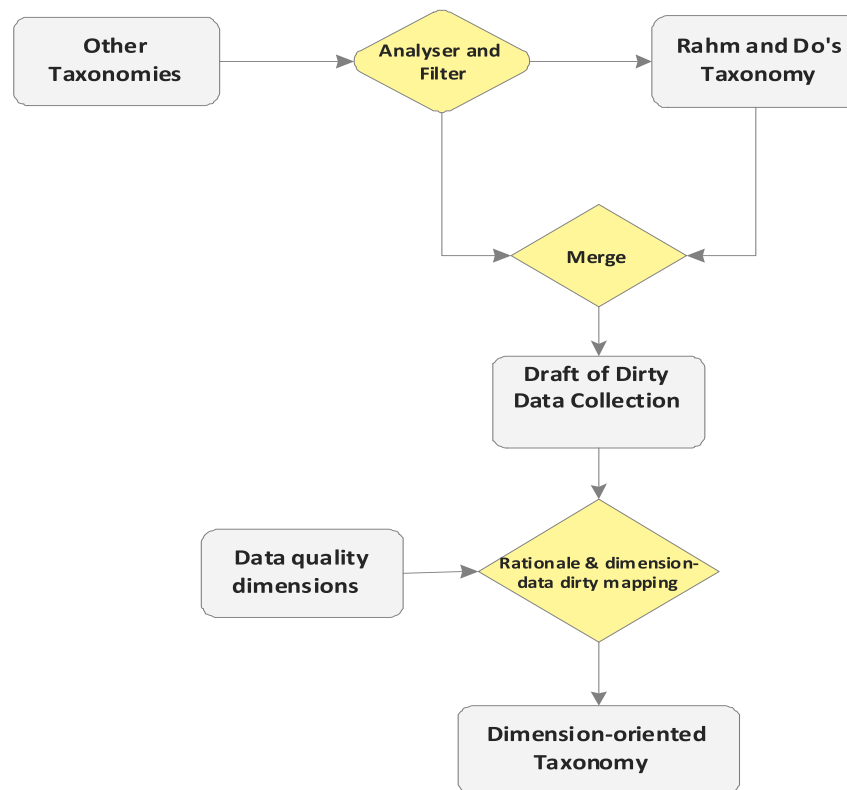


Figure 1. Process of developing an initial taxonomy of dimension-oriented data quality problems

We compiled a draft of types of ‘dirty data’ covering all the aspects of errors mentioned in the literature. The last step was a rationale stage in which each type was examined against data quality aspects (dimensions), consequently each type has its respective dimension. Table 1 shows the initial taxonomy of dimension-oriented of ‘dirty data’.

Table 1. The initial taxonomy of dimension-oriented dirty data

ID	Data Quality Problems	Dimension
D1	Illegal values due to invalid domain range	ACCURACY
D2	Mis-spellings	
D3	Misfielded values	
D4	Embedded values	
D5	Word transposition	
D6	Wrong reference	
D7	Erroneous entry	
D8	Violated attribute dependencies	CONSISTENCY
D9	Uniqueness violation	
D10	Naming conflicts in multi-source	
D11	Structural conflicts in multi-source	
D12	Wrong categorical data	
D13	Relational integrity violation	

<b>D14</b>	Violated attribute dependencies	
<b>D15</b>	Duplicated records in single/multi data source(s)	
<b>D16</b>	Contradicting records in single/multi source(s)	
<b>D17</b>	Inconsistent spatial data	
<b>D18</b>	Different measure units in single/multi source(s)	
<b>D19</b>	Syntax inconsistency	
<b>D20</b>	Missing data where Null-not-allowed constraint enforced	
<b>D21</b>	Missing data where Null-not-allowed constraint not enforced	
<b>D22</b>	Missing record	<b>COMPLETENESS</b>
<b>D23</b>	Ambiguous data due to incomplete context	
<b>D24</b>	Semi-empty tuple	
<b>D25</b>	Outdated temporal value	<b>TIMELINESS</b>
<b>D26</b>	Outdated reference	
<b>D27</b>	Different representations due to use of abbreviation and cryptic values	
<b>D28</b>	Different representations due to use of alias/nickname	<b>INTERPRETABILITY</b>
<b>D29</b>	Different representations due to use of encoding format	
<b>D30</b>	Different representations due to use of special characters	

#### 4. CONFIRMATION OF THE NEW TAXONOMY

In order to confirm the data quality items associated with data quality dimensions, interviews were conducted with experts and data consumers. Semi-structured interviews were carried out with several experts and EHR stakeholders in the health sector.

##### 4.1 Data Collection

Semi-structured interviews were used to collect data from two groups. This kind of interview was selected due to the advantage of gathering statements regarding individuals' attitudes and exploring in-depth their experience (Drever 2003).

This study was conducted at National Guard Health Affairs (NGHA) in Saudi Arabia in February 2013. NGHA is one of the leading health organizations providing healthcare to National Guard employees and their dependants. It was chosen first as it has four hospitals and 60 primary and secondary health centres across Saudi Arabia, and secondly as it received the Middle East Excellence Award in EHR in 2010.<sup>1</sup>

Interviews were conducted with two groups. The first was of IT experts with responsibility for implementing and maintaining EHR systems, comprising five IT professionals with various responsibilities belonging to the Information Services and Informatics Division (ISID) and the Clinical Information Management Systems (CIMS). Table 2 provides a snapshot of the IT experts interviewed in this study.

<sup>1</sup> <http://www.ngha.med.sa/English/Pages/ArabHealthAward.aspx>

Table 2. Selected expert interviewees

Participant	Position	Experience (years)	Justification
P1	Database administrator	+15	Direct involvement with quality problems in databases
P2	Database administrator	+10	Direct involvement with quality problems in databases
P3	Physician team leader	+5	Link between medical staff and IT support
P4	Physician team leader	+5	Link between medical staff and IT support
P5	Application analyst	+5	Direct involvement with application processes and duty of application enhancement

The other group consisted of data consumers. They were all selected from King Abdulaziz Medical City (KAMC). The reason for choosing staff from here was that in 2006 it was accredited under Joint Commission International standards (JCI) with excellent performance. The other reason was that its staff are highly qualified and well-trained, and some hold academic positions at King Saud bin Abdulaziz University for Health Sciences. Table 3 gives a snapshot of the data consumers selected for interview.

Table 3. Selected data consumers for interview

Participant	Position	Experience (years)	Justification
P6	Paediatric consultant	+15	Main decision maker in patients' medical care
P7	Radiology consultant	+10	Data generator and decision maker in patients' medical care
P8	Paediatric consultant + assistant professor	+15	Main decision maker in patients' medical care
P9	Medical director	+10	Decision maker in policy and work regulations
P10	Emergency consultant	+10	Decision maker in a highly critical department
P11	Nurse	+13	Data generator due to direct involvement in patient medical care

The interviews featured confirmatory and exploratory questions about the data quality problems making up the each dimension. The Livescribe<sup>2</sup> pen was used as the tool for recording the interviews.

## 4.2 Data Analysis

Thematic analysis was used to analyse, identify and report the themes within raw data. The themes reflect the patterns within the collected data and the patterns that describe the phenomenon. Therefore, it is a method of organizing and describing a corpus in a way that helps researchers to capture important aspects describing their research questions (Aronson 1994; Braun & Clarke 2006).

As the interview questions revolved around data quality dimensions and their quality items, themes and sub-themes were dimensions while sub-themes addressed any related issues. To facilitate the qualitative data analysis, NVivo 10 software was used to theme the raw data. Each dimension was given a node, each node had certain characteristics and its quality items were clustered into 'confirmed', 'irrelevant', 'additional' and 'overlapping'. The next step was to code and to assign data in the transcript to related nodes.

<sup>2</sup> <http://www.livescribe.com/uk/>

### 4.3 Findings and Results

The proposed dimension-oriented data quality problems were discussed with experts and health professionals in order to confirm their relevance and to explore more quality problems that fall into dimensions as yet not covered by this taxonomy. The results and findings of the interviews were categorized into confirmed; irrelevant; overlapping; and additional items for each dimension.

#### 4.3.1 Accuracy

As discussed in the literature review, there are seven items that fall into the category of accuracy assessment, according to their implications on the definition of accuracy. These underwent preliminary refactoring and classification, and ended up under the accuracy metric. This would allow objective assessment of the quality of accuracy.

After analysing the semi-structured interviews with the experts and data consumers, all interviewees confirmed that the proposed quality items are sound measures and relevant to accuracy. They believe that these items do not overlap with any others in a particular dimension. One expert added that orphan data could represent a data quality problem that should be considered under ‘accuracy’.

#### 4.3.2 Consistency

The consistency quality items underwent a process of examination and refactoring to achieve a list of relevant and reliable measures of consistency. Table 4 highlights the outcome of the interviews analysis.

Table 4. Experts' findings for consistency

ID	P1			P2			P3			P4			P5		
	C	I	O	C	I	O	C	I	O	C	I	O	C	I	O
D8	✓			✓			✓			✓			✓		
D9	✓			✓			✓			✓			✓		
D10	✓			✓			✓			✓			✓		
D11	✓			✓			✓			✓			✓		
D12		✓	✓		✓		✓			✓			✓		
D13		✓			✓		✓			✓				✓	
D14	✓					✓	✓			✓			✓		
D15	✓			✓			✓			✓			✓		
D16		✓			✓		✓			✓			✓		
D17		✓			✓		✓			✓			✓		
D18	✓			✓			✓			✓			✓		
D19	✓			✓			✓			✓			✓		

C: Confirmed item                      I: Irrelevant item                      O: Overlapped item

The two physician team leaders (P3 and P4) confirmed that all quality items are relevant and sound measures for consistency. However, the two senior DBAs (P1 & P2) and an application analyst (P5) claimed that the item ‘referential integrity violation’ is not a consistency-related measure but is accuracy-related. Moreover, the two DBAs (P1 & P2) considered the items D12, D16 and D17 were sound measures of accuracy. One DBA expert claimed that the items of ‘wrong categorical data’ and ‘referential integrity violation’ overlap, as they address the same issue.

It is worth noting that the experts emphasized that the metric items of consistency are comprehensive and that they cover the required aspects to measure this dimension.



Although experts had many issues with regard to items that assess the quality of consistency, data consumers almost all agreed that these were good measures relevant to consistency. Moreover, they felt that there was no overlap between the quality items. However, one paediatric consultant claimed that ‘*contradicting records*’ and ‘*duplicated records*’ addressed the same problem, being caused by duplication. Another paediatric consultant did not consider the item ‘*inconsistent spatial data*’ was applicable to the EHR domain. The following quote supports this point:

Paediatric consultant: I am not sure whether it is applicable to our area.

It is worth noting that a medical director and an emergency consultant commented on an annoying problem with dual-language names. They expressed concern at the absence of any standard or protocol for translating Arabic names into English. This problem gives rise to different spellings of the same name. An emergency consultant highlighted this by stating:

We have a noticeable consistency problem with patients’ names as one family name could have many spellings in English. Many fatal incidents occurred here [were] caused by such consistency problem.

### 4.3.3 Completeness

Considering the phrases relating to the completeness metric, the responses showed agreement on its functionality and relevance; experts and data consumers gave the same response towards the proposed quality items of completeness.

### 4.3.4 Timeliness

Responses from both the experts and data consumers were almost entirely positive, aside from the second item. The two DBA experts considered that item ineffective, as the DBMS avoids such problem by update cascading. No overlap was detected within this metric and the experts did not add any items, believing it was sufficient.

## 5. DISCUSSION

The data quality problems were refactored and mapped against corresponding dimensions. Subsequently, the initial dimension-oriented data quality problems were discussed and validated with two groups, formed of experts and data consumers. Table 5 shows the final dimensions compromising data quality.

With regard to accuracy-related data quality problems, experts and data consumers confirmed that all items associated with accuracy are sound and relevant measures. They found no overlap among the proposed items. With regard to their sufficiency, they agreed on their adequacy for accuracy assessment, although some suggested additional items.

A senior DBA (P1) proposed orphan information as a quality problem that needs to be addressed. Orphan information (so-called ‘dangling data’) is caused by a problem known as ‘*Referential integrity violation*’, already present in items making up consistency assessment. The other two suggestions, data validation and type of dataset for assessment, are not quality problems.

Regarding consistency-associated, in relation to items associated with consistency there were many issues pointed out by the experts and data consumers. The first issue, suggested by technical experts, was that the item ‘*Referential integrity violation*’ belonged to the accuracy metric rather than consistency. This is true, as the root cause of this problem is that wrong data has been entered into the foreign-key field. Thus, this item was moved to the accuracy metric.

With regard to suggestions by two DBAs, the item ‘*Wrong categorical data*’ is not rationally accuracy-related, as claimed, but is associated with consistency as its value is not considered as an incorrect value but as a user-specified term. However, the two other items ‘*Contradicting records in single/multi source(s)*’ and ‘*Inconsistent spatial data*’ are indeed likely to be associated with accuracy, as claimed. This is due to the fact that these quality problems are triggered by incorrect data. The claim of ‘*Inconsistent spatial data*’ being inapplicable may be logical, but it cannot be omitted as it received no objection besides from a paediatric consultant.

It is worth noting that several professionals expressed concern at having different spellings for a single name. They had witnessed many incidents of this quality problem that had ended in serious danger due to inconsistent naming.

In the interviews of experts and professionals regarding the completeness dimension, all responded positively to completeness-related quality items. They agreed on them being adequate, relevant and comprehensive for completeness assessment.

With regard to timeliness-related quality problems, both experts and professionals responded positively in their interviews to timeliness-related quality items. However, the two DBAs considered the item ‘*Outdated reference*’ ineffective, as such problems can be avoided using RDBMS features. This may be true in an ideal situation, where all data sources enforce such features to allow cascading updates. However, the problem could arise as a result of integration with legacy systems, so it is recommended to keep this item within the category of timeliness-related.

The final result of the proposed taxonomy is displayed in Table 5.

Table 5. The taxonomy of dimension-oriented data quality problems for EHR

<b>Accuracy:</b> The extent to which registered data conforms to its actual value.	
1-	Illegal values due to invalid domain range
2-	Mis-spellings
3-	Misfielded values
4-	Embedded values
5-	Word transposition
6-	Wrong reference
7-	Erroneous entry
8-	Contradicting records in single/multi source(s)
9-	Inconsistent spatial data
10-	Referential integrity violation
<b>Consistency:</b> Representation of data values remains the same in multiple data items in multiple locations.	
11-	Violated attribute dependencies
12-	Uniqueness violation
13-	Naming conflicts in multi-source
14-	Structural conflicts in multi-source
15-	Wrong categorical data
16-	Violated attribute dependencies
17-	Duplicated records in single/multi data source(s)
18-	Different measure units in single/multi source(s)
19-	Syntax inconsistency
20-	Inconsistent name spelling
21-	Different representations due to use of abbreviation and cryptic values
22-	Different representations due to use of Alias/nickname
23-	Different representations due to use of encoding format
24-	Different representations due to use of special characters

---

**Completeness:** The extent to which data are of sufficient breadth, depth, and scope for the task at hand

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- 25- Missing data where Null-not-allowed constraint enforced
- 26- Missing data where Null-not-allowed constraint not enforced
- 27- Missing record
- 28- Ambiguous data due to incomplete context
- 29- Semi-empty tuple

**Timeliness:** The state in which data is up to date and its availability is on time.

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- 30- Outdated temporal value
  - 31- Outdated reference
- 

## 6. CONCLUSION AND FUTURE WORK

In this paper, a taxonomy of dimension-oriented data quality problems has been produced. Data quality problems were analysed and mapped onto the most common data quality dimensions found in the literature. Thus, the proposed taxonomy is concerned with identifying the problems from the perspective of quality dimensions. This will help health organizations to prioritize the data quality problems associated with the most desirable dimensions in the process of data quality assessment. Such a mechanism would facilitate the involvement of the data consumers at the assessment stage, as they are familiar with dimensions terminology but not other, related works.

Future work involves the development and deployment of severity factors, those that render quality problems more severe, into these data quality problems. These factors were clearly apparent from the interviews. Such a mechanism would help organizations to save time and money by prioritizing their most severe problems.

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# ARTIFICIAL NEURAL NETWORKS IN STROKE PREDISPOSITION SCREENING

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## ABSTRACT

On the one hand there are stroke events that cannot be avoid, which stem from unchangeable processes like aging, sex, family or medical history. In particular, elderly people have a higher risk of stroke, with almost 80% of strokes occurring in individuals over 60 years of age, and at an earlier age than in women, although women are catching up fast (in fact more women than men die from heart incidents). Stroke diseases have severe consequences for the patients and for the society in general, being one of the main causes of death. On the other hand these facts reveal that it is extremely important to be hands-on, being aware of how critical is the early diagnosis of this kind of diseases. Indeed, this work will focus on the development of a diagnosis support system, in terms of its knowledge representation and reasoning procedures, under a formal framework based on Logic Programming, complemented with an approach to computing centered on Artificial Neural Networks, to evaluate stroke predisposing and the respective Degree-of-Confidence that one has on such a happening.

## KEYWORDS

Stroke Disease; Healthcare; Knowledge Representation and Reasoning; Logic Programming; Artificial Neural Networks

## 1. INTRODUCTION

Stroke stands for a major health problem nowadays. Indeed, every year in the USA, about 850,000 people experience a new or recurrent stroke; mortality data from 2008 indicate that stroke accounted for 1 in 19 deaths in the USA (Go et al, 2014). The Framingham Study showed that 1 in 5 women and 1 in 6 men aged 55 to 75 years will experience stroke sometime during their life time (Seshadri et al, 2006). Although the incidence may be reducing in developed countries, it has been estimated that stroke mortality will double worldwide by 2020, owing to an ageing population and with an increasing incidence in developing countries. Stroke denotes a blood supply interruption that occurs in the brain. This interruption happens when a blood vessel is obstructed, causing an ischaemic event, or bursts, causing a haemorrhagic stroke. Being a major factor related with mortality, this disease is closely followed with the main purpose of preventing it from happening since, when diagnosed, it becomes less dangerous and more treatable, comparing with similar ones (Go et al, 2014). Among the risk factors associated with stroke, there are those that transport a higher threat. Some may be treated or controlled, like high blood pressure (Go, et al. 2014; Lindgren, 2014), smoking (Bhat et al, 2008; Shah and Cole, 2010; Lindgren, 2014), diabetes mellitus (Khoury et al, 2013; Lindgren, 2014), high blood cholesterol (Amarenco et al, 2008; Zhang et al, 2012; Lindgren, 2014), physical activity (Grau et al, 2009; McDonnell et al, 2013).

However there are those that cannot be controlled, such as age, i.e., older people have more tendency to stroke (Sealy-Jefferson et al, 2012; Go et al. 2014; Lindgren, 2014), gender (i.e., stroke is more common in men than in women), though more women die from strokes than men, and the mere fact of having suffered a

previous stroke represents an increased risk factor not controlled by any means (Kissela et al, 2012; Lindgren, 2014), ethnicity (Kissela et al, 2012; Sealy-Jefferson et al, 2012; Lindgren, 2014), among others.

The stated above emphasizes that it is difficult to make an early diagnosis of stroke predisposing, since it has to consider different conditions with intricate relations among them, where the available data may be incomplete, contradictory and/or default. In order to overcome these drawbacks, the present work reports the founding of a computational framework that uses knowledge representation and reasoning techniques to set the structure of the information and the associate inference based computational mechanisms. We will centre on a Logic Programming (LP) based approach to knowledge representation and reasoning (Neves, 1984; Neves et al, 2007), complemented with a computational framework based on Artificial Neural Networks (ANNs) (Cortez et al, 2004).

## 2. KNOWLEDGE REPRESENTATION AND REASONING

Many approaches to knowledge representations and reasoning have been proposed using the Logic Programming (LP) paradigm, namely in the area of Model Theory (Kakas et al, 1998; Gelfond and Lifschitz, 1988; Pereira and Anh, 2009), and Proof Theory (Neves, 1984; Neves et al, 2007). In this work it is followed the proof theoretical approach in terms of an extension to the LP language to knowledge representations and reasoning. An Extended Logic Program is a finite set of clauses in the form:

$$p \leftarrow p_1, \dots, p_n, \text{not } q_1, \dots, \text{not } q_m \quad (1)$$

$$?(p_1, \dots, p_n, \text{not } q_1, \dots, \text{not } q_m) \quad (n, m \geq 0) \quad (2)$$

where  $?$  is a domain atom denoting falsity, the  $p_i$ ,  $q_j$ , and  $p$  are classical ground literals, i.e., either positive atoms or atoms preceded by the classical negation sign  $\neg$  (Neves, 1984). Under this emblematic formalism, every program is associated with a set of abducibles (Kakas et al. 1998; Pereira and Anh, 2009) given here in the form of exceptions to the extensions of the predicates that make the program. Once again, LP emerged as an attractive formalism for knowledge representations and reasoning tasks, introducing an efficient search mechanism for problem solving.

Due to the growing need to offer user support in decision making processes some studies have been presented related to the qualitative models and qualitative reasoning in Database Theory and in Artificial Intelligence research (Halpern, 2005; Kovalerchuck and Resconi, 2010). With respect to the problem of knowledge representation and reasoning in Logic Programming, a measure of the *Quality-of-Information* (*QoI*) of such programs has been object of some work with promising results (Lucas, 2003; Machado et al. 2010). The *QoI* with respect to the extension of a predicate  $i$  will be given by a truth-value in the interval  $[0,1]$ , i.e., if the information is *known (positive)* or *false (negative)* the *QoI* for the extension of *predicate* $_i$  is 1. For situations where the information is unknown, the *QoI* is given by:

$$QoI_i = \lim_{N \rightarrow \infty} \frac{1}{N} = 0 \quad (N \gg 0) \quad (3)$$

where  $N$  denotes the cardinality of the set of terms or clauses of the extension of *predicate* $_i$ ; that stand for the incompleteness under consideration. For situations where the extension of *predicate* $_i$  is unknown but can be taken from a set of values, the *QoI* is given by:

$$QoI_i = 1/Card \quad (4)$$

where *Card* denotes the cardinality of the *abducible* set for  $i$ , if the *abducible* set is disjoint. If the *abducible* set is not disjoint, the *QoI* is given by:

$$QoI_i = \frac{1}{C_1^{Card} + \dots + C_{Card}^{Card}} \quad (5)$$

where  $C_{Card}^{Card}$  is a card-combination subset, with  $Card$  elements. The next element of the model to be considered is the relative importance that a predicate assigns to each of its attributes under observation, i.e.,  $w_i^k$ , which stands for the relevance of attribute  $k$  in the extension of  $predicate_i$ . It is also assumed that the weights of all the attribute predicates are normalized, i.e.:

$$\sum_{1 \leq k \leq n} w_i^k = 1, \forall_i \quad (6)$$

where  $\forall$  denotes the universal quantifier. It is now possible to define a predicate's scoring function  $V_i(x)$  so that, for a value  $x = (x_1, \dots, x_n)$ , defined in terms of the attributes of  $predicate_i$ , one may have:

$$V_i(x) = \sum_{1 \leq k \leq n} w_i^k * QoI_i(x)/n \quad (7)$$

allowing one to set:

$$predicate_i(x_1, \dots, x_n) :: V_i(x) \quad (8)$$

that denotes the inclusive quality of  $predicate_i$  with respect to all the predicates that make the program. It is now possible to set a logic program (here understood as the predicates' extensions that make the program) scoring function, in the form:

$$LP_{Scoring\ Function} = \sum_{i=1}^n V_i(x) * p_i \quad (9)$$

where  $p_i$  stands for the relevance of the  $predicate_i$  in relation to the other predicates whose extensions denote the logic program. It is also assumed that the weights of all the predicates' extensions are normalized, i.e.:

$$\sum_{i=1}^n p_i = 1, \forall_i \quad (10)$$

where  $\forall$  denotes the universal quantifier.

It is now possible to engender the universe of discourse, according to the information given in the logic programs that endorse the information about the problem under consideration, according to productions of the type:

$$predicate_i - \bigcup_{1 \leq j \leq m} clause_j(x_1, \dots, x_n) :: QoI_i :: DoC_i \quad (11)$$

where  $U$  and  $m$  stand, respectively, for "set union" and the cardinality of the extension of  $predicate_i$ . On the other hand,  $DoC_i$  denotes one's confidence on the attribute's values of a particular term of the extension of  $predicate_i$ , whose evaluation will be illustrated below. In order to advance with a broad-spectrum, let us suppose that the Universe of Discourse is described by the extension of the predicates:

$$f_1(\dots), f_2(\dots), \dots, f_n(\dots) \text{ where } (n \geq 0) \quad (12)$$

Assuming that a clause denotes a happening, such a clause has as argument all the attributes that make the event. The argument values may be of the type unknown or members of a set, or may be in the scope of a given interval, or may qualify a particular observation. Let us consider the following clause where the first argument value may fit into the interval [20,30] with a domain that ranges between 0 (zero) and 50 (fifty), where the second argument stands for itself, with a domain that ranges in the interval [0,10], and the value of the third argument being unknown, being represented by the symbol  $\perp$ , with a domain that ranges in the interval [0,100]. Let us consider that the case data is given by the extension of predicate  $f_1$ , given in the form:

$$f_1: x_1, x_2, x_3 \rightarrow \{0,1\} \quad (13)$$

where “{” and “}” is one’s notation for sets, where “0” and “1” denote, respectively, the truth values “false” and “true”. Therefore, one may have:

$$\{$$

$$\neg f_1(x_1, x_2, x_3) \leftarrow \text{not } f_1(x_1, x_2, x_3)$$

$$f_1(\underbrace{[20, 30], 5, \perp}_{\text{attribute's values for } x_1, x_2, x_3}) :: 1 :: DoC$$

$$\underbrace{[0, 50] [0, 10] [0, 100]}_{\text{attribute's domains for } x_1, x_2, x_3}$$

...

$$\}$$

Once the clauses or terms of the extension of the predicate are established, the next step is to set all the arguments, of each clause, into continuous intervals. In this phase, it is essential to consider the domain of the arguments. As the third argument is unknown, its interval will cover all the possibilities of the domain. The second argument speaks for itself. Therefore, one may have:

$$\{$$

$$\neg f_1(x_1, x_2, x_3) \leftarrow \text{not } f_1(x_1, x_2, x_3)$$

$$f_1(\underbrace{[20, 30], [5, 5], [0, 100]}_{\text{attribute's values ranges for } x_1, x_2, x_3}) :: 1 :: DoC$$

$$\underbrace{[0, 50] [0, 10] [0, 100]}_{\text{attribute's domains for } x_1, x_2, x_3}$$

...

$$\}$$

Now, one is in position to calculate the *Degree of Confidence* for each attribute that makes the term arguments (e.g. for attribute one it denotes one’s confidence that the attribute under consideration fits into the interval [20,30]). Next, we set the boundaries of the arguments intervals to be fitted in the interval [0,1] according to the normalization procedure given in the procedural form by  $(Y - Y_{min}) / (Y_{max} - Y_{min})$ , where the  $Y_s$  stand for themselves.

$$\{$$

$$\neg f_1(x_1, x_2, x_3) \leftarrow \text{not } f_1(x_1, x_2, x_3)$$

$$x_1 = \left[ \frac{20 - 0}{50 - 0}, \frac{30 - 0}{50 - 0} \right] \quad x_2 = \left[ \frac{5 - 0}{10 - 0}, \frac{5 - 0}{10 - 0} \right], \quad x_3 = \left[ \frac{0 - 0}{100 - 0}, \frac{100 - 0}{100 - 0} \right]$$

$$f_1(\underbrace{([0.4, 0.6], [0.5, 0.5], [0, 1])}_{\text{attribute's values ranges for } x_1, x_2, x_3 \text{ once normalized}}) :: 1 :: DoC$$

$$\underbrace{[0, 1] [0, 1] [0, 1]}_{\text{attribute's domains for } x_1, x_2, x_3 \text{ once normalized}}$$

...

$$\}$$



The *Degree of Confidence (DoC)* is evaluated using the equation  $DoC = \sqrt{1 - \Delta l^2}$ , as it is illustrated in Figure 1. Here  $\Delta l$  stands for the length of the arguments intervals, once normalized.

$$\{$$

$$\neg f_1(x_1, x_2, x_3) \leftarrow \text{not } f_1(x_1, x_2, x_3)$$

$$f_1(\underbrace{0.98, 1, 0}_{\substack{\text{attribute's confidence} \\ \text{values for } x_1, x_2, x_3}}) :: 1 :: 0.66$$

$$\underbrace{[0.4, 0.6][0.5, 0.5][0, 1]}_{\substack{\text{attribute's values ranges for } x_1, x_2, x_3 \\ \text{once normalized}}}$$

$$\underbrace{[0, 1] [0, 1] [0, 1]}_{\substack{\text{attribute's domains for } x_1, x_2, x_3 \\ \text{once normalized}}}$$

$$\dots$$

$$\}$$

where the *DoC*'s for  $f_1(0.98, 1, 0)$  is evaluated as  $(0.98+1+0)/3$ , assuming that all the argument's attributes have the same weight.

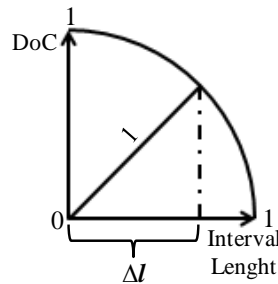


Figure 1. Evaluation of the Degree of Confidence.

### 3. A CASE STUDY

In order to exemplify the applicability of our approach to problem solving, we will look at the relational database model, since it provides a basic framework that fits into our expectations (Liu and Sun, 2007), and is understood as the genesis of the LP approach to Knowledge Representation and Reasoning (Neves, 1984).

As a case study, consider the scenario where a relational database is given in terms of the extensions of the relations depicted in Figure 2, which stands for a situation where one has to manage information about stroke predisposing risk detection. Under this scenario some incomplete and/or default data is also available. For instance, in the *Stroke Predisposition* database, the *Systolic Blood Pressure* in case 1 is unknown, while the *Risk Factors* range in the interval  $[1,2]$ .

The values presented in the *Lifestyle Habits* and *Risk Factors* columns of *Stroke Predisposing* database are the sum of the correspondent databases, ranging between  $[0,6]$  and  $[0,4]$ , respectively.

Now, we may consider the relations given in Figure 2, in terms of the *stroke* predicate, in the form:

$$\text{stroke: Age, Gender, PreviousStrokeEpisodes, BloodSystolicPressure, Cholesterol}_{LDL}, \text{Cholesterol}_{HDL},$$

$$\text{Triglycerides, LifestyleHabits, RiskFactors} \rightarrow \{0,1\}$$

where 0 (zero) and 1 (one) denote, respectively, the truth values *false* and *true*. It is now possible to give the extension of the predicate *stroke*, in the form:

```

{
  ¬stroke(Age, Gen, PSE, BSP, CholLDL, CholHDL, Trigly, LH, RF)
      ← not stroke(Age, Gen, PSE, BSP, CholLDL, CholHDL, Trigly, LH, RF)

  stroke(
      (
          69, 0, 1, ⊥, 131, 49, 200, 4, [1,2]
          attribute's values
      ) :: 1 :: DoC
      [22,95][0,1][0,1][70,200][50,250][20,90][90,600][0,6][0,4]
      attribute's domains
  )
  ...
}

```

In this program, the first clause denotes the predicate *stroke* closure. The next clauses correspond to patient 1, taken from the extension of the *stroke* relation presented in Figure 2. Moving on, the next step is to transform all the argument values into continuous intervals and then normalize the predicate's arguments in order to obtain the *Degree of Confidence* of any clause or term of the extension of the *stroke* predicate. One may have:

```

{
  ¬stroke(Age, Gen, PSE, BSP, CholLDL, CholHDL, Trigly, LH, RF)
      ← not stroke(Age, Gen, PSE, BSP, CholLDL, CholHDL, Trigly, LH, RF)

  stroke(
      (
          1, 1, 1, 0, 1, 1, 1, 1, 0.968
          attribute's confidence values
      ) :: 1 :: 0.885
      [0.64,0.64][0,0][1,1][0,1][0.4,0.4][0.41,0.41][0.22,0.22][0.67,0.67][0.25,0.5]
      attribute's values ranges once normalized
      [0,1] [0,1][0,1][0,1] [0,1] [0,1] [0,1] [0,1] [0,1]
      attribute's domains once normalized
  )
  ...
}

```

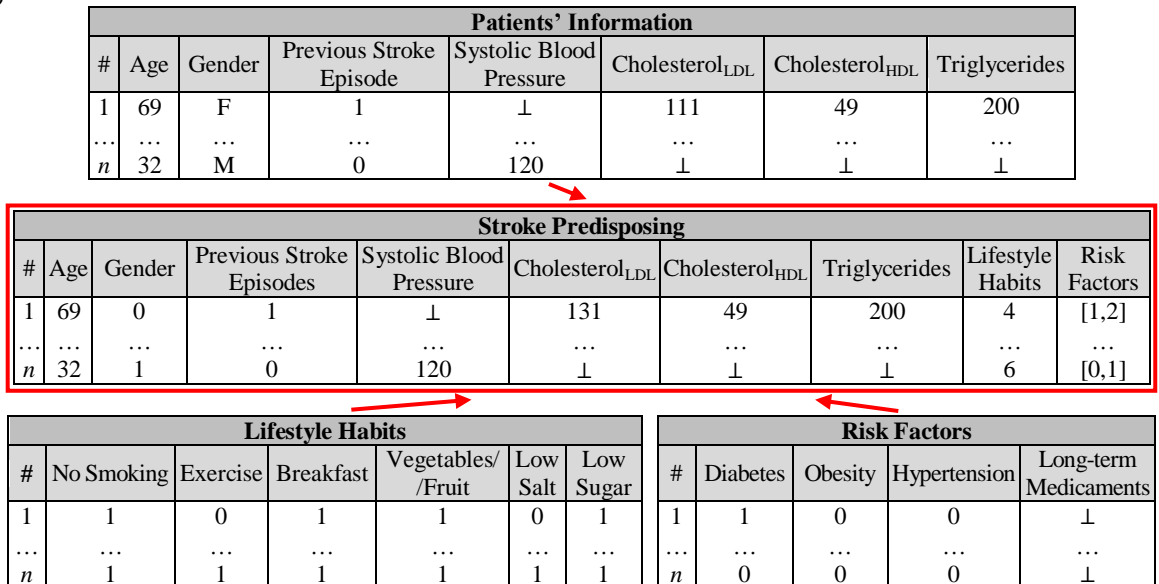


Figure 2. An Extension of the Relational Database Model. In *Previous Stroke Episode* column of *Patients' Information* database 0 (zero) and 1 (one) denote, respectively, *nonoccurrence* and *occurrence*. In *Lifestyle Habits* and *Risk Factors* databases 0 (zero) and 1 (one) denote, respectively, *yes* and *no*. In *Gender* column of the *Stroke Predisposition* database 0 (zero) and 1 (one) stand for, respectively, for *female* and *male*.

where its terms make the training and test sets of the Artificial Neural Network given in Figure 3.

#### 4. ARTIFICIAL NEURAL NETWORKS

Several studies have shown how Artificial Neural Networks (ANNs) could be successfully used to model data and capture complex relationships between inputs and outputs (Caldeira et al, 2011; Vicente et al, 2012; Salvador et al, 2013). ANNs simulate the structure of the human brain being populated by multiple layers of neurons. As an example, let us consider the last case presented in Figure 2, where one may have a situation in which an evaluation of stroke predisposing is needed, and given in the form:

$$\begin{aligned}
 & \{ \\
 & \quad \neg stroke(Age, Gen, PSE, BSP, Chol_{LDL}, Chol_{HDL}, Trigly, LH, RF) \\
 & \quad \quad \leftarrow not\ stroke(Age, Gen, PSE, BSP, Chol_{LDL}, Chol_{HDL}, Trigly, LH, RF) \\
 & \quad stroke\left(\underbrace{32, 1, 0, 120, \perp, \perp, \perp, 6, [0,1]}_{attribute's\ values}\right) :: 1 :: DoC \\
 & \quad \quad \underbrace{[22,95][0,1][0,1][70,200][50,250][20,90][90,600][0,6][0,4]}_{attribute's\ domains} \\
 & \quad \dots \\
 & \quad \}
 \end{aligned}$$

According to the formalism presented above, once the transition to continuous intervals is accomplished, it is possible to have the arguments of the *stroke* predicate's extension set to the interval  $[0, 1]$  in order to obtain the *Degree of Confidence* of any clause or term of such an extension, which will be given in the form:

$$\begin{aligned}
 & \{ \\
 & \quad \neg stroke(Age, Gen, PSE, BSP, Chol_{LDL}, Chol_{HDL}, Trigly, LH, RF) \\
 & \quad \quad \leftarrow not\ stroke(Age, Gen, PSE, BSP, Chol_{LDL}, Chol_{HDL}, Trigly, LH, RF) \\
 & \quad stroke\left(\underbrace{1, 1, 1, 1, 0, 0, 0, 1, 0.97}_{attribute's\ confidence\ values}\right) :: 1 :: 0.66 \\
 & \quad \quad \underbrace{[0.14,0.14][1,1][0,0][0.38,0.38][0,1][0,1][0,1][1,1][0,0.25]}_{attribute's\ values\ ranges\ once\ normalized} \\
 & \quad \quad \underbrace{[0,1] [0,1][0,1] [0,1] [0,1][0,1][0,1][0,1] [0,1]}_{attribute's\ domains\ once\ normalized} \\
 & \quad \dots \\
 & \quad \}
 \end{aligned}$$

In Figure 3 it is shown how the normalized values of the interval boundaries and their *DoC* and *QoI* values work as inputs to the ANN. The output translates the stroke predisposition evaluation and the confidence that one has on such a happening. In addition, it also contributes to build a database of study cases that may be used to train and test the ANNs.

In this study 250 patients (i.e. two hundred and fifty terms or clauses that make the extension of the *stroke* predicate) were considered, with an age average of 57 years, ranging from 31 to 87 years old. The gender distribution was 47% and 53% for female and male, respectively.

To ensure statistical significance of the attained results, 20 (twenty) runs were applied in all tests. In each simulation, the available data was randomly divided into two mutually exclusive partitions, i.e., the training set with 67% of the available data and the test set with the remaining 33% of the cases. The back propagation algorithm was used in the learning process of the ANN. As the output function in the pre-processing layer it was used the *identity* one. In the others layers was used the *sigmoid* function.

The model accuracy was 97.6% for the training set (164 correctly classified in 168) and 95.1% for test set (78 correctly classified in 82).

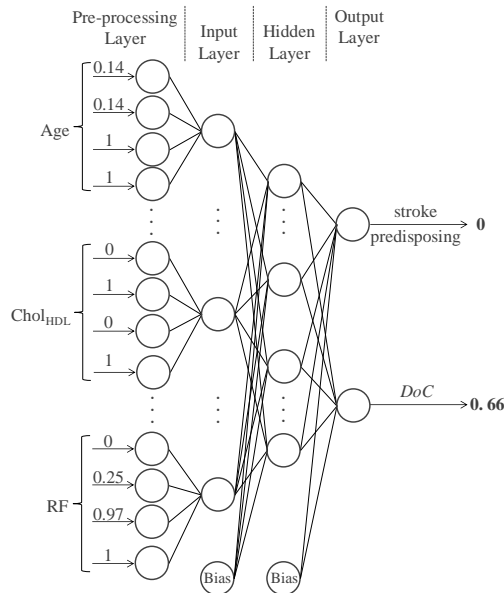


Figure 3. The Artificial Neural Network topology.

## 5. CONCLUSIONS AND FUTURE WORK

Diagnosing stroke predisposing has shown to be a hard task, once the argument values of the extensions of the predicates that as an ensemble describe the disorder, are not fully represented by objective data. These characteristics put this problem into the area of problems that may be tackled by Artificial Intelligence based methodologies and techniques to problem solving.

Indeed, this work presents the founding of a consistent framework that uses powerful and unprecedented knowledge representation and reasoning techniques to set the structure of the information and its computational mechanisms. This finding takes as its genesis:

- Data is not equal to information;
- The translation of the raw measurements in terms of incomplete, unknown, and even contradictory information, into interpretable and actionable read-outs is challenging; and
- Read-outs can deliver markers and targets candidates without pre-conception, i.e., knowing how personal conditions and risk factors may affect the liver disease predisposition.

Indeed, this method brings a new approach that can revolutionize prediction tools in all its variants, making it more complete than the existing methodologies and apparatuses available for problem solving. It must be emphasize that this approach to knowledge representation and reasoning enables one to use the normalized values of the interval boundaries of the clauses or terms arguments that make the extension of the *stroke* predicate and their DoC values, as inputs to the ANN (as numbers that bring with themselves some degree of incompleteness). The output translates a patient's stroke predisposing risk and the confidence that one has on such a happening.

Future work may recommend that the same problem must be approached using others problem solving and computational frameworks like Case Based Reasoning (Carneiro et al, 2013), Genetic Programming (Neves et al, 2007) or Particle Swarm (Mendes et al, 2004), just to name a few.

## ACKNOWLEDGEMENTS

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# **FUTURE LOCATION OF HOSPITAL SERVICES ANALYSIS OF A NEWSPAPER DEBATE**

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## **ABSTRACT**

In spite of a Government initiated initiative to reshape the public hospital structure in Norway due to pass Parliament in the autumn session 2015, Sørlandets Sykehus Helseforetak (SSHF, a local public health enterprise) has already started planning the future hospital structure and services to be provided in their three hospitals for the inhabitants in their service area in the year 2030. Presentation of plans has led to a newspaper debate especially in the newspapers in the communities where today's hospitals are suggested degraded to lower levels of service. Applying a case study approach this research finds that arguments presented in the newspapers cannot be explained by New Public Management or Public Value theory. The study finds a lack of attention to future technological innovations in e-health and their possible influences on location of hospital services and therefore suggests that possible future development in e-health and their consequences for future location of hospitals in the service area of SSHF is included in the planning process.

## **KEYWORDS**

New Public Management, Public Value, Organizational and technological development, e-health.

## **1. INTRODUCTION**

The Norwegian health and care sector is, continually, undergoing large changes for several reasons: development and use of more advanced technology for treating serious illnesses with better results, quest for better quality in hospital treatments, an aging population increasing the need for hospital treatments, a cry for more hands in the health and care sector, and increasing cost in public hospital sector. New Public Management (O'Flynn, 2007) and Public Value (Moore, 1995) are theoretical moves for better management of the public sector supposedly answering a call for continued innovation in the sector (Hallén, 2013). Innovations in the e-health sector are gaining speed increasing the use of technology in the sector.

SSHF, the public health enterprise for Aust-Agder and Vest-Agder counties has initiated a planning process for future hospital structure and provisions of health and care services offered to inhabitants in the year 2030. Plans are presented for people living in the three cities where the SSHF's hospitals are located at present. The plans have received much attention and given rise to a rather heated newspaper debate.

The purpose of this paper is to analyze the newspaper debate answering the following research question: How may a newspaper debate about a strategic planning project for future possible changes in location of hospitals be understood through New Public Management doctrinal components and principles, Public Value's key positions and components and the importance of e-health related to the plans?

## **2. LITERATURE REVIEW**

Public sector is searching for ways to improve health and care services and make them more efficient and cost effective. Different theories have been presented as helping hands in the above mentioned search for efficiency and effectiveness in public sector.

## 2.1 Theories for Efficient and Effective Public Sector

New Public Management (NPM) (O'Flynn, 2007) has been sought implemented in public sector as an alternative to more traditional models of public administration and traditional bureaucracy (Hood, 1991). NPM includes 7 key doctrinal components (Hood, 1991, p. 4-5): 1, Hands-on professional management, 2, Explicit standards and measurements of performance, 3, Greater emphasis on output controls, 4, Disaggregation of units in the public sector, 5, Greater competition in the public sector, 6, Private sector styles of management practice, and 7, Greater discipline and parsimony in the resource use.

Fifteen years after Hood (1991)'s publication Hughes (2006) characterized NPM along four axes: 1, management is a higher order function than administration, 2, economic principles can assist public management, 3, modern management theory and practices can improve public management, and 4, service is important to citizens (Hughes, 2006, referred in Hood, 1991, p. 354). The NPM concept does provide doctrinal components and principles as shown (Hood, 1991, Hughes 2006) but does not provide any leads for developing and using technology.

Implementing NPM brought some challenges to public sector (O'Flynn, 2007). Moore (1995) therefore suggested Public Value for understanding public sector and describing the relationship between public servants/leaders and the public/citizens. Moore (1995)'s strategic triangle suggested that operational and administrative capabilities, values, and goals and mission must be aligned to create public value. Stoker (2006) suggested four key positions to define public value: 1, public interventions are defined by the search for public value, 2, many stakeholders have legitimacy and should be included and involved in public activities, 3, an open minded relational approach to procurement should be adapted in each situation, and 4, public services delivery needs to adapt a learning-based approach.

Kelly et al (2002) referred in O'Flynn (2007) prepared some suggestions for UK Cabinet Office containing three key components related to public value: 1, service provides the vehicle for delivering public value through service encounters with users or clients focusing fairness, equality and associated value for the citizens, 2, outcomes should be considered serving a much higher purpose than just the service itself, and 3, trust, legitimacy and confidence in government is vital to provide citizens' confidence in the public sector's provisions of public value. According to Kelly et al (2002) these three elements of public value will give public officials a possible new way of thinking or guiding their activities and decisions to create public value.

## 2.2 Technological Innovations

NPM and Public Value do not include concepts about technology use in public sector. The increased pace of technological innovations in the health sector challenges the sector and will revolutionize the health and care sector in the years to come: keyhole technology has opened for outpatient treatment reducing hospital time and cost; possibilities for patients to stay at home while being treated; medicine that can report its own effect in the patients, or body near technology including Internet on Things (IoT)/wearables were mentioned at the South by South West conference in March 2014.

## 2.3 Organizational Changes and Technical Innovations and Development

Developing and using e-health systems is intimately related to changes in the organization, the routines or the ways of performing work, and the use of the IT/IS systems. Failures in developing and implementing information systems (Lucas, 1975) has been coined in many ways as escalation of software projects (Keil et al, 2000), problems and practices that persist in information systems development (Kautz et al, 2007), organizations experience learning failures, including both fail to learn and learn to fail (Lyytinen and Robey, 1999) or paradigmatic mismatches and drifts in method deployment (Päivärinta et al, 2010).

The challenges do not diminish when information systems are to be developed and deployed successfully in the health and care sector since the sector is complex with several layers of actors i.e. the RGP doctors and the specialist level i.e. hospitals and specialist treatment. The people working in the sector are also generally patient-orientated meaning that the care for the patients is an important value. How may the health and care sector including the hospitals find an acceptable balance between implementing e-health systems and IoT/wearable technologies and keeping the patient in the focus for the care? Hospitals using e-health systems need to consider and understand the relationships between people and e-health systems (Nurminen, 1988)



since such understanding, “worldview”, will influence the use of them and will be important for furthering organizational strategies and reaching organizational objectives.

Changes, organizational and/or technical, are basically development processes (Pillay et al, 2012) and are prone to possible failures even more in the complicated health and care sector. Pillay et al (2012) therefore developed a four phased experiential learning model for implementing change strategies: planning, leadership, learning and culture. Informed change is supposed to take place in interaction with the four elements through to experiential theorizing on the individual, the team and the organizational level. Changes in the teams or in the organization depends on change in the individual, the influences between individuals, and between individuals and context for a change “in-action” can take place and become more than an espoused change. Understanding such change may be even more important as patients are learning more about their illnesses challenging the health and care sector to rethink their services in radical ways.

### 3. RESEARCH METHOD

A case study approach was chosen since such approach is appropriate to answer questions related to the phenomenon studied (Benbasat et al, 1987) and is a preferred research strategy in explorative research (Yin, 2014) where phenomenon studied is in its natural setting focus on contemporary events (Benbasat et al, 1987 Yin, 2014). Furthermore this study does not control or manipulate events in the case studied or participate in the newspaper discussion (Benbasat et al, 1987, Yin, 2014).

The case studied a newspaper debate where the general public, two newspapers, employees in two hospitals, management of SSHF and politicians discussed a strategic plan and the planning process for locating future hospitals and services in Aust-Agder and Vest-Agder counties. Vest-Agder county (160 000 inhabitants) has two public hospitals, Kristiansand Hospital, the largest, situated in Kristiansand (85 000 inhabitants) and the smaller Flekkefjord Hospital located in Flekkefjord (10 000 inhabitants). Kristiansand Hospital provides the most advanced specialist treatment and serves as the local hospital for the Kristiansand area, while Flekkefjord hospital serves as a local hospital for the Lister area (consisting of 6 municipalities in western Vest-Agder) and for some local municipalities in the south-eastern part of the neighboring county Rogaland. SSHF is part of the South-Eastern Regional Health Authority. The slogan for SSHF is “Safety when you need it most” (“Trygghet når du trenger det mest”). The distance between Kristiansand Hospital and Flekkefjord Hospital is 108 km by road.

Data was collected through reading all articles/entries about the strategic plan published in two newspapers, the daily regional paper *Fædrelandsvennen* (Kristiansand) and the local newspaper *Agder Flekkefjord Tidende* (Flekkefjord, three issues a week) in the period from March 12th 2014 through to May 9th 2014. *Fædrelandsvennen* published 9 entries whereof 2 were editorials, 6 written by newspapers journalists and one special entry about use of technology in the hospital sector, and a general comment on e-health published in several Norwegian newspapers. *Agder* published 30 entries whereof 1 was Editorial, 17 were written by journalists of the newspaper, 8 were written by readers of the newspaper, and 4 containing general information.

### 4. CASE DESCRIPTION

The main actors in the planning process were: a project manager based in the central management of SSHF in Kristiansand, the Chief Executive of SSHF and the Board of SSHF. The Chair of the SSHF Board is also a Chief Municipal Executive in Kvinesdal Municipality, neighboring Flekkefjord while the Deputy Chair is a Labor Party politician and a former Mayor of Kristiansand, living in Kristiansand. The two might therefore be in a squeeze between local interests, county level interests and central government interests in the case. A commoner criticized Kvinesdal Municipality for allowing the double role of the Chief Officer in Kvinesdal Municipality being the Chair of the SSHF Board fearing that she would not give full support for keeping Flekkefjord Hospital running. The double role of the Deputy Chair was not problematized. One of the Board members was from Flekkefjord and was very active raising support for Flekkefjord hospital in the Board and in the newspaper debate. The financial director of the SSHF was in a way setting the background for the

debate foreseeing that an explosive growth in the so-called high-cost medicine and high-cost patients' treatment will further fuel the hospital location discussion.

Many people participated in the newspaper debate. The project manager and the Chief Executive of SSHF were mostly giving information and supporting each other. The Chief Executive expressed his trust in the project manager and the project manager stated that the plans were proposals that were to be debated.

Several of the participants in the debate were MPs in the Norwegian Parliament ("Stortinget"). The county of Vest-Agder has two Labor Party MPs, one from Kristiansand and one from Kvinesdal. The MP from Kvinesdal is a former mayor of Kvinesdal Municipality. He wanted the planning process "frozen" and brought the hospital location plan to the attention of all MPs in Parliament requesting, unsuccessfully, the Minister for Health and Care Services to clarify the present government's plans for the future hospital structure in Norway. The Minister referred to the government's report on the future national structure of health and care services due 2015. The MP argued further that Flekkefjord Hospital was important for the Lister area (Flekkefjord and surrounding municipalities) and some municipalities from the neighboring county Rogaland receiving support from a Labor Party politician Rogaland county.

Politicians were constantly challenging the political leaders in the Flekkefjord area to give more attention to the hospital location strategy plan and to promote Flekkefjord Hospital complaining that political leaders in Flekkefjord were more or less "...invisible in the hospital case".

The Standing Committee on Health and Care Services in the Parliament arranged an open hearing about the plans for the future hospital structure in the two Agder Counties especially for emergency units and maternity wards. The chairman of the committee, a Socialist Left Party MP, invited and received input from Flekkefjord area. He wanted to stop the strategy plan for SSHF until central government had issued their report on the future hospital structure. "He (the chairman of the committee) is pushing the pause button" was the heading of one newspaper entry. However, some days later Agder informed that the Secretary of Health and Care had no intention of stopping the planning process in SSHF.

Several MPs from the Socialist Left Party argued that it was unwise to close down local hospitals that function well like Flekkefjord Hospital. One MP expressed her frustration of how the public hospital sector was organized and suggested that the Parliament should revert to the old system with direct central government control of public hospitals.

Consequences for the local communities were debated especially the locations of the emergency units and the maternity wards. Should such wards be located in Kristiansand Hospital (centralized) or should both hospitals have their own wards? An argument for keeping the wards local was early treatment of patients in need. An emergency drill performed in Flekkefjord visualized consequences for patients injured in a car accident without an emergency ward in the vicinity. The leader of the ambulance service in Flekkefjord stated that without an emergency ward in Flekkefjord patients would die in ambulances or helicopters on their way to emergency treatment in Kristiansand. People felt more secure with emergency units and maternity wards available locally. Counteracting such arguments were suggestions that more video conference equipment could make necessary treatment competence available to Flekkefjord Hospital online from Kristiansand Hospital.

One line of arguments by the newspaper Agder was to present successes of Flekkefjord Hospital like: the hospital is very good on hygiene and the maternity ward was praised by patients. To further increase political pressure on location planning Agder reported on a Torchlight protest in Flekkefjord with 5000 participants.

People in Flekkefjord were eagerly searching for mistakes, faulty information and inconsistency in the documents produced by the project manager leading to the SSHF Board's decision to prolong the deadline for comments to the strategy plan a second time and to ask the Director of SSHF to go through the critical comments that had been given especially directed towards the strategy planning process.

Some writers referred a report developed on behalf of a national interest organization for local hospitals arguing that small hospitals are as good as larger, that smaller local hospitals are not more expensive than larger, and that the small hospitals provide equal if not better quality health services than larger hospitals. The report criticized the strategy processes for being too shallow, not providing reliable figures for financial advantages or improved quality for services given in larger hospitals, or listening to people that use local hospitals. One writer suggested that the planning process in SSHF lacked democratic foundation and criticized the Minister of Health and Care Services for not listening to people's voices in the hospital location discussions.

As a curiosity, in the period studied the newspaper Fædrelandsvennen published "Synspunkt" (View Point) with the title "Mail me, doctor!" co-written by a researcher in the Norwegian Centre of Integrated Care

and Telemedicine and a Senior Advisor. The writers discussed a possible future technical revolution in e-health solutions. In the same period an Oslo-based newspaper, Dagbladet (10.03.2014), published news from the South by South-West conference in USA using the ingress “Meet your new RGP (fastlege): yourself”. The article contained information on trends within e-health as described in section 2.2 above including use of DNA-profiles in future health treatment and IoT/wearables that can report continually information on the patient and possible give medicine or other treatment on the spot without entering a hospital. The newspaper Dagbladet concluded that a gigantic health revolution has started; for the general public, for the RGPs, for the health services, for the politicians within health and care, and the society at large. No mentioning or discussion of consequences of technological advances for future hospital location and services was found in the newspaper entries studied in this case. Even if technology and e-health was not directly mentioned in the debate the discussion on quality of services did imply both use of technology and competence present in the hospitals.

If a hospital treats too few patients with special deceases the patients should be transferred to larger hospitals to ensure the competence of doctors and nurses in the treatment exemplified by a debate on stroke treatment. A medical director in SSHF stated that the three stroke treatment centers in SSHF (one in each hospital) did not satisfy new international standards and suggested that all stroke treatment is centralized to Kristiansand Hospital to comply with international standards for such treatment while a group in SSHF discussing the same disagreed internally where representatives from Kristiansand support the directors suggestion and the representatives from Arendal and Flekkefjord opposed the suggestion for medical reasons.

Some writers are afraid that services at the local hospitals will be reduced over time leaving the local communities without hospitals and fear the consequences at large for the local communities. One writer is discussing the advantages and disadvantages for patients travelling to the local versus the central hospital related to the quality of service and stress for the patients.

## 5. CASE ANALYSIS

### 5.1 Analysis using NPM

Analyzing the case follows the 7 key doctrinal components mentioned by Hood (1991):

1. *Hands-on professional management*

SSHF has hands-on professional management. The project manager is professional and is supported by the Chief executive of SSHF. The Board of SSHF does not voice strong criticism of the management.

2. *Explicit standards and measurements of performance* were not directly discussed in the debate

3. *Greater emphasis on output controls* were not directly discussed in the debate.

4. *Disaggregation of units in the public sector*

The political reform in the hospital sector originally promoted disaggregation of units by establishing regional and sub-regional health enterprises bringing health services out of political control. The present trend nation-wide seems to be towards larger units reversing former disaggregation contradicting this NPM-principle related to future public medical services. The main argument from the project leader is that ‘quality-in-the-services’ is difficult to provide in smaller units.

5. *Greater competition in the public sector*

Centralization leading to one hospital or centralized hospital services will not lead to greater competition county-wise. On a national level, however, it may lead to greater competition as the hospital in Kristiansand may strengthen its competence in special areas of service.

6. *Private sector styles of management practice*

This principle is in force in SSHF. The management is private sectors styled with the Chief Executive of the SSHF being responsible to a Board. The private sector style of management was, however, indirectly challenged in the newspaper discussion. Politicians suggested more political control. Ordinary people did the same as they called on politicians to influence the strategy planning process through political channels. From the newspaper entries it seems that both politicians, reporters in the newspapers and the general public do not understand that through this NPM principle the politicians gave away their power to the SSHF Board.

7. *Greater discipline and parsimony in the resource use*

This principle may be seen as a driver for the centralization process as it focuses on saving money for SSHF especially by centralizing the costly emergency units and maternity wards. However, this principle only considers the cost for SSHF. In a wider societal view some entries argued that a local hospital has an important role in the local community for employment, cost of travel, and safety for the inhabitants.

To widen the understanding of the case the four conceptual axes (Hughes, 2006) presented in chapter 4 are used in the following analysis starting with axis 1.

1. *Management as a higher order function than administration* is giving the board and the Chief Executive of SSHF more room for maneuvering and having more power in the daily business of running the hospitals in SSHF. However some of the entries wanted to introduce more political control with the HFs in Norway reducing the power of the Board and the Chief Executive.
2. *Economic principles can assist public management* is certainly in operation in this case and, at the same time provide some of the challenges or problems in this case. Measuring the economic principles against SSHFs slogan “Safety when you need it most” is certainly challenging and not included in the present strategy plan for 2030 as the plans seems to focus on SSHFs cost only, not the cost at large.
3. *Modern management theory and practices can improve public management* is certainly hoped for by many of the people participating in the debate. However, the word “can” in this axis provides no criteria for measuring improvements. It is therefore difficult to conclude on this axis as the evaluation criteria seems to be differing amongst the writers.
4. *Service is important to citizens* is important, but presents the same challenges as the third axis because citizens have different opinions of what health services they want. Furthermore some participants in the debate and the planning processes may have conflicting roles as the Chair of the SSHF Board that is also Chief Municipality Executive in Kvinesdal Municipality.

Surprisingly only one entry about e-health and use of technology was published in the period of the study and provided information on the race for inventions in the health sector gaining speed as described in section 2.2 and chapter 4.

## 5.2 Analysis using Public Value

Analyzing the case from the four key positions defining the public value paradigm (Stoker, 2006) may contribute to an even greater understanding of the case:

1. *Public interventions are defined by the search for Public Value*  
SSHf seems to argue that Public Value in this case is the quality of the treatment in the future hospital(s) not mentioning other future consequences of the plans. However, as SSHf is organized at present the general public has no direct possibilities for intervening in the processes. From the data in the case it seems that the public disagree with SSHf in what is Public Value.
2. *Many stakeholders have legitimacy and should be included and involved in government activities*  
SSHf management structure is outside political control except for hiring or firing the Boards in the Regional Health Authorities. This political decision reduces considerably the number of stakeholders that can influence the planning process directly. Possibilities for influence are mainly indirect through the “commenting process” on the plans, through public opinion in the newspaper debate, and direct to the members of the Board. In this case the principle was not catered for. However, it is also important that the citizens actively take part in consultations and surveys (Horner and Hazel, 2005).
3. *An open minded relational approach to procurement should be adapted*  
Decisions on hospital location have important implications for the communities where the hospitals are located as procurement in a wide context includes the need for employees, procurement of goods locally and investment that may open work opportunities locally. A local hospital is more important for the smaller communities than for the bigger as it often will be a large employer.
4. *Public services delivery needs to adapt a learning-based approach*  
Some learning-based approach was found in the case data. The time limits for receiving comments were postponed twice. However, concerning the realities of the plan, no or little learning-based approach was seen. The reason may simply be that the period of study was too short.  
Kelly et al (2002)’s view of Public Value relates to the case analysis as follows:

1. *Service provides the vehicle for delivering public value through service encounters delivered on fairness, equality and associated value for citizens.*  
This point is challenged directly in this case. Which users and/or citizens should be served and what service should they receive? Users of hospital services want ordinary good service where they live and the best quality of treatment for severe illness at specialized hospitals. To find a good balance between the different interests may be difficult in a county that is partly sparsely populated.
2. *Outcomes should be considered serving a much higher purpose than just the service itself.*  
This point collides directly with intentions from SSHF's location of future hospital services. A hospital creates considerable advantages for the society where it is located exemplified with income tax, value of local procurements, a general optimism and willingness for well educated people to move and live there.
3. *Trust, legitimacy and confidence in government is vital to provide citizens' confidence*  
These three elements will provide government officials a possible new way of thinking or guiding their activities and decisions to create public value. However, the challenge for the SSHF's officials may be that the citizens to be served have different opinions of what it means to be served.

## 6. DISCUSSION

This research seeks to understand how a newspaper debate about a strategic planning project for future possible changes in location of hospitals may be understood through New Public Management doctrinal components and principles, Public Value's key positions and components and the importance of e-health related to the plans.

The participants in the discussion have different interests in future localization of hospitals in Vest-Agder. Using the 7 key doctrinal components of NPM (Hood, 1991), the four axes (Hughes, 2006), the four key positions of PV (Stoker, 2006) and the three key components related to public value (Kelly et al, 2002) to analyze the case for understanding the case do not render any definite answers. The analysis reveals that the different stakeholders have different interests in the situation and that the different interests do not consider the theories of NPM or PV when arguing for their points of view. Data does not render any differences in the debate or newspaper entries if they are written or argued by politicians rather than ordinary people.

The analysis presented in sections 5.1 and 5.2 shows that the newspaper debate can partly be understood by the components of NPM and Public Value. Many of the components of NPM are found in SSHF's organization and actions. However, a striking feature of the debate is that some participants seems to operate generally at will and do not understand the consequences of using NPM as a theory of making public sector more efficient. Even politicians and MPs seem not to understand what NPM mean when implemented in practice. It may however be reasonable to anticipate that the politicians especially the MPs understand, but they act politically in the debate hoping that political activity may overrule the implemented NPM concepts or that they at least gain some political favors with the voters in the next election.

The same considerations may be applicable to the Public Value concept. Even though the theory of Public Value came as a reaction to NPM the consequences in this case is not that different as the hospital management is running a health enterprise outside of political control except for the hiring and firing of the board of the regional health enterprises.

There seems to be a lack of understanding in the debate of governmental responsibilities and where to draw the borders for direct governmental intervention. Different stakeholders in the process have different opinions of the situation. This seems obvious and cannot be solved by introducing NPM or Public Value concepts alone. The SSHF officials are considering the quality of hospital services while some politicians and the general public seem to be occupied with their own interests. A suggestion may be that the SSHF Board could clarify their positions by following the Framework Model of value drivers efficiency, democracy and effectiveness when making strategic plans (Kelly et al, 2002) to improve their planning process and get a broader consideration of the interests involved in the future results for the planning process if possible.

Since few national standards for hospital health services and availability of services to the citizens are present the discussion may go on forever. It is reasonable to anticipate that in the end money/funds will have the final say. Funds are granted by the Parliament which is possible to influence through public activity, protests etc. and through the ballot box.

The most surprising finding is that the debate did not include future technological development of e-health equipment and treatment made possible by such equipment. Such equipment including IoT/wearables may have a much larger impact on both hospital locations and treatment of patients than the sum of all arguments aired in the debate studied. Hopefully the planning process will incorporate the technological development to prepare for the best treatment for future patients in the Agder counties. Theory on the relationships between organization and technology (Nurminen, 1988), the importance of considering the possibilities for failure in the development e.g. (Lyytinen and Robey, 1999), the learning opportunities in technological and organizational development (Argyris, 1977), or the change and contextual factors (Pillay et al, 2012) seem invisible in the debate. It would be reasonable to anticipate that the Board of SSHF and the project leader were occupied with these aspects of the localization debate.

## 7. CONCLUSION

This case study seeks to understand a newspaper debate on future location of hospital(s) in Vest-Agder by analyzing the debate using NPM and PV lenses and questioning the need for organizational and technological development for hospital services provided 2030. It is not possible to understand the debate by analyzing it by using the lenses mentioned. The two lenses provide some understanding of the debate; the most important seems to be that the people that participate in the debate act from their own interests. In situations where participants in the debate have different roles some people air concern that participants will misuse their roles to close down Flekkefjord Hospital. The debate lacks a futuristic view, specifically related to future technological revolution in the health and care sector, and therefore seems, from the SSHF's perspective, to concentrate on the quality of the services to be provided without providing measures for the quality.

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# REDEFINING TRAVELLER TYPES TO ENABLE BESPOKE TRAVEL INFORMATION SOLUTIONS

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## ABSTRACT

Current models that outline behavioural traits of travellers are failing to incorporate the fundamental factors that drive travellers' information needs. Furthermore, service providers need to shift away from assuming that travellers have a detailed knowledge of their services. In recent years the pervasive nature of Ubiquitous Computing has attracted attention from transport service providers. It has the potential to improve pre and in-trip information provision whilst promoting take up of sustainable travel choices, particularly for unfamiliar or anxious travellers. The triangulation study described in this paper used city and county level data to develop a framework of key influences behind traveller needs and behaviours. These were identified as; time of journey planning; familiarity with available services; traveller preferences used to control uncertainty. These three areas affect not only the format and level of information required but also how travellers make decisions based on this information. The aim of this proposed framework therefore is to provide a vital foundation for future information provision strategies thereby enabling bespoke travel information solutions.

## KEYWORDS

Travel Information Systems, Travel Information Management, Ubiquitous Computing (UBICOMP)

## 1. INTRODUCTION

In the UK prioritization of public transport (PT) services resulted in independent service providers, increasing service efficiencies. However, traveller uptake is decreasing – a consequence of increasing travel experience uncertainty. To resolve this issue two key approaches are gaining momentum; behavioural traits models designed to understand traveller intentions, and subsequent travel behaviour, in an attempt to promote sustainable travel choices. Alongside the utilization of ubiquitous computing techniques improving data collection (Big Data), and dissemination (RTI and mobile devices), providing travellers with better information relating to travel experience. The question remains as to why these strategies remain ineffective in promoting a larger modal share for PT services (Parliamentary Office of Science and Technology, 2014).

This paper addresses a key weakness in behavioural trait models and draws attention to; the time the traveller seeks travel information, the methods they use to evaluate that information and the significance that traveller familiarity of PT services affects the type of information sought after. Ultimately leading to the premise that, service providers and future information provision strategies need to move away from the assumption that travellers have a detailed knowledge of those PT services.

### 1.1 Understanding the Traveller

Understanding travellers and their specific information needs which influence their behavioural traits has become an increasing topic within the literature. Early papers on the subject called for change in behavioural traits frameworks to consider the context of the travellers and their information needs (Al-Deek et al., 1998, Probert, 2001). This led to revised models for traveller information needs being developed, attempting to understand the complexities behind the travellers decision-making processes (Wang and Ning Jia, 2013). Hensher (2011) stated that over the last 15 years there has been a growing interest in the Prospect Theory

(Kahneman and Tversky, 1979) and its representation of traveller behaviour. This interest is specifically in the field of travel choices and the role that travel preferences have on the traveller's decision-making process. Some of the studies that have applied this model in the context of travel choices are Avineri and Prashker, 2005, Schwanen and Ettema, 2009, Hensher, 2011. The Prospect Theory paradigm has practical applications in understanding the conceived choices made as a result of a traveller's behavioural responses. This includes the complex role that traveller preferences have on behavioural responses and how preferences highlight uncertainties about the public transport (PT) network. The Prospect Theory is weak however in its understanding of what factors contribute to how a traveller initially obtains their information and to what level this then affects their behaviour.

It is well established throughout the literature that travellers try to minimize the uncertainty they perceive with the PT network by making travel choices which reduce the causes of their concerns (Chorus et al., 2006a, Chorus et al., 2007, Spitzadakis and Fostieri, 2012, Gavalas et al., 2014). David McClelland had investigated the motivating factors involved in human behaviour and concluded that at any given time the traveller could exhibit competing preferences, which influences the travellers actual travel behaviour (Boyatzis, 2000).

Studies like this, however, show that amongst literature on this topic there is still a gap in knowledge about the drivers behind travel information needs. How significant is a traveller's regret in relation to making decisions under uncertain conditions? Does that traveller have a higher likelihood for travel anxiety? (Loomes and Sugden, 1982, Chorus et al., 2006b). What factors influence the traveller's anxiety and how much PT information would distil that anxiety? (Ajzen, 1991, Montañó and Kasprzyk, 2008). This paper's conjecture is that more emphasis needs to be given to the context in which the traveller is planning their journey, as a fundamental factor controlling information needs. But, the most crucial factor affecting these needs is their familiarity with PT services coupled with their perception of those services. Therefore, a triangulation study was conducted to establish the fundamental factors that influence the traveller's information needs.

## 1.2 Research Context

The aim of this triangulation study was to assess the way traveller's information needs are met by mobile solutions. In consideration of the plethora of applications reaching the market by either a service provider or a third party (AppAnnie, 2014a, AppAnnie, 2014b). A triangulation of different travel information sources was required to act as a mechanism for developing a framework for assessing mobile information provision and need. This approach was selected as it combines several investigative methods. Considering the different sources through 'Theoretical Triangulation' it was possible to evaluate the theoretical position and underlying theories of each source and corroborate the diverse findings (Denzin, 1978). It was a useful model to adopt considering the natural complexities behind human behaviour, traits and information needs (Ajzen, 1991). The research was conducted as a case study on two geographical levels evaluating PT mobile applications in Southampton (city) and in Hampshire (county), UK. The triangulation acted as a mechanism for developing the framework for assessing mobile applications. The context of this study was to assess traveller behaviour in and out of Southampton in order to evaluate location specific apps available at the time of research. Whilst the results of that study are not documented in this paper, some of the key highlights that related to the proposed 'traveller types' framework will be included.

## 1.3 Triangulation Study Methods

The key source in the triangulation study was the literature review which provided understanding of the travellers' profiles and planning mentality in three main areas. The first area identified the current traveller profile and current travel tendencies, based on travel statistics collected by local government. The second area looked at the effects of the rapid transport information improvements such as the uptake of ITSO Smartcards and automated vehicle location tracking (AVL). The final area focused on understanding the traveller's information needs by identifying the factors influencing those needs and the effects that journey planning had on influencing traveller's intent to travel.



The second source used was focus group transcripts that detailed traveller's perceptions about obstacles to using bus travel. These transcripts were from sessions conducted in August 2013 and consisted of around 7-12 participants per session. The survey was run by the Transport Research Group (TRG), University of Southampton, on behalf of Southampton City Council, UK. The participants of the focus groups were shortlisted from respondents expressing interest in further participation in travel related surveys. Those participants were filtered according to demographic and bus travel preferences in order to get an even distribution of both bus and non-bus travellers. The focus of the study was to provide insight for policy holders as to the barriers regarding uptake for buses, to identify barriers to modal shift in the local area.

The final source of the triangulation study was a non-contact contextual, observational study to obtain indirect opinions from travellers in real travel scenarios. The qualitative data collected during the course of this study provided anecdotal evidence both supporting and contradicting the findings from sources one and two. However, of significant interest was how travellers reacted in the face of service disruption, and the consequences of information provision that met, or failed to meet, traveller information needs. The purely observational context of this study intended to limit the external influences on travellers and their natural habitual travel patterns.

The observational study was held between October 2013 and March 2014 and the parameters included;

- Multi-modal public transport – Buses and Trains.
- Different times of the day: 6:30am – 9:30am, and 3:30pm – 8:30pm

## 2. TRAVELLER TYPES FRAMEWORK

This section of the paper outlines how the traveller type framework was identified and how the triangulation was formed to identify the three themes.

### 2.1 Identified Themes Found From Triangulation

The findings from the triangulation study identified three key themes which determined what information the traveller was seeking and how they made judgements on that attained information, these being:

- Theme 1: Time of planning (in-journey vs. pre-planning)
- Theme 2: Familiarity with PT services and general on-board service provision
- Theme 3: Travellers own travel preferences (time, cost etc.)

#### 2.1.1 Theme 1: Time of planning (in-journey vs. pre-planning)

This theme focused on the format the travel information was required by the travellers. For example, the in-journey traveller preferred more dynamic and instant information, obtainable via departure boards and mobile applications. According to the literature review there are various options available to the traveller at both the pre and in-journey planning stages. For the pre-planner they have access to more information through the use of journey planners that enable the traveller to fully research the journey. (Molin and Timmermans, 2006, Chorus et al., 2007, Grotenhuis et al., 2007, Klöckner and Friedrichsmeier, 2011, Zografos et al., 2012). Journey planners such as WISETRIP consider all the available route options, alternatives and allow the traveller to assess the travel specifications, comparing the journeys utilities in accordance with their travel preferences (Spitadakis and Fostieri, 2012, Mahmood and Abdul-Salam, 2013, Tirachini et al., 2014)

It was apparent from the literature that areas still needing considerations were journey planning support and traveller planning mentality. There is a particular lack of information around in-journey planning or re-planning due to service disruption. Further examination was needed into the form this takes and how traveller information needs are affected by journey planning mentality (Duncan et al., 2009, Lane et al., 2010, Nyblom, 2014).

However, literature does comment on various factors that benefit travellers such as dynamic real-time information, departure boards and mobile application support. Consequently, mobile devices, being pervasive yet unobtrusive, have great potential for delivering travel information and are able to deliver better insight into the state of the PT network as a whole (Solar and Marqués, 2012, Spitadakis and Fostieri, 2012).

Moreover, they offer the direct advantage of increased support for travellers making in-journey and re-planning decisions whilst indirectly boosting service take-up rates and customer loyalty (Barnett, 2014).

The following example comments from the focus group narrative demonstrated the travellers need to pre-plan and what they took into consideration during this stage.

- *“I usually catch the number 1 which is Winchester to Southampton. That runs every 20 minutes and I find it’s actually very reliable”*
- *“I keep thinking of the journey time, so I’m most likely to take the mode that gives me the least journey time”*

Participants also described, through the narrative, what in-journey information they needed to ensure their on-going journey completes successfully. One stated that:

- *“If you know that the bus is not coming, you can plan ahead for that. So if I knew, then I could have probably got a taxi.”*

This particular comment highlighted that there is a level of access to information for many travellers which is currently unavailable. It also demonstrated that the travellers mentality is more geared towards in-journey re-planning based on new pertinent travel information becoming available, such as the bus not arriving at its specified time.

During the observational study it was noted that as travellers progress on their journey they are able to compare what was pre-planned with what they are directly experiencing. Thus, providing an interesting dynamic as to the way travellers want to use travel information. They gathered information when pre-planning journeys but also used the same information to ensure their in-journey experience matched with what they were expecting. In such cases some travellers were using their mobile devices to check maps or timetable information for continuous validation. However, mention has been made of information needs that remain unfulfilled in-journey such as the ability to know what on-board services were on offer or what connecting services were available at calling points on that journey. In respect to connections, travellers that required connections between buses and trains were more vocal about their information needs. They stated the need for continuous validation of personal journey progress and information to let them know if they would miss their on-going connections. This important observation was evidenced by literature on this topic as a direct information need, which mobile driven transport solutions should resolve (Barnett, 2014). Connection information has an immediate impact on travel time and journey experience and is considered key to travellers’ pre-planning and in-journey travel information needs.

Grotenhuis et al. (2007) defines in detail the settings in which a traveller plans a journey and in what context information is gathered at each stage. These settings include;

- Pre-trip planning: taking place prior to the journey and is done to evaluate journey options for its applicability. In this setting journey planners become the most prevalent.
- Wayside planning: taking place in-journey at the calling points relevant to the service undertaken, and is for the purposes of tracking on-going connections and their reliability. In this setting RTI departure boards become the most prevalent.
- On-board journey planning: taking place inside the vehicle and is predominately designated for journey support. In this setting mobile devices and on-board announcements become the most prevalent sources for travel information.

### **2.1.2 Theme 2: Familiarity with PT Services and General On-Board Service Provision**

This theme determined how much information the traveller required. For example, the less familiar travellers are naturally unsure of what services are available to meet their needs. They would therefore require information to be presented in a clearer format, with good explanations that do not assume the traveller to have a higher level of understanding of the service. The difficulty that travellers face when considering the use of PT modes is the ever present complexity behind it (Klößner and Friedrichsmeier, 2011, Zografos et al., 2012). This complexity stems from;

- Different service providers that have different policies for situations like service disruption and the way they manage the services in light of those policies (Grotenhuis et al., 2007).
- The number of routes available by all those service providers including their timetabled arrival and departure times (including at-stop wait times and journey lengths)(Chorus et al., 2006a)

- The various modes of transport - considering that these are not fully integrated across the UK in the same way that it is in London, meaning that the traveller has to consider the different costings that each mode requires (Molin and Timmermans, 2006).
- The number of access points that the traveller could use to board or depart from any given service. (Grotenhuis et al., 2007, Barnett, 2014)

This complexity adds to the travellers need to rely on travel related preferences in order to evaluate that complexity (Chorus et al., 2006a). This factor alone is controlled by the traveller's perceived familiarity and opinions in relation to their knowledge of the PT system (Ajzen, 1991, Montaña and Kasprzyk, 2008). A traveller's intention to undertake a journey is dependent on various elements, such as;

- Perceived control of the PT network
- Knowledge of the PT network,
- Beliefs associated with the PT network.

A perceived lack of control and/or knowledge about the PT network will heighten the traveller's negative perception of the consequences, should any service related disruption occur during travel. Similarly, if they have concerns, such as 'the buses are not reliable', it influences their intended actions towards travel behaviour. Therefore the traveller considers these preferences in light of any perceived regret and anxiety when making decisions under uncertainty (Loomes and Sugden, 1982, Chorus et al., 2006b). Again, examples from the focus group show anxieties relate to simple, but variable, things like cost and time.

- *"One of the reasons I don't use buses more is just that it's difficult to just get on a bus and go on one journey"..." you've got to have the right money"*
- *"You don't know what the fare's going to be, you've got to have change and all the rest of it. That does put me off."*
- *"Everything takes so damn long, especially if you've got to change buses or go by bus and train, it just takes so long"*

These beliefs and potential fear of service disruption are barriers to sustainable uptake of PT network services, if traveller's feel that they are unable to manage the uncertainty. It is crucial therefore that travel information provision via ubiquitous computing needs to provide the traveller with the correct level of information. It must allow them to evaluate the extent of that uncertainty and determine the necessary mitigation strategies required to manage or avoid it (Grotenhuis et al., 2007).

The observational study had plenty of opportunity to observe service disruptions and the ensuing consequences of how information was delivered in uncertain circumstances. It was evidenced that travellers needed to know the new estimated time of arrival (ETA) and this information was lacking. Additionally the travellers displayed concerns or asked questions to available personnel as to how the disruptions would affect their connecting services. Where anxiety is heightened there is an increased potential to make incorrect decisions regarding on-going travel, especially if a traveller lacks information about their options. Regarding departure boards and mobile applications, they were proven to lag behind the real travel situation or were rendered ineffective as a mechanism for delivering traveller information. The observations made during severe service disruptions (service cancellations or delays greater than 30mins) demonstrated that PT providers relied on platform or on-train announcements in order to communicate alterations being made to the subsequent services.

In another example, anxiety was witnessed amongst bus travellers who were unsure when to press the bell to indicate to the driver their intention to depart at the next calling point. Travellers travelling by bus are forced to indicate their intention for the bus to stop and the consequence of a poorly timed bell press would mean that they would disembark away from their target location. Therefore, those travellers demonstrating due concern over when to press the bell had a higher anxiety because of their perceived unfamiliarity with the route they were taking (Grotenhuis et al., 2007)

### **2.1.3 Theme 3: Travellers own Travel Preferences (Time, Cost etc.)**

This theme focused on how the traveller filtered out certain travel options according to their personal preferences. In most cases stated during the focus groups and contextual review the primary preferences related to time and cost. As previously mentioned in theme 2, preferences influence travel behaviour and familiarity with the PT network is key in establishing preferences. Using just one example of a vital information need, time is used to assess the suitability of any travel option. When evaluating when to travel time can be broken down into three main stages; timetabled departure and arrival times (Spitadakis and

Fostieri, 2012), stop-wait time and in-journey travel time (Tirachini and Hensher, 2011, Tirachini et al., 2014). However, the availability of that information also needs to be timely and accurate. A need that has recently emerged due to the existence of RTI, created the desire for realistic departure / arrival times compared to the outmoded static timetable estimations (Duncan et al., 2009, Lane et al., 2010, Nyblom, 2014). The influence of cost on travel choices also adds an additional dynamic to the traveller's information needs. For instance, those in a lower income bracket display a tendency to choose bus services out of all available travel modes (Department for Transport, 2014c). Additionally, cost comes into play when dealing with multiple PT service providers different fare structures (Chorus et al., 2006a, Chorus et al., 2007, Spitadakis and Fostieri, 2012, Gavalas et al., 2014). Finally as demonstrated by statistics collected from the Department for Transport (DfT), there is the need for further information regarding;

- The ease of access in getting to key services. (Department for Transport, 2014a)
- Passenger loading factors in order to find and avoid congested services, (Anderson, 2014)
- Finding services that support elderly and disabled, such as low floor buses. (Department for Transport, 2014b)

These elements have been corroborated throughout the literature as part of the travellers need for comfort and security during travel. For example, a traveller with limited mobility may well have a preference pertaining for services offering low floor entry on buses. Thus indicating an information need to know which planned or arriving services offer that function. (Tirachini and Hensher, 2011, Nunes et al., 2014, Shahin et al., 2014)

Some example comments from the focus group narrative that highlight the traveller's preferences focused on time, cost and accessibility.

- *"I keep thinking of the journey time, so I'm mostly likely to take the mode that gives me the least journey time"*.
- *"Very occasionally I've got on and it's got a step and I can't get on with my mum" ... "there are sort of certain routes and we know not to go on those because we can't get on"*.

Additionally the factors that influenced those traveller's preferences were also indicated throughout the narrative.

- *"Because I needed to be there on time"*
- *"The issue I have is sort of inflexibility on ticketing. Because I'm not a regular user, "... " I cycle to work. Outside work it's just the odd journey"*
- *"The only time that I would choose the bus, if the other alternatives were less attractive, was if the bus was faster "*
- *"If there was a dedicated bus lane from here to home and I could get to work in half the time on the bus than it would take me to cycle then I would probably take the bus, even if it cost me money."*

The contextual review itself did not expressly aim at understanding what travellers motivations were but focused instead on their actions in certain situations. Therefore, it is difficult to evaluate a traveller's behavioural reasoning when needing to re-plan while they are in-journey. However, some of the stated needs, like time and costs, were evident by people's reactions. If the journey was delayed it could be assumed that those that vocalized annoyance to such disruptions were bothered by the effect it had to journey times.

## 2.2 The 'Traveller Types' Framework

The three aforementioned themes provide an interesting dynamic which reveal four distinct passenger types. Themes 1 and 2 define the segmentation that stems from splitting travellers by the type of journey planning against the level of their transport knowledge. Theme 3 however, adds additional and individualistic qualities to the framework as traveller attitudes and travel preferences are considered. In this way it is possible to define these four different abstract traveller types as;

- Pre-planning and familiar, e.g. *"I have work in the morning; are there any problems with the number 4 service to Southampton?"*
- Pre-planning and unfamiliar, e.g. *"How do I get to the local hospital from my house?"*
- In-Journey and familiar, e.g. *"I see that the bus is delayed, what is my new arrival time?"*
- In-Journey and unfamiliar, e.g. *"The bus is delayed, I'm going to miss the connection, what do I do?"*

These types are represented by figure 1 ‘Traveller Types’ Framework, demonstrating the interplay between the themes identified.

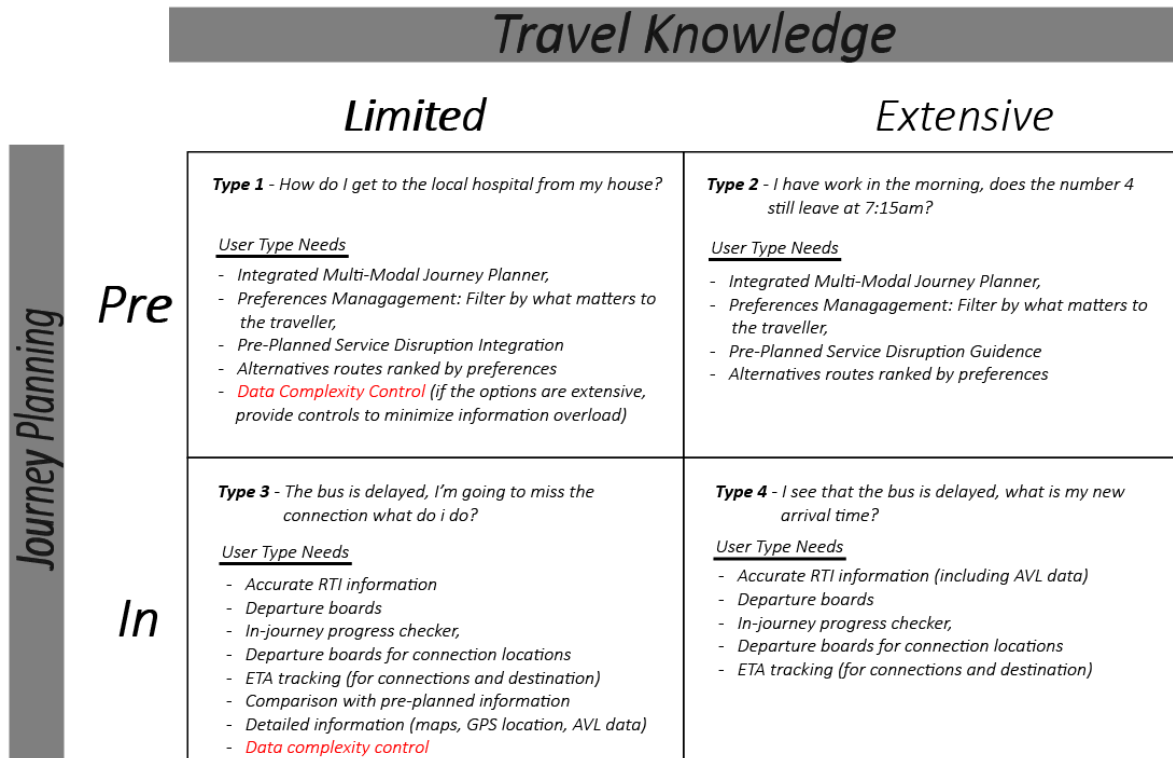


Figure 1. ‘Traveller Types’ Framework

### 3. CONCLUSION

In conclusion, due to the factors outlined in this paper the ‘Traveller Types’ framework (represented by figure 1) can be used to yield better data collection regarding travellers and travel behaviour. Rapid changes in traveller demands for timely, accurate and available information regarding the PT network have created a need for better understanding of this field. Furthermore, the emergence of travellers seeking in-journey travel information for last minute travel plans, or journey disruption induced re-planning is putting pressure on service providers to adapt. The necessary response is to enable better bespoke travel information solutions that consider meeting travellers’ direct needs as essential.

In the same way, the traveller’s familiarity with the complexity behind the PT system is also a crucial factor. Service providers need to shift away from assuming that travellers have a detailed knowledge of their services. A primary example being the First Group (2014) app for Hampshire, where the traveller is forced to select the service they need first, which presumes the traveller knows that the service they select will meet their journey needs.

It has been stated throughout the literature that traveller preferences act as the mechanism for travellers to control the perceived uncertainty. This suggests that travellers regret in relation to decision-making processes is the final key factor in any tailored bespoke travel information solution. Moreover, the travellers with the least familiarity are the most likely to have a higher degree of travel anxiety, especially if that traveller is in-journey and they meet problems that prevent the successful completion of the original pre-planned route.

This framework is consequently designed for the purpose of underpinning data collection and dissemination strategies in light of the identified traveller types. This base of understanding could then be developed for the purpose of dealing with incident management in the eventuality of service disruptions.

One final aspect to conclude is the weaknesses of this ‘traveller types’ framework. As it stands there are three perceived areas for further validation; transferability, quantification and demographic make-up. Transferability refers to the fact that this framework was identified through a case study of Southampton, UK and may be considered as only being indicative of the case study location and its travellers. Quantification refers to the need to validate the size and shape of those four traveller type segments. It may be that the categorisation of traveller types is accurate but that most travellers will only fit into one specific segment of that framework. For instance, it is possible that travellers could demonstrate that they favour in-journey planning over pre-planning.

Finally, the last issue that needs further research is the demographic relationship in regards to the segmentation. A number of questions will need to be answered such as:

- Is the younger generation of travellers predisposed to in-journey planning because of the prevalence of mobile devices?
- Is there a higher number of elderly travellers in the pre-planning and familiar segment (type 2), due to a preference for consistency and pre-determined times via routes that they know?

In order to rectify those three weaknesses further research will need to be conducted. An initial peer-review Delphi survey (Hasson et al., 2000) will resolve the transferability weakness. Then a follow-on quantitative survey will be held with actual travellers to provide answers regarding the quantification and demographic make-up.

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# A BRAND NEW APPLICATION FOR REMOTE CONTROL OF ANDROID DEVICES

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## ABSTRACT

Remote administration and remote implementation are the main uses of remote desktop systems. Although they were first designed to computers, nowadays they are also desired for mobile systems, like Android, for example. There are several approaches to remotely control Android devices. However, they require special permissions and/or software installation to perform remote actions. Here we present “Remote Resources”: a new tool for remote control of Android gadgets. Unlike other solutions, it is not necessary any pre-configuration or installation of additional applications in the device before using our tool. “Remote Resources” is an open-source platform that enables real time communication with Android smartphones and tablets all over the world. It can be used in several contexts, especially for development support, testing at laboratories and videoconferences when you cannot have the hardware in your hands.

## KEYWORDS

Android, Remote desktop, Telework, Remote visualization.

## 1. INTRODUCTION

Technological advances culminated in the emergence of mobile devices. Today they are essential to everyday tasks and are responsible for a constantly growing market share (Gartner Group, 2013). The mobile market has generated a high demand for development of new hardware and software.

For those who work with system development and testing, it is not unusual to collaborate with geographically dispersed teams. In this context, remote management and remote implementation are the main uses of remote desktop systems. They enable the user to control a machine, usually a computer, that is away from him/her.

It is possible to find several solutions for remote control of computers (Warner, 2012). Nevertheless, it is also important to provide such feature for the mobile environment too. We are especially interested in providing remote control for Android devices (Google, 2007), since it is the mobile operating system with the highest market share, as can be seen in Figure 1.

Mobile remote control can be used in several contexts, for example, for developers or people who need remote support for their smartphones and/or tablets. It is also desirable for mobile industry, enabling laboratory testing across the world and verification of how the device acts in conditions when we cannot simulate the real case scenario (like network tests abroad).

The literature brings some solutions for Android remote control. Samsung, an Android device manufacturer, has a tool called Kies (Samsung, 2014) that allows the user to manage files, do backups and upgrade the firmware. The native Android platform also has a solution for remote control. It is known as Android Debug Bridge (ADB) (Android Developers, 2009) and allows file and applications management and also shell console commands. Some authors have also exploited the use of Virtual Networking Computing protocol (Richardson, 1998) to build implementations for Android, like RealVNC™ (2002) that enables the user the use the Android device from a computer.

In this paper we present “Remote Resources”, a new open-source application to remotely control any Android device. Our proposal does not need to install extra applications on the mobile device nor complex settings on the remote computer to which the device is connected. Our approach uses a client-server architecture to communicate via TCP/IP to any machine that has a remote device plugged.



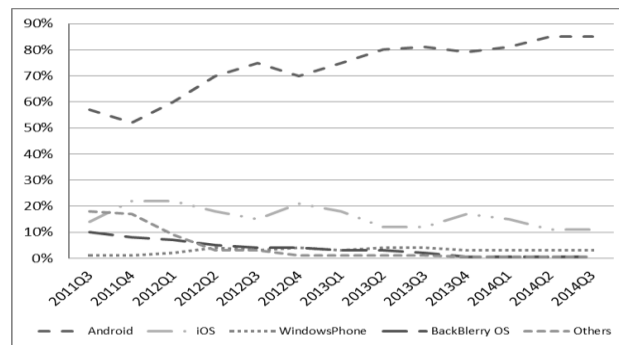


Figure 1. Worldwide smartphone OS market share. This figure shows that, in terms of unit shipments, Android has been conquering space in the market. This justifies the amount of research on this OS. Figure adapted from International Data Corporation (2014)

The main contributions of our approach are a new and easy way to remotely access any Android device (from version 2.3 - Ginger Bread), and a new tool for development and testing teams of the Android platform. Since it is an open-source project, it is possible to extend the approach and integrate other functionalities as desired, allowing its extension to other uses.

This paper is organized as follows. Section 2 presents some related work. Section 3 introduces our approach, describing its architecture and functionalities. Then, section 4 resumes the validations of the system and discusses the results. Finally, section 5 concludes the paper.

## 2. RELATED WORK

The literature has exploited several approaches to control machines remotely. The most part of them focuses in computers, but it is possible to find solutions designed for mobile devices. For example, Lumia Beamer (Microsoft and Nokia, 2014) is a remote controller for Windows Phone smartphones. RealVNC™ (2002) is a commercial solution that works for both Android and iOS systems. Since Android is an open-source platform, the amount of software developed for this operating system is higher compared to other ones.

The literature in this field can be divided in two groups: the first one focused in final users and the second one focused in development teams. In the first group, the main functionalities of the remote control systems are those related to basic operations, like file management (Berserker, 2012), (Rye, 2013), (SmartDog Studio HK, 2013), (Berserker, 2014), (Mobogenie.com, 2014) and contact administration (Sand Studio, 2014). In these solutions, it is usually required to install the system in the device, but there is no need for special access privileges to perform the actions.

In the second group, the remote control system is designed to perform advanced operations like shell commands and system management (Villan and Jorba, 2013). In these solutions, besides the installation of the system in the device, it is also needed *root* access in order to perform advanced operations that control the device operating system. This is the main difficulty in using these systems, since the special access is not always easily obtained. Until now this remains an open problem, motivating, thus, this work.

As will be detailed in the next section, our approach also belongs to the second group, but our main innovation is that we don't need any configuration in the device to perform remote control. Table 1 anticipates some functionalities of our system and compares it to similar solutions of the state-of-the-art described here, summarizing, thus, this section.

According to Table 1, the most common functionalities are file opening and management. This indicates that the most part of the users are interested in use a mobile remote control system to manage files of their devices as easily as they would do in a computer. Other functionalities, as providing remote access to contacts and send/read messages, suggest that users would like to perform these actions in a computer since it is easier to read/write text.

Table 1 also shows a trend in developing solutions focused on final users. Nevertheless, it is also important to provide remote control of mobile devices to development and testing teams, since they are responsible to create new products. In this sense, functionalities like application management, content synchronization and shell commands are desired, so, applications like proposed by Villan and Jorba (2013) are well recommended and motivated our work.

Table 1. Comparison with the state-of-the-art. This table compares, in terms of functionalities, other solutions with the approach proposed in this paper for remote control of Android devices. It is important to highlight that our solution is the only one that dispenses special access privileges and pre-configurations to use the system

Functionality	<b>AirDroid</b> (Sand Studio, 2014)	<b>Android Remote</b> (Villan and Jorba, 2013)	<b>FTPDroid</b> (Berserker, 2014)	<b>Mobogenie</b> (Mobogenie.com, 2014)	<b>qrSend</b> (Rye, 2013)	<b>Remote Web Desktop</b> (SmartDog Studio HK, 2013)	<b>WebDroid</b> (Berserker, 2012)	<b>Our approach – Remote Resources</b>
Access to contacts	X							X
Application management		X		X				X
Content synchronization			X					
File management	X	X	X			X	X	X
File transfer		X		X	X			
No configuration needed								X
Open files	X	X	X	X		X	X	X
Phone location	X							
Send and read messages	X					X		X
Shell commands		X						

### 3. OUR PROPOSAL

In this section we will discuss the details of Remote Resources in terms of architecture, its main functionalities and how it was implemented.

Our motivation for building this system came from project demands in which development teams need to connect with mobile devices and simulate test conditions that could not be satisfied in our country. Thereby, to find a way to access a device that had the appropriate conditions for testing was extremely necessary and desired. The system was developed collaboratively among several developers and testers. They adopted the *Feature Driven Development* methodology, in which the feature list was prioritized before each delivery and the development started by the priority requirements.

#### 3.1 Architecture

In summary, our solution is designed in two parts: the remote and the local connections, as described in Figure 2. The remote connection is done with a client and server architecture implemented in Java. The local connection between the computer and the device is done by means of USB interface and Android Debug Bridge (ADB) communication (Android Developers, 2009).

The server is the computer on which the device is physically connected in the USB port and the client is any computer that remotely interacts with this device. The communication between the client and the server is done based in control messages (command transfers) and data exchanges (information transfers). The same computer can take the client and server roles. In this case, any connected device is treated as a local device, automatically recognized by the tool.

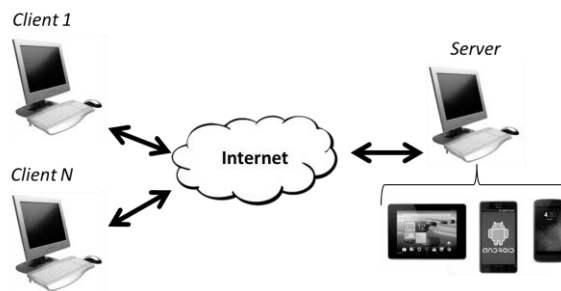


Figure 2. The architecture of our system. It is designed as a client-server application implemented in Java. The server has the Android devices connected in USB ports and communicating through Android Debug Bridge. There is no other software running at the server side. Our user interface appears only in the client side

The core of our system is the incorporation of the Android Debug Bridge. It is a command line tool addressed to communicate with an Android emulator or a real device connected in a computer via USB port. This tool is part of the Android SDK and allows a set of operations to be performed in the device by programming commands. Among these operations, we highlight forwarding ports, file transferring and simulations of touches. Another advantage of ADB is that it is packaged into a library that allows its usage in Java applications. Although the ADB is the basis of our tool, it was improved in our system in order to convert computer clicks into device touches and vice versa. This conversion is extremely important and enables other usages of ADB, for example, to simulate drag and drop movements.

As mentioned before, the code of our system was written in Java and is organized according to the model-view-controller (MVC) standard. The *model* is a package addressed to encapsulate and interpret the messages exchanged between the client and the server. The *controller* is the packages that represent the server and the client and organizes the protocol of communication between them. These packages are responsible to communicate directly with the device in the server and to obtain user commands in the client. Finally, the *view* package is included in the client and is intended to provide interaction between the user and the application. This interface layer is designed in Java Swing, once that it is a desktop application, but it could be implemented as a web application as well. It is clear that the server computer is only used as a bridge between the client computers (on which the remote actions are done) and the connected devices that are being controlled.

The actions taken by the user in the system interface are transformed into messages that are sent to the server. Once received, these messages are decoded and interpreted according to its type: (a) Android system commands (touches, slides, getting screenshots, etc.); (b) use of standard buttons (home, back, etc.); (c) scripts recording; (d) device configuration; (e) getting the list of registered devices.

The messages of the types (a) and (b) are transformed into ADB events and sent to the device through Chimpchat, DDMLIB, GuavaLib and SDKlib APIs. The messages of the types (c), (d) and (e) are treated directly with Java.

## 3.2 Features

As described in Table 1, section 2, our solution is one of the most advanced tools for Android remote control. It can be addressed for both final users and development teams, since provides functionalities to almost completely control any Android device.

The usage of our tool is straightforward and dispenses complicated configurations. It allows sending events to the devices (including moves, touches and drag&drop), input text through the computer keyboard, capture screenshots and extract logs. In addition to these features, our solution also enables to communicate with the device physical keys (like power and back buttons, for example). Any action done on the device is reflected in the screens of the client computers. Similarly, any action done on the client computer is reflected to the real device connected to the server computer.

Figure 3 shows the main screen of the proposed tool, with an active device connected. The main screen is divided into four parts: (1) language setting, (2) a list of servers and devices per server, (3) the viewing area of the active device screen, (4) the device control buttons and the main menu of the tool.

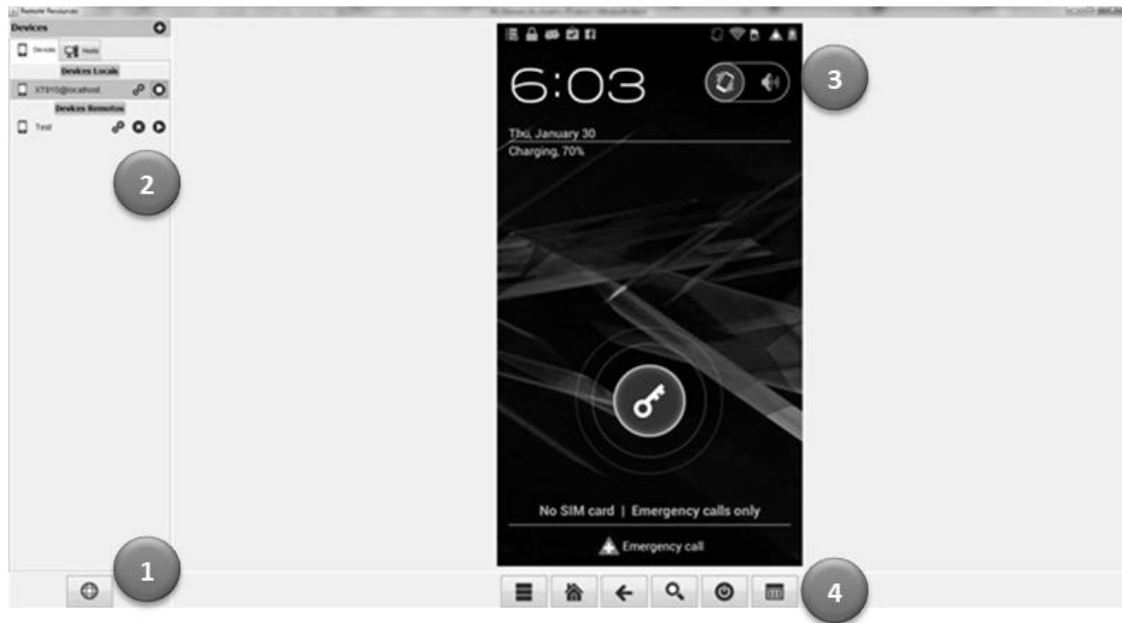


Figure 3. The main screen of Remote Resources. It is divided in four parts: (1) language setting, (2) list of servers and devices per server, (3) viewing area, (4) control buttons. The viewing area is adjusted according to the device resolution

The proposed tool can also be used in videoconferences and presentations, enabling the user to make in the device any action that would do if he/she had the real hardware in hands (except multi-touch simulations, which are reflected on the computer when performed on the phone, but the reverse doesn't happen). Finally, due to the ADB commands, it is also possible to handle devices without display (maybe caused by crashes on the screen). Unfortunately, since a server computer is required, it is not possible to remotely control a device in field use (to speak in a phone call, for example).

## 4. VALIDATION AND ANALYSIS

In this section, we will detail how our system was validated and discuss the main results obtained so far. The validation phase was very important to identify new features for our system and to guide the future work. For now the system is not compatible with operating systems other than Android, since communication is done through ADB (Android Debug Bridge).

### 4.1 Usage Requirements

To use our tool it is only necessary to install Java JRE and Android SDK in the client and server machines, as well as the JAR file of the tool in the client computer. As mentioned before, Remote Resources works with any Android device from version 2.3 (Gingerbread) and higher. It is also required that the USB debugging mode is enabled and the device is recognized by the ADB.

### 4.2 Validations

In order to validate the remote control protocol of our system, we evaluated it with different models of smartphones and tablets during the development process. For each device to be tested, we followed the same validation protocol: (1) plug the device in the server machine; (2) connect the client to the server machine using our system; (3) get the list of attached devices in the server; (4) choose one device to connect to; (5) start the connection; (6) manipulate the real device and see if the actions are reflected in our system; (7) manipulate the device through our system and see if the actions are reflected in the real device.

These tests showed that different resolutions of devices were perfectly mapped into the display area of our system. In addition, mobile devices of several manufacturers were successfully recognized and could be used by our tool. It was also proved that the remote control protocol proposed in this paper is suitable for the problem.

For a final validation round, a beta version of our system was submitted to a two-week user trial with the purpose of real users report issues that were not observed in previous stages. The validation team was composed by programmers specialized in mobile development that need to execute remote actions in smartphones very often, as part of their work. The most part of the reported issues were related to performance and user interface problems that were already solved. A simple usability test was done by Nielsen's Usability Heuristics (Nielsen, 1994), which revealed that the usage of the tool is very simple and intuitive.

### 4.3 Analysis

The validations done so far were very important to identify the main advantages of our tool and to guide the future work. It is clear that our approach is among the most complete solutions in the literature to control devices remotely. By using our tool, it is possible to control almost all functionalities of any Android device. Nevertheless, in higher versions of Android operating system, like KitKat and Lollipop, the use of multi-touch is more frequent. So, an important thing to be done in the future is to support this kind of command.

Besides that, sometimes the communication between the server and the clients get slow due to the amount of screenshots exchanged by them. A possible solution is to investigate the "Tight" VNC data encoding described in Villan and Jorba (2013). It is also important to highlight that our solution deals with simple messages exchanges, but in order to improve security, Remote Resources can easily incorporate cryptography techniques.

Finally, we cannot deny that mobile devices are evolving. Added to this, we have the context awareness computing that is completely related to sensors. Mobile devices present several sensors like GPS, accelerometer, proximity and others. It is also good to keep in mind that future versions of mobile remote control systems must deal with this kind of technology.

## 5. CONCLUSION

This paper introduces "Remote Resources", a new tool for remote control of Android devices. In particular, we showed a new protocol for mobile remote control that dispenses any special access privileges and software installation in the gadgets. Our solution is among the most complete systems to perform remote actions in Android smartphones and tablets, being suitable for both final users and development teams.

The system works through a client-server architecture implemented in Java and is based in the Android Debug Bridge for device communication. We have done an extensive state-of-the-art review in order to compare our approach to other solutions available in the literature.

Our first validations and analyses indicated that the proposed system is relevant for many scenarios, especially for remote support and tests when we cannot simulate the real devices' conditions of use. Despite the high potential for the area of interest, there is still room for advances, as porting the solution for the web environment and performance improvements.

Finally, a stable version of the system is ready for use and the code is freely distributed under the GNU LGPL license (2007). It can be found at: <https://github.com/IPEldorado/RemoteResources>. Further contributions are welcome, expanding the scope of the tool.

## ACKNOWLEDGEMENT

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# MULTI-STEP DECISION MAKING PROCESS FOR NON-PLAYABLE CHARACTERS IN AN RPG

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## ABSTRACT

The main concept behind Role-Playing Games (RPGs) is to provide the user with a wide variety of decisions so that a single problem can be approached in different ways. The choices present for the Non-Playable Characters (NPCs) are however quite limited and their actions are mostly dependent on the actions done by the user. The NPCs do not normally have their own objectives to complete, therefore their actions do not appear natural. They do not have objectives to complete which limits their interaction thus reducing their impact on the overall game world. The authors propose a system where every character has some specific objectives which can be achieved by formulating a plan. The successful application of the plan is dependent on the ability of the NPCs to perform the actions contained in that plan. For the achievement of the objectives a multi-step decision making process is used which evaluates the possibility of performing actions at every level of the graph. Depending on the actions that a character can perform and the orientation that the character has, the outcome can be different under the same circumstances. This in turn causes the game world to change not only due to the actions of the user, but also due to those done by the NPCs.

## KEYWORDS

Character creation, planning graph, decision making, non-playable characters.

## 1. INTRODUCTION

The most common methodology used for programming Artificial Intelligence (AI) in games has been Finite-State Machine (FSM). This powerful organizational tool helps the programmer to break a problem into sub-problems and allows the implementation of intelligence systems with ease and flexibility (Schwab 2009). The FSM is initialized by first declaring all the states, then declaring each state's transitions with its required conditions. If some transition has occurred during the time the game was run, then the correct state is acquired as the current state of the FSM. This system however has its limitations as the programmer has to handcraft the flow of actions for every possible scenario. In order to introduce a single change the flow graph needs to be redesigned all over again thus complicating the FSM. FSM is actually a reactive mechanism which checks the changes in its surroundings to initiate transition to the next state. There is however no suitable plan of action or initiative that governs the states that it must achieve in order to complete its goals.

In order to solve this problem, we are seeing an increased use of techniques such as fuzzy logic and neural networks to enhance the decision functions of the characters (Ayesha et al. 2007). Orkin (2006) introduced planning techniques based on STRIPS (Fikes and Nilsson 1971) and goal-oriented action planning (Orkin 2003) in the game, F.E.A.R., which resulted in creating an illusion of a thinking AI and garnered great reviews. An overall graph is created that holds all the possible plans to achieve the objectives. Failure of one plan only directs the NPC to consider one of the other plans to reach its goal.

In our past research (Khan and Okada 2014) we suggested how evolutionary algorithms and autonomous agents can be used for creating animated stories in a game world. The user makes choices while defining the characters and the objectives that they need to accomplish. Based on their available states, the characters formulate a plan and perform actions to achieve it. Pollack and Horty (1999) argue that in a dynamic and real-time planning the autonomous agents must be able to manage the plans that they generate. These agents should have the capability to decide when a plan should be kept inflexible and when more detail should be

added to it. Our research follows this approach as there is a chance for re-planning due to the changes in the states of the items.

Adobbati et al., (2001) introduces Gamebots, a multi-agent system based on a multi-player video game called Unreal Tournament. The game allows both human players and agents, to play simultaneously; thus creating an environment where agents can collaborate with humans. The Gamebots however does not employ any planning technique that can help the agents in performing their tasks.

Dignum et al., (2009) argues that agents should be included from an early stage in the design process to profit from specific agent characteristics such as communication, cooperation, proactive behavior, and adaptability. In our system the agents are added at the beginning and their overall interaction with the items contained in the game world defines the story.

The closest work has been done by Yu and Xu, Z (2012) where they have used the graphic structure to describe the interrelated criteria in multi-criteria decision making and have properly solved various graph-based multi-agent decision making problems by analyzing how the graphic structure of agents affects the benefits and the importance weights on agents. Furthermore, where the graphic structure is uncertain, they have developed another method called the fuzzy graph-based multi-agent decision making method and have argued that this kind of decision making methods can be well applied into the actual decision making problems. In this paper we explain the entire process from the creation of items, the characters, the actions that can be performed and the decision making process that helps in achieving the goals.

## **2. THE SYSTEM**

The main components are Characters, Items and a collection of Actions that can be performed within the bounds of this system.

### **2.1 Characters**

Characters are intelligent agents within the system that can perform different Actions on Items. It should be made clear here that not every Action can be done by every Character. Similarly every Action cannot be performed on every Item. This brings us to the following deductions:

- Characters perform Actions
- Actions have two categories, one is called Abilities and the other is called Common Actions
- Not every character has the same Abilities
- Common Actions are the same over all the characters
- In order for some Ability to be performed, it may rely on one or more Common Actions
- Abilities define the orientation of the character

In our past research (Khan and Okada 2013) we displayed that a character is composed of good and bad Actions; we refer to these Actions here as Abilities. The combination of these Abilities defines the orientation of the Character. We also explained that a system might contain many allowable Abilities, but only a few can be contained by any one Character. As a result, if two different characters are assigned the same objective, they may achieve it differently based on their Abilities. Every Character's overall orientation also dictates which Abilities it will most probably use and which it will avoid. This will be explained further when we will explain the decision making process.



## 2.2 Items

Items are important in RPGs as many quests are dependent on them. Normally, Items enhance the capabilities of the Character that owns them within the game and can be used to perform different tasks. We wanted to create a mechanism where any Action can be assigned to any Item and only that Character which contains the Action as one of its Abilities can perform it. Every Item has a set of initial states that define the condition of the Item. Using these initial states, the Actions that can be performed on the Item and the goals to be achieved by a Character, a planning graph is generated that lays out all the possible paths to arrive at the goal states. In short, every Item has a set of initial states and a set of Actions that can be used to achieve the goal states for that Item as shown in Figure 1.

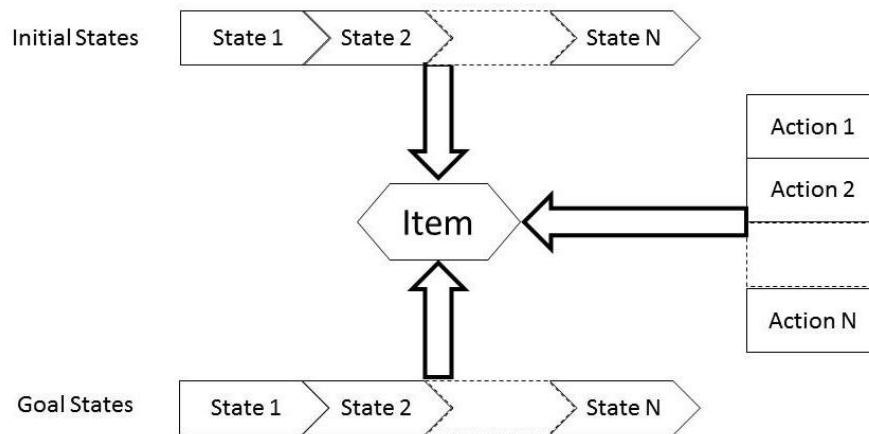


Figure 1. Structure of an Item

## 2.3 Actions

Every Action contains a list of states called Preconditions that need to be satisfied for that Action to be performed. When the Action is done, it produces a list of states called Effects. When Actions are performed in a series, then the Effects of one Action might become the Preconditions of another, thus creating a plan that might reach the goal states.

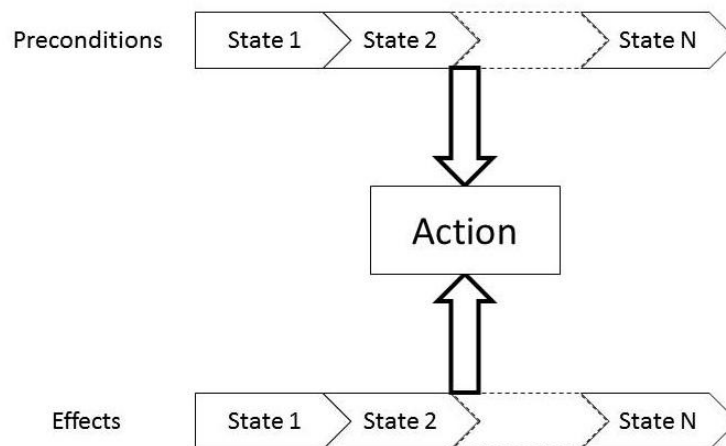


Figure 2. Structure of an Action

Actions themselves have been categorized into two types, Good and Bad. This is done for two reasons; the first being the defining of the orientation of the Characters and the second being the calculation of willingness of the Character to perform that Action during the decision making process.

### **3. SYSTEM SETUP**

Now we will explain how the entire system is setup which includes adding the Items, assigning different Actions to the Items, adding goals of the Characters with respect to every Item and then defining the Abilities of the Characters and their physical appearance.

#### **3.1 Item Creation**

For Item creation, we chose to keep a finite number of Items. This is because of the limitation that there needs to be specific art associated with every item. These items are not the part of the game till they are added by the administrator of the system. The administrator decides how many Items will be present in the system, what will be their initial states and what Actions will be performed on them. The administrator can be termed as the Game Master, which is a more common term used in traditional RPGs. The game master sets up the entire RPG and then the users take part in that RPG and control their characters. Our system allows the same functionality here which is normally missing from the digital RPGs that have come into the market.

#### **3.2 Character Creation**

Character creation is a 2-step process. In the first step we select the orientation of the Character and what relationship it has with every Item within the game. Goal states are added with respect to every Item that the Character is going to use during the course of the game. We also declare one of these Characters as the main Character so that it can be controlled by the user. In our previous discussion (Khan and Okada 2013), we used Genetic Algorithms coupled with Knapsack problem to produce Characters according to the desired orientation. Different numerical values are given to the Abilities that a Character possesses and their combined sum beyond a chosen threshold defines the Character's orientation towards good or bad.

A Character can have good, bad or a mixture of random Abilities. Based on the orientation selected by the administrator, the system automatically selects a combination of Abilities. The administrator however can change this selection if it does not seem satisfactory. Similarly, the physical attributes of the Character are selected based on the choices made by the administrator during the previous run of the system. The administrator can make changes to the physical attributes and then add the Character to a list of parents that will then be used for the generation of the next ideal candidate through sigma selection. The administrator can control the number of generations used to produce the selection. Currently, every Character is composed of 11 body parts and each body part has 50 possible types. Hence the total number of possible combinations that can be used to generate a character comes out to be  $50^{11}$ . For such a huge number of combinations, Genetic Algorithm was deemed appropriate. We use sigma selection because we believe that people belonging to a certain culture will choose Characters which are similar in appearance. With multiple selections the system will learn to produce Characters that best define the choice of the majority of people in a certain demographic.

Once all the Characters have been finalized the administrator can then choose to simulate the system. This will start the game engine where all the Characters and Items will interact with the Items based on their Abilities and the planning graphs that are given to them. Each Character will perform Actions based on a step-wise decision making process, which will be responsible for determining the outcome of the entire simulation. This detail is important as normally, the NPCs do not cause an impact on the overall game as they do not have properly defined errands to run. In this system, every Character can be assigned any objective and then the character will perform actions to achieve that objective. With a decision making process that evaluates the character's orientation and abilities to make a decision, we believe that the outcome produced by the characters will be new every time even if all the characters and items have the same initial states.

## 4. DECISION MAKING PROCESS

A planning problem in AI is usually specified as follows: Given a description of the current states of some system, a set of actions that can be performed on the system and a description of a goal set of states for the system, find a sequence of actions that can be performed to transform the system into one of the goal states (Blythe 1999). Decision Making is a lengthy process which depends on many factors present in our system. As explained before, every Item in our system has some initial states of which all the Characters are aware of and the Characters may have separate goal states for the Item in question. The first step in this process is the creation of a planning graph that uses the initial states of the Item and the Actions that can be done on it and then generates a graph which highlights the order in which those actions should be done to reach the goal states.

### 4.1 Planning Graph

A Planning Graph encodes the planning problem in polynomial time (Blum and Furst 1997) so that many useful constraints contained in the problem become available. The amount of search needed is reduced and it can be created quickly as it has polynomial size. For this, we are using a technique called “Graphplan” and create a planning graph based on the defined rules.

Graphplan was first introduced with the STRIPS language but later more expressive languages like (ADL) Action Description Language (Koehler et al. 1997) and (UCPOP) Universal Conditional Partial Order Planner algorithm (Gazen & Knoblock 1997) have been used in its representation. These languages allow the use of disjunctive preconditions, conditional effects, and universally quantified preconditions and effects in action and goal representation.

We construct our planning graph by following the guidelines as given by Hong (2000) for the construction of a Goal Graph and the literature that we found with regards to the creation of a Graphplan. For our system, we needed an option to create and change a planning graph in real-time as the system is dynamic in nature. As a Character works on an Item, its initial states are bound to change before another Character comes in contact with it triggering the need for the generation of a new planning graph. Once the graph has been created, there can be two or more Actions that lead to the same state at any level of the graph. This requires the Character to choose the most suitable available Action.

### 4.2 Evaluating Choices

In order to make a choice, we need an algorithm that searches for the lowest costing Actions from the goal states to the initial states; we do this by using the A\* algorithm. A\* algorithm is actually a path-finding algorithm used in games (Orkin 2006) and seems to be the ideal fit in this situation. A\* is a directed algorithm and does not search for a path blindly (Matthews 2002) as it allows backtracking. At any point during the traversal, a suggested Action can be rejected because of 3 factors:

#### 4.2.1 Availability of Action

The suggested Action is not available in the list of Abilities of the Character. This means that the graph is sound but the Character does not have the capability of performing that specific Action.

#### 4.2.2 Evaluating Orientation

The suggested Action is against the orientation of the Character. When the graph is created, it might suggest an Action which is low costing, but since it is against the orientation of the Character, it will be rejected in favor of a high costing Action which is favorable to the orientation of the Character. This is done by adding an additional cost to the Actions with opposite orientation during run-time. This change will however not take place for a Character that has neutral orientation.

#### 4.2.3 Character Willingness

The willingness of a Character to perform an Action is defined by setting a certain threshold value above which a random number needs to be generated. For an Action that favors the orientation, this threshold value

will be lower and higher for an Action with opposite orientation. The lower or higher value is dependent on the number of Actions of a certain orientation contained by the Character.

This elaborate decision making process was deemed necessary because we wanted the outcome of the simulation to be as random as possible even with same initial and goal states, Items and Characters. Another strong point of this approach is that, it directs the Characters to a very few number of Actions from a large list which reduces the total overhead generally experienced in FSM. The entire graph is generated automatically thus reducing the need for manual designing.

Every Character has a list of Common Actions that are not considered by the planning graph in our implementation. These Actions are mundane and cannot be used for defining the orientation of the Characters. Therefore they are the same for every Character in the system. They however facilitate in performing the Abilities of every Character. For example, if a Character needs to give an Item to another Character, then the other Character needs to be in the vicinity of the first Character. Otherwise the Character will first need to perform the Walk Action to reach the other Character and only then can it perform the Give Action. The end result of the planning graph is the generation of an Action order list; that is, a list that dictates the order in which Actions should be performed. On the basis of whether an Action can be performed or not, it is either removed from the list or a new Action is added to the list as shown in Figure 3.

We wanted to mimic the behavior of an actual human when deciding about performing Actions. Humans exhibit indecisiveness, determination, and clarity of thought, procrastination and other emotions while performing their daily business; this multi-step decision making process hopes to accomplish a similar response from the NPCs in our system. We could have easily accomplished this by only using random number generation for the performance of any task, but we wanted the orientation of the Character to play a major role. As a result, we can speculate how the entire scenario will play out as according to the orientation of the Characters, but we can never be entirely sure of it. This goes according to the natural behavior of the people where we can decide what the outcome will be based on the capacity of the individual to do good or bad.

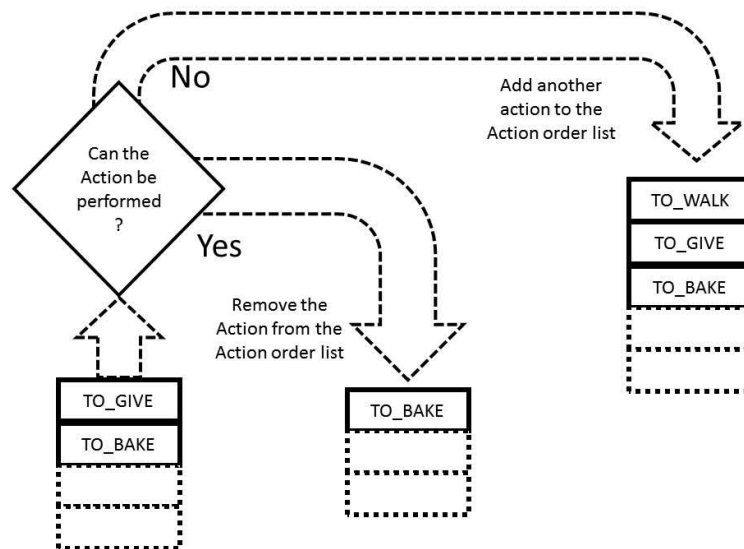


Figure 3. Changes in Action order list

### 4.3 Multi-step Decision Making

To completely understand this decision making process, we need to explain the complete working of the system. This process starts when the game iterates through the list of Items which have goal states assigned to them in a Character’s inventory. Once an Item is identified the system sends the initial states and the goal states and a list of all the possible actions that can be done on the Item to a DLL which contains the code for the creation of the planning graph. Based on this information, the DLL generates the Action order list which contains the Actions that can be performed to reach the goal states as explained in Figure 4.

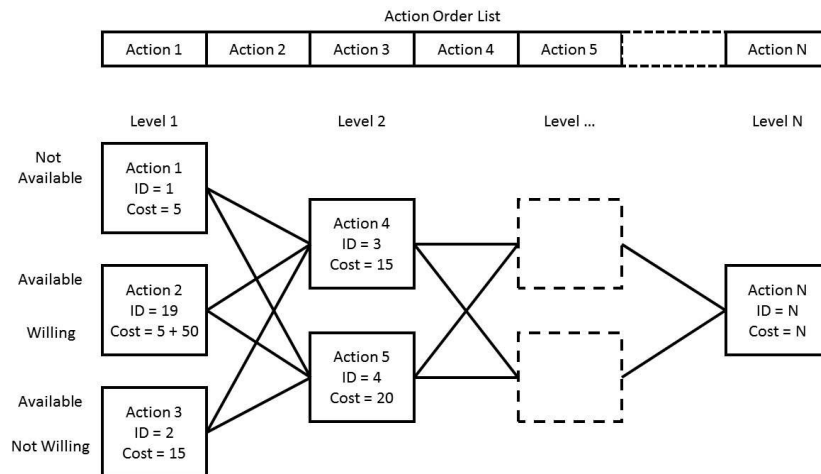


Figure 4. Decision making process

According to this figure, suppose that a good Character demands a planning graph and gets the Action order list. Based on the Actions present in the list, the graph is generated that contains all of those Actions that lead to the goal states. These actions are distributed into levels and we consider that all the Actions in level 1 lead to the Actions in level 2 and so on. Now any one of the first 3 Actions can be selected and going by the A\* algorithm, the Action with the lowest cost will be selected. Both Action 1 and 2 exhibit the lowest cost among the 3 options. Therefore the system will first check for the Availability of Actions. In this case Action 1 is unavailable as it is not one of the Abilities of the Character; therefore that Action will not be selected.

The second step will be to check the orientation of the Character. As explained in our previous discussion (Khan and Okada 2013) this is dependent on the ID of the Action to be above or below a certain threshold value which in this case is 10. In order to ease the working of the A\* algorithm, we add a certain high value to the original cost of the Action 2, thus increasing it beyond any possible good Action cost. The A\* algorithm will pick Action 3 as the favorable Action in this scenario.

However, the Character might choose to not select Action 3 thus limiting the accessibility to the algorithm. The A\* will backtrack and select Action 2 even though it goes against the orientation of the character, because it was the only doable Action left.

From this example, we can see that while the A\* algorithm works, it has to go through several checks that depend on the personality of the Character and the Abilities that the Character possesses. At the same time, the Character needs to check repeatedly if the generated plan is still applicable with the passage of time. This is because some other Character might change the initial states of the Item in question. If a change has taken place, it will result in the generation of a new planning graph. With these steps present in the decision making process, we hope to produce a human like response from the Characters while they try to achieve their goals.

## 5. CONCLUSION

The aim of our research is to create a game environment where all NPCs in the game behave autonomously in order to achieve their goals. The NPCs are created by an administrator of the system which decides on their physical appearance and orientation. At the same time the NPCs are given a list of abilities that they can make use of during the running of the game. Items are also added to the game and the NPCs are given goals with respect to those items that they must achieve. The NPCs create a plan and once they get the order in which to carry out the actions, they act on it using an elaborate decision making process. This decision making process helps in deciding whether an action can be performed or not thus producing a totally different end result of the game than the previous iteration. As a result, the end-users will always experience a different playing experience when using the system thus increasing the life-cycle of the single player component of the game.

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# KEY PRINCIPLES OF THE GOOD INFORMATION SOCIETY

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## ABSTRACT

What is the good information society? It is a vital question but one that is rarely asked, still less satisfactorily answered. This paper addresses the issue in three stages. First, it analyses what is meant by the terms ‘information society’ and ‘information revolution’, drawing upon the pioneering ideas of scholars such as Daniel Bell and Manuel Castells. Secondly, it sets out a theory of the good society inspired by idealistic thinkers of the Victorian era, who found themselves in a structurally similar position to our selves, struggling with normative problems brought about by a sociotechnical paradigm shift. We can, it is argued, apply nineteenth-century principles to twenty-first century problems. The final main section briefly assesses a particular model, using first-hand observation of a ‘micro’ information society in the making in the United States. Does it meet the criteria of the good society, or is it taking us in the wrong direction? The paper concludes with the suggestion that the future hangs on our picking the correct model.

## KEYWORDS

Information Society Information Revolution Common Good T.H. Green Californian Model Possible Futures

## 1. INTRODUCTION

In this paper<sup>1</sup> I wish to discuss the nature of the good information society, surely an important, and hopefully also an interesting, topic. I am hoping thereby to provide a clearer idea of what the information society ought to be. The topic will be covered in three parts. The first section makes clear what I mean by an information society, still quite a disputed term. The second sets out, insofar as space allows, a philosophical theory of the good society, calling upon some ideals from the nineteenth century, the much-maligned Victorian era. Thirdly, I will be bringing things right up to date and looking at Silicon Valley to see whether it offers a practical model of the good information society.

## 2. INFORMATION SOCIETY AND INFORMATION REVOLUTION

Let us start by asking: what exactly is the information society? There are numerous opinions about this, lots of definitions, and probably everyone at IADIS 2015 has their own view. I believe that there are actually three strands of argument packed into the information society thesis and that these are usually confused. First, there is a claim about the transition in rich nations from manufacturing economies based on the production of goods to service economies based on the processing of information. The work of economists like Fritz Machlup (1962) and Marc Porat (1976) was important in laying the groundwork for this idea of the information economy, but it was the Harvard sociologist Daniel Bell who established it in his classic book *The Coming of Post-Industrial Society* (1973). Bell has had his critics, but few today doubt that his analyses and forecasts about socioeconomic change were more or less accurate. He put his finger on the sense that we

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are living through the ending of one era and the birth of another. That is what can be called the American version of the information society thesis.

The second line of argument is about a communications explosion and this should be credited to the Japanese. There had been previous attempts to estimate the huge increase in flows of various kinds of information—everyone sensed that they were on an ‘exponential’—but the Japanese were the first to properly measure it, in their annual information flow census. They proved beyond doubt that their nation was undergoing what they call ‘johoka’, a process of informatisation, and turning it into a ‘joho shakai’, an information society. Little credit is given to the Japanese, but they did not just measure the information society, they coined the very term, in 1964, long before anyone used it in the West. So we must respect the Japanese contribution to information society studies (Duff 2000b).

The final and most well-known development is of course the information technology revolution that we are all experiencing. This is of course what the press and the general public mean by the information society. As I have just suggested, they are mistaken to think that this is all there is to it, but there can be no doubt that ICTs have been having a massive impact on our economies, cultures and politics (e.g. Shallis 1985). I would also be happy to concede that without information technology, and particularly the personal computer, the other long-running developments already mentioned, namely the move from materials to information in the economy and the information-communications explosion, would not have been enough to push industrial society over the edge into information society. So the information society thesis is really a synthesis of three things, a post-industrial economy, a communications explosion, and information technology—especially computerisation (Duff 2000a).

The leading theorist of all this now is of course Manuel Castells, who right at the start of his trilogy *The Information Age* endorses the concept of an information revolution, writing that ‘The information technology revolution, because of its pervasiveness throughout the whole realm of human activity, will be my entry point in analyzing the new economy, society, and culture’ (Castells 1996, p. 5). Castells can be saluted as a worthy successor to Bell, but I should like to pause just for a little on this claim about revolution. The industrial revolution brought about not just technological and economic changes but also a shift in the basis of power, away from ownership of land to ownership of capital and factories. Is the information revolution giving us another upset like that?

Some say yes (e.g. Masuda 1981; Brate 2002). But others do not see such a great difference. A new technoeconomic paradigm perhaps, perhaps even a new sociotechnical system, but not a new society. Some even say that the information society is just a continuation of the industrial revolution by other means, just capitalism turning to information and intellectual property now that it has more or less exhausted all our reserves of oil and cheap labour. In other words, it is only the revolution of a fixed wheel (Webster and Robins 1986; May 2002). I have some sympathy with this critique, but I think that it overstates its case. It sets the bar too high. We all accept that there was an industrial revolution, but that did not eliminate agriculture or the influence of landed wealth. Information is indeed a new force in society, and it is undoubtedly having weird and wonderful effects on our normal ways of doing things. There is at least *some* evidence of a knowledge class and of a new politics. As a result, industrial-era institutions are not as comfortably in control as they used to be. There are still constants, but also enough innovations to validate a moderate claim about information revolution and an information society. Anyway, that is my own position, and it is why I feel able to conclude this section with the declaration that, if it is carefully unpacked and weighed—if one dumps all the technological utopianism and determinism—the information society thesis can be held as true. Or, if I may be permitted to put it in more grandiose language, ‘the existential crisis of the information society is over’ (Duff 2012, p. 1).

So the issue is now not, are we living in an information society, but what kind of information society ought it to be? It is this second question—a normative one—that I want to try to address below. I would put it as strongly as this, that while the existential crisis is over, we are in the midst of an even bigger *normative* crisis, over issues like access to information, privacy, copyright, content regulation, etc, and at a deeper level a crisis over what is the very meaning of the ‘good society’ in an information age. This is a question not so much for information science or social science, as for political philosophy. In my recent work, I have been digging right down into the nineteenth century for answers. Why? Because the thinkers of the industrial revolution faced similar challenges to ourselves: a time of unprecedented, unsettling change, of restructuring and paradigm shift, and they had to work out principles that could guide their society through those frightening changes. We, I am convinced, can learn from at least some of the principles that they arrived at, and apply them suitably updated to our own situation.



### 3. A VICTORIAN IDEAL OF THE GOOD SOCIETY

So what is the good society? That is of course a massive question and space does not allow a fully-fledged theory. So I want to focus on the work of one Victorian thinker, the idealist T. H. Green (1836-1882). He is probably not very well-known to most e-Society participants, but he has a respectable place in the history of philosophy as the leading figure of the Oxford Hegelians, and the author of two excellent works, *Prolegomena to Ethics* (1883) and *Lectures on the Principles of Political Obligation* (1986). He has been more or less eclipsed by contemporaries like Jeremy Bentham and Marx. That is highly regrettable, because Green has as much to teach us today as these two, or anyone from his era. I am not alone in thinking this. There is a growing number of what might be called Green revivalists, not just specialists such as John Rodman (1973) and Colin Tyler (2010, 2012), but people such as Roy Hattersley, one of our most distinguished British politicians. He was once asked by a journalist, 'What is the philosophical basis of English social democracy?' and replied, after a pause, 'T.H. Green' (Tyler 2010, p. 15). What none of the other Green enthusiasts has done, however, is work out how Green's ideas apply to the information age. That is what I am trying to do, so could have headed this section of the paper, 'Cyber-Green' (cf. Duff forthcoming). I am borrowing this title from Nick Dyer-Witheford, author of a highly-cited book entitled *Cyber-Marx* (1999), but I trust that he will not mind; imitation is of course the sincerest form of flattery. My effort to retrieve nineteenth-century insights is part of an ongoing project called *Informing the Good Society: New Directions in Information Policy*, similar in intention to the twentieth-century effort coordinated by Christopher May (2003).

Step 1 of Green's philosophical project was rejection of the utilitarianism of Bentham and Mill, with its slogan of 'the greatest happiness of the greatest number'. This had become virtually the official ethic of British and indeed western policy-making, and it still is, but Green thought that it had two fatal flaws. In the first place, it is hedonistic, making happiness, understood quite crudely in terms of pleasure, the goal of policy. This for Green, who was influenced by left-wing Christian moralists such as John Ludlow (1881) and F.D. Maurice (1872), was fundamentally immoral. Secondly, it is majoritarian not universalistic, leaving open the possibility of some people's rights being traded in to maximise the welfare of others. And that, as John Rawls would later persuasively demonstrate (1971), is fundamentally unjust. In its place, Green offered a superior theory based on universalism and a more elevated understanding of the good.

The key concept in his philosophy was the common good, a term we rarely hear these days. Green meant by it the self-realisation of every member of society. But self-realisation is not just about maximising pleasure over pain, because we do not just have an animal, empirical nature, but also a higher, ideal self and it is in the cultivation of this higher self that true fulfilment is found. Green also believed—and this is crucial—that the individual could not achieve self-realisation in isolation, that we are programmed, as it were, maybe by God himself, for fellowship and interaction. In a notorious idealist slogan, but an attractive one, man (he championed women) is a concrete universal. So Green's was very much a social and civic idealism. And unlike some intellectuals he practiced what he preached by getting elected to the city council and spending several nights a week at various public meetings. Anyway, he arrives at a richer formula of the good society than that of the utilitarians, as an egalitarian community of synergistically-interacting higher selves. This he believed was the ultimate goal of reform in the context of industrialisation, and I would in all seriousness suggest that it should remain our guide today. So the first step was to show what was wrong with utilitarian welfarism and the second was to replace it with a stronger theory of the good.

The third essential step in Green's philosophical project was to validate the role of the state. As he put it in a famous quote from *Principles of Political Obligation*, 'the state is an institution for the promotion of a common good' (Green 1986, p. 437). Again, this is a message that we need to hear today, perhaps more so than at any time since the nineteenth century and especially in information society circles, where antistatism is rampant and the state is often dismissed as a dinosaur from the industrial era. The key word here is 'promotion': Green believed in an interfering, what we might call a proactive state, one that, contrary to the Establishment ideology then and now of *laissez-faire*, steps in to combat the atomism and entropy of the market. It should be, to quote a few of Green's lovely phrases, a 'remover of hindrances', a 'harmoniser of social relations', and a 'powerful friend of the poor' (Green 1986, pp. 453-454). I cannot go into the full argumentation, but I have selected a few core policies which I believe can be deduced from Green's ideas. These then are in nucleus the principles of the good society, updated to the information age:

*First, the Good Society has Informed Citizens*

Green's ideal of active citizenship required a strong infrastructure of information institutions, such as newspapers, libraries and discussion forums. He personally set up a Working Men's Institute in Oxford, where people could go after an honest day's work in the factory. It was a kind of prototype Habermasian public sphere, where ordinary people could get the best information on the topics of the day and engage in 'the rational and temperate discussion of public affairs'—Green's words, not Habermas's. This of course implies leisure time in the evenings, a point I will return to when discussing Silicon Valley below.

*Second, the Good Society is an Open Society*

Green's work also provides the philosophical basis for what we now know as open government and freedom of information. His doctrine of the common good was always dynamic; because industrialism had brought exploitation and pollution the common good required factory legislation and municipal sanitation. Now that information is a central resource, the state needs likewise to pass laws to ensure easy and safe access to the machinery of government.

*The Good Society Promotes Fair Use*

As regards political economy, Green was an advocate of a mixed economy and in this he is arguably more relevant than Marx. He believed strongly in the right to private property, which he regarded as essential for the realisation of the higher self. But he also believed that the state should continuously review the operation of property rights to make sure that the common good was being secured. Much like Rawls, he argued that the appropriation of finite resources is acceptable only if it contributes on the whole to social well-being. So while Green's work supplies a basis for the rewarding of creative labour, it also clearly points to firm limits. There is no way that the ongoing relentless vertical and horizontal expansion of intellectual property rights is compatible with the ideal of an egalitarian, synergistically-interacting community of selves. In fact, Green's entire political philosophy could be read as an essay in fair use.

*The Good Society Regulates Content*

A weakness, arguably, of twentieth-century philosophy's preoccupation with social justice is that other aspects of the good society were forgotten. Goodness is about justice but also, old-fashioned though this might sound, other virtues like self-control. According to Green—a temperance activist—the good society needs to be morally good in the narrow sense, to have standards of public morality. As a parent, at least, I agree, and I am increasingly alarmed at what is freely available, particularly on the internet. Utilitarian hedonism cannot help us here, since it is essentially a philosophy of bread and circuses, of giving people anything they want. Responsible politics for Green was also about giving people what they objectively need, and for that we need the standard of the moral or ideal self. This is perhaps a culturally conservative element in Green's thought, but it is none the worse for that. I am not implying that we have to go back in toto to Victorian morality, only that we should retrieve that Victorian sense of boundaries, of certain moral limits on the personal and political exercise of liberty.

*The Good Society Protects Privacy*

Last but by no means least, the good information society protects privacy. Green was adamant that the distinction between the public and the private should always be respected and now, in the internet era, this boundary is surely in acute need of repair. As Wikileaks disclosures illustrate, states surveil without restraint the activities of innocent citizens. Employers for their part increasingly disrespect the convention of office hours—a major achievement of the Victorian reformers of the industrial period—by demanding continuous availability. Facebook's founder has literally declared the obsolescence of privacy as a social norm. Given that totalitarianism, the total suppression of private life, is for the first time in history a real possibility, the battle to contain intrusive social power may now be the supreme democratic issue of the 21<sup>st</sup> century. I am not saying anything new here, but I might add, just to tie this section up, that it is possible that privacy will never be secure in the absence of widespread subscription to a thicker metaphysics of the self than what is on offer in contemporary empiricism. Green basically saw the higher self as sacred. It was this metaphysical status that for Green dignifies every human being, setting non-negotiable limits on state and other modes of interference. I am among those students of Green who believe that he was right.

While the foregoing may have been abstract, even abstruse, I hope that it has provided a basis for considering the case that the Victorians in general, and Green in particular, remain a relevant and inspirational normative resource, and that, in some ways, we need precisely what many people say we do not need: nineteenth-century principles for twenty-first century problems.

#### 4. THE CALIFORNIAN MODEL

This final main section will be much more concrete. Specifically, I wish to ask how a particular space-time location, namely California's Silicon Valley in its current incarnation, measures up as a site of the information society. Cyber-Marxists dismiss it outright as a hot-bed of alienation, of the 'Californian ideology' (Barbrook and Cameron 1996; Dyer-Witheford 1999, pp. 96-98). While such is not my view, I too reject the triumphalism that normally accompanies Valley pronouncements, and I certainly do not think that this extraordinary business cluster is off-limits for normative critique. On the contrary, I am increasingly worried about the popular view that Silicon Valley is some kind of model information society. So let us treat it fairly as a case study and see what the real lessons are.

Silicon Valley, which is generally taken to include the cities of San Francisco and San Jose, is the nickname for Santa Clara County, formerly—perhaps surprisingly—the prune capital of the United States. It is of course now the home of several thousand technology companies, notably Oracle, Intel, Twitter, Apple, Facebook, Google, eBay, PayPal, YouTube, Netflix, indeed seemingly more or less 'everyone' in information technology. These are the brands that are arguably remaking the world—the new 'masters of the universe'. The Valley has the highest concentration of self-made millionaires in the world; even the masseuse and the cook at Google became such when the company went public. Another hard fact: Valley companies absorb an astonishing one-third of the entire venture capital of the United States (Rao 2013, p. 21). The conventional wisdom puts all this success down to a combination of factors: the frontier spirit of the 'Wild west', the lack of political regulation, the presence of Stanford and other universities, the waves of immigration, large contracts for research and development from the US Defense Department, the talent of people like Steve Jobs and Larry Page, and of course the Bay Area sunshine. At a deeper level, scholars say that the way to understand Silicon Valley is to see it as a very unusual, probably unique, combination of materialism and idealism. People flock there hoping to make their fortunes, as they did during the Gold Rush in the 1840s. But it is not just about money; there has also been a strong element of idealism, in the ordinary sense of a desire to do something to change the world, to make it a better place. This mentality of course goes back to sixties San Francisco and outfits like the Home Brew Computing Club, whose members included two of the world's most famous drop-outs, Steve Wozniak and Bill Gates. Some at least of these adventurous individuals really believed that microcomputers could connect and perhaps even save the world (Forester 1990; English-Lueck 2002; Turner 2008).

Anyway, as a teacher of information society studies, I felt that it was my duty to get out there and see with my own eyes the place I had been referencing for years. So I travelled in the summer of 2014 on a Carnegie grant, and interviewed a wide range of people. I wish to mention some of my interviews and observations, in the spirit of field notes rather than sophisticated theory. As regards the celebrated new start-ups, I found many of them to be distinctly unhelpful. Google refused repeated requests for an interview, as did several other prominent companies. However, one top brand did agree to let me speak to their chief technology officer (CTO, next only to CEO in Valley pecking order), but only on condition of anonymity and with a press officer present. I asked the CTO if he saw himself as an 'information revolutionary'. He replied: 'not on a daily basis, but yes, sometimes, when something politically important happens using our product'. He also saw his company as directly challenging the mass media, on the same scale as the Gutenberg revolution. And he asserted that Silicon Valley is definitely the centre of the information revolution, just as Wall Street and London are the centres of the financial world. On close questioning, he acknowledged some of the downsides, the dubious copyright behaviour of some companies, the displacement of jobs, the privacy threat from data mining, but he was emphatic that the answer to social problems is not the state. I met such antistatism all over the Valley.

Another interviewing coup was Howard Rheingold, known locally as 'the first citizen of cyberspace' and credited with coining the terms 'virtual community' and 'smart mobs'. He is a colourful personality and a personification of techno idealism. He was strongly of the view that ideals have been a significant factor in Silicon Valley. He cited Doug Engelbart, inventor of the computer 'mouse', and also Elon Musk, formerly of PayPal and now pioneering electric cars and space travel. However, he was emphatic that this idealism has always operated strictly within capitalism, not as an alternative. Computers carried the ideal of personal empowerment, but they are also about large-scale selling. And he is quite cynical about recent developments. For example, he said that one would have thought that the Snowden revelations would have been a 'Chernobyl' for the privacy issue, but it has not turned out that way. Nothing has changed. The revolution is

not having the desired impact. I detected very frequently this sense from the older respondents that something has been lost.

I also interviewed James Gosling, who invented the Java programming language. Gosling is another child of the revolution and he too agreed that the Valley used to be, and to some extent still is, powered by ideals. He told me that everyone at the beginning saw computers as intrinsically democratic, unlike one-way TV, and that they were a genuine threat to the political and media Establishments. And he put his principles into practice by giving Java away for free—that is why it has been called the ‘Esperanto of the Internet’. Another older source I met was Skip Vaccarello. He too was there in the early days, working as marketing director for Visicorp, whose claim to fame was VisiCalc, the first effective computer spreadsheet and the ‘app’ that made the Apple 2 an overnight success. What one might call a classic ‘organisation man’, he was initially totally positive about the Valley but on probing even he acknowledged some negative aspects. He admitted that the pace is much quicker now, in fact too quick. He also agreed that there is excess in the work culture, for example that working days are abnormally long. He said that his wife felt ostracised when she stopped paid employment to have a baby. He had recently counselled a younger person on just this issue.

An experienced engineer I interviewed was also concerned about the directions in which Valley traditions were moving. This well-grounded Scottish expatriate has worked for many companies, as is the norm, including ‘big names’ like Salesforce.com and Amazon, but he is sceptical about the fragile business models of some of the newer companies, such as Facebook. He does not think that he could get a job there anyway, because he is too old—the cult of youth in Silicon Valley is obvious to everyone. He mentioned also the patent wars that rage in the background all the time. Nor does he like the crossing of the boundary between work and play. He does not engage in work emails at weekends, but finds that many of his colleagues do, and he is finding it increasingly difficult to hold the line. It is a massive problem out there, and it is spreading across the globe—a symptom, surely, of the normative crisis of the information society.

Danese Cooper embodies the dualism to which I have been alluding. She is a well-known open-source activist; in fact, according to *Wikipedia* this has earned her the nickname ‘Open Source Diva’. She now works for San Jose-based online payments company PayPal. I asked her how that capitalist world fits with open-source ideals. Her response was that she wants to make international payments easier for marginalised people such as economic refugees, so that they can send their earnings home to their families without transaction records and without a large cut going to banks and other middle-men. She says that one gets much further faster working within the system than by utopian schemes outside. However, given the harsh fact that PayPal abandoned WikiLeaks when the political heat on the whistle-blowing website went up, it is hard not to see this stance as somewhat naïve.

Finally, there was a splendid character whom I met next to the railway track in San Antonio. A migrant from Texas, unemployed, age 63, Vietnam veteran and Black. He offered a completely different perspective. He believes that the system is totally rigged, that the Valley is infinitely far from being any kind of utopia. His debunking statements included: ‘We have people walking around with experience who cannot make it’; ‘I was in the communications corps in ’Nam and I am not eligible [for telecoms jobs] round here’; and—my favourite—‘These people in Silicon Valley are selling our secrets, yet they don’t trust me!’

## 5. CONCLUSION

There is a surfeit of eulogistic literature about Silicon Valley (e.g. Piscione 2013), but the best social science has picked up the ‘dark’ sides alluded to in the fieldwork data. For example, Everett Rogers concluded in *Silicon Valley Fever* (1984) that the area’s most striking feature is not technological marvels but socioeconomic inequality. So what were my own conclusions, and, more particularly, to what extent does Silicon Valley model the good information society, as that has been construed above? The answer is that it is a mixed picture. I do not think that we can condemn Silicon Valley completely. Some good work is going on. Interesting jobs, fine algorithms, creativity, a smooth-running and failure-friendly business ecosystem, new, somewhat cleaner wealth (compare ethically the tech billionaires with, say, the average Putin oligarch), a culture of information sharing, an openness to immigrants, multiculturalism, etc. But the good information society it is not. Most of my informants and observations showed that there is undoubtedly still an element of idealism, but also that it is an idealism subject to a very primitive, irresponsible, almost infantile form of capitalism (Borsook 2000).

It does not fulfil the Greenian ideal not just because too many people are excluded but because even the included are not leading healthy, fulfilled lives. I observed very few public goods. There seem to be few parks, few swimming baths, few places to walk, few places of worship, very little culture, very little philanthropy, very little politics, very little evidence of San Francisco-style people-power. If the norm is that people work 24/7/365—a term originally designed for computer mainframes, not human beings—local politics and other vital civic and social activities are not going to happen. Privacy and private life too are simply disappearing. And while there might be an abundance of venture capital there seems to be very little social capital in this heartland of the worldwide information revolution. (As someone else has observed, in Silicon Valley no one knows anyone else's mother!) The attitude to the state is also the antithesis of Green's philosophy. Silicon Valley might have started out ethical, but it is turning more and more into an acquisitive society; it is almost 'cowboy' capitalism, almost, indeed, a form of (post-industrial) piracy. It is clear that the Valley is producing social innovations as well as technological ones, but many of them should not be welcomed, not if we want to build a good information society. And my worry is that the Valley is de facto showing us how things are going to be if we do not do something to stop the process. Societies will become much more subject to technological and market imperatives, more frenetic, individualistic and acquisitive, less spiritual, less civic, less human. What will be the Next Big Thing to come out of Silicon Valley? I am not sure, but I am fairly certain that it is not going to be a model of how we should live. What we can learn from its example is the faith that information technology can change the world—if properly used by individuals, corporations and the state. So let us imbibe the information revolutionaries' optimism, let us share their highest ideals, but let us also keep our feet firmly on the political and economic ground. Let us not be foolishly utopian, but instead let us take the trouble to build the infrastructure of a robust, just and sustainable sociotechnical system, one governed by time-honoured and universal principles of the good society.

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# REPRESENTATIVENESS OF GERMAN PARTIES AND COALITIONS IN THE 2013 BUNDESTAG ELECTION

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## ABSTRACT

The goal of the paper is empirically evaluating the representative capacity of German political parties and that of the 2013 Bundestag and the Bundestag coalitions. For this purpose, the positions of German parties, Bundestag and Bundestag coalitions on 36 policy issues are compared with the results of public opinion polls, and the indices of popularity (the average percentage of the population represented) and universality (frequency in representing a majority) are constructed. The 2013 election winner, the CDU/CSU, is shown to be the least representative among the 28 parties considered. The most representative among the four parties in the Bundestag (with >5% of the votes) is DIE LINKE, which received only 8.6% of the votes. The representativeness of the Bundestag is about 50%, not much surpassing the decision results when on every policy issue a coin is tossed. The current practice of parliament coalition formation aggravates the situation even further. The cause of such a low representativeness of both parties and coalitions is the ‘irrationality’ of the voters themselves, who vote inconsistently with their own political profiles, disregard party manifestos, and are likely driven by political traditions, even if outdated, or by personal images of politicians. Finally, an alternative election method, which is shown to improve the representativeness of the Bundestag, is discussed.

## KEYWORDS

Mathematical theory of democracy; German parties; coalitions; Bundestag election 2013; indices of representativeness.

## 1. INTRODUCTION

Table 1 shows the four German parties which, having received > 5% of the votes in the 2013 federal election, are eligible for the Bundestag seats. The goal of the paper is empirically estimating the representativeness of these and other German parties, of the Bundestag, and of the Bundestag coalitions from the viewpoint of direct democracy. For this purpose, we compare the parties’ positions, as well as that of the Bundestag and the Bundestag coalitions, on 36 topical policy issues with the outcomes of public opinion polls on these issues and construct indices of popularity (average percentage of the population represented) and universality (frequency in representing a majority), according to the methodology described in (Tangian 2014).

The results of our study are discouraging. The 2013 election winner, the CDU/CSU, is the least representative among the 28 parties considered, the Bundestag’s representativeness is about 50%, the same as if its position on every policy issue were decided by coin tossing, and the representativeness of the governing coalition CDU/CSU-SPD is even lower. We explain the low representativeness of the Bundestag elected by the known phenomenon of irrationality of the voters (Caplan 2006, Leighley 2010) who may vote unreasonably, even contrary to their own interests.

Table 1. Results of the 2013 German Bundestag election

	CDU/CSU (conservative union)	SPD (social-democrats)	DIE LINKE (The Left)	GRÜNE (The Green)	Other 25 parties (< 5% of the votes)
Votes (%)	41.6	25.8	8.6	8.4	15.7
Bundestag seats (%)	49.3	30.6	10.1	10.0	—

Source: Bundeszentrale für politische Bildung (2013)

The contradiction with the rational voter model is sometimes explained as *rational ignorance* (delving deeply into sometimes explained as rational ignorance (delving deeply into the matter for an optimal choice

is too costly and makes little sense, especially because of negligible role of one vote (Downs 1957, pp. 244–46, 266–71), or in terms of expressive voting (since a single vote is not decisive, one can vote altruistically ‘for its own sake rather than to bring about particular consequences’ (Brennan and Lomasky 1993, p. 25). Besides, voters are often influenced by *a priori* judgments about the candidates’ platforms or pay more attention to the candidate’s personal images than to their actual political profiles and real merits (Adams, Ezrow, Somer-Topcu 2011, pp. 219–221, Manin 1997). The seemingly arbitrary behavior of voters is also explained by the existence of issues beyond the political agenda, including ideological, religious, ethnical, traditional, cultural, and intellectual reasons (Roemer 1998). Some authors even suppose that electors can intentionally vote for non-favorite candidates (Alesina and Rosenthal 1995, Kedar 2009). For instance, one who prefers a moderate policy can vote for the left party to shift the conservative status quo to the left-wing direction. This practice of compensatory voting resembles bargaining when the sides declare extreme requirements to finally come to a medium agreement.

Most authors, recognizing the gap between voters’ preferences and political reality, nevertheless defend the viewpoint that, in representative democracy, political institutions are well controlled by the public. It is argued that the electorate is not as superficial as it seems (King 2002, Kedar 2009, Soroka and Wlezién 2010) and, on the other hand, regular elections with variable results provide an adequate electorate’s feedback about the policies pursued (Stimson, MacKuen and Erikson 1995, Manin 1997, Powell 2000, McDonald and Budge 2005, Kedar 2009). Policymakers are however more concerned than scholars, characterizing the same situation as democratic deficit, which is currently being discussed at all political levels, including the European Union and the United Nations (European Union 2014, UN Parliamentary Assembly 2008). Only recently, scholars started to realize the real problem:

We find no substantively or statistically significant evidence that voters adjust their perceptions of parties’ Left-Right positions in response to the policy statements in parties’ election manifestos — a conclusion that is striking given that interviews with European political elites that we conducted (discussed below) suggest that parties campaign on the basis of these manifestos . . . By contrast, we find that European citizens do react to their perceptions of parties’ Left-Right positions, i.e., citizens adjust their Left-Right positions and their partisan loyalties in response to the parties’ policy images . . . But, because voter perceptions do not track the parties’ actual policy statements, there is a disconnect between shifts in elite policy discourse and voter reactions. Voters react to what they perceive the parties stand for, but these perceptions do not match up with the actual statements in the parties’ policy manifestos, which form the basis for the parties’ election campaigns (Adams, Ezrow and Somer-Topcu 2011, p. 371).

The superficiality of voters and insufficient attention to party profiles would be not much dramatic if it would imply no discrepancy between the electorate and the government. Now the latter manifests itself in the readiness of society to explode at a minor impulse. For instance, the German population responded with unprecedented violence to quite ordinary and rational decisions, like constructing a new railway station in Stuttgart to replace its terminus by modern through-tracks for rapid trains (Protest gegen Stuttgart 21 2012) or transporting and disposing nuclear waste (Castor-Transport geht auf schwierigste Etappe 2010). The discrepancy between the electorate and the government is clearly detected by our model. A serious warning is the low representativeness of moderate parties and high representativeness of extreme right and left parties. Currently they receive few votes, but if the discrepancy between the citizenry and government will increase, the people can suddenly realize it and elect extreme politicians.

## 2. THE PARTIES’ AND THE BUNDESTAG INDICES

The party positions are taken from the voting advice application *Wahl-O-Mat* (Bundeszentrale für politische Bildung 2013)— an internet site of the German Federal Agency for Civic Education. Recall that the *Wahl-O-Mat* (an invented word composed from the German *Wahl* = election and *Automat*) is the German version of the Dutch *StemWijzer* (VoteMatch), which was originally developed in the 1990s to involve young people in political participation. Both websites help the users locate themselves on the political landscape by testing how well their opinions fit with party positions. Before an election (local, regional, federal, and even European), a special governmental supervising committee compiles a list of questions on topical policy issues (‘Introduce minimum wage?’—Yes/No, ‘Introduce a general speed limit on motorways?’—Yes/No,



etc.) and asks the parties participating in the election for their answers. A user of the site answers the same questions, eventually attributing weights to reflect their importance, and then the program compares his or her political profile with that of the parties and finds the best-fitting party, the next best-fitting party, etc. No statistical data are available from the Wahl-O-Mat, and if any were available, they would be biased toward internet users. Therefore, by any reason, the balance of public opinion is better reflected by relevant public opinion polls. For the given model, we consider the Wahl-O-Mat answers of 28 German parties participating in the 2013 Bundestag election and the results of 36 public opinion polls relevant to 36 out of 38 Wahl-O-Mat questions. The full information on the party answers with their comments on them as well as on the public opinion polls with all the references is given in (Tangian 2013).

Figure 1 shows the balance of public and Bundestag opinions on 38 topical policy issues, as well as the position of the DGB (Confederation of German trade unions, whose influence in Germany is compared to that of political parties). To explain the figure, consider the top question: '1. Introduce a nationwide minimum wage'. The question number '1' is as in the 'official' Wahl-O-Mat questionnaire filled by the parties shortly before the Bundestag elections 2013. The small red rectangle above the blue bar shows the Yes/No position of the DGB, which does not participate in the election but nevertheless has a position on the issue. The balance of public opinion on the issue 86%: 12% is shown by the blue bar whose length is normalized to 100% (the abstained are ignored). The length of the bar on the left side and on the right side of the central axis corresponds to the percentage of antagonists and protagonists in the society, respectively. The blue bar's bias from the center indicates at the prevailing public opinion. A Bundestag faction is depicted by a rectangle with the 'official' party color. Its length is proportional to the number of the party seats in the Bundestag. The 'No/Yes' party opinion on the question is shown by the location of the rectangle to the left or to the right of the central vertical axis, respectively. A Bundestag majority is attained if the cumulative length of party rectangles surpasses the 50%-threshold (marked with dotted lines). If the position of DGB, public, or party is unknown, the corresponding rectangle is missing.

Let us show how these data are used to construct the party indices of representativeness. For every question, a given party represents a certain fraction of the population (identified with the fraction in the opinion polls). For instance, the CDU/CSU with their 'No' answer to the first question '1 Introduce nationwide minimum wage' represents the opinion of 12% of the population versus 86%. After removal of abstaining respondents and normalization, we obtain the CDU/CSU representativeness for Question 1:

$$r_{\text{CDU/CSU},1} = 12 / (12 + 86) \times 100\% \approx 12.2\% .$$

Answering 'Yes' to the next question '2 The parents of children who do not attend day care should receive a childcare subsidy', the CDU/CSU expresses the opinion of 20% of the population versus 77%. After removal of abstaining respondents and normalization we obtain the CDU/CSU representativeness for Question 2:

$$r_{\text{CDU/CSU},2} = 20 / (20 + 77) \times 100\% \approx 20.6\% ,$$

and so on. Taking the average representativeness of the CDU/CSU over the questions with known results of public opinion polls and definitive party responses (there are 36 such questions), we obtain the party's unweighted popularity index

$$P_{\text{CDU/CSU}} = (12.2 + 20.6 + \dots) / 32 \times 100\% \approx 40\% .$$

A higher popularity means that, on average, a larger fraction of the electorate is represented. Taking the average with the weights, we obtain weighted versions of popularity. For every party, the questions with missing opinion polls or party positions are removed from consideration, and the question weights are proportionally adjusted to the total of 100%.

The frequency in representing a majority ( $\geq 50\%$ ) is defined to be the unweighted universality of the party. The CDU/CSU represents a (non-strict) majority on 11 out of 32 questions that are backed up by public opinion polls and the CDU/CSU positions. Hence, the frequency in representing a majority is

$$U_{\text{CDU/CSU}} = 11 / 32 \times 100\% \approx 34\% .$$

A higher universality means that a majority is represented more frequently. If the questions are counted with weights, we obtain the weighted versions of the universality index.

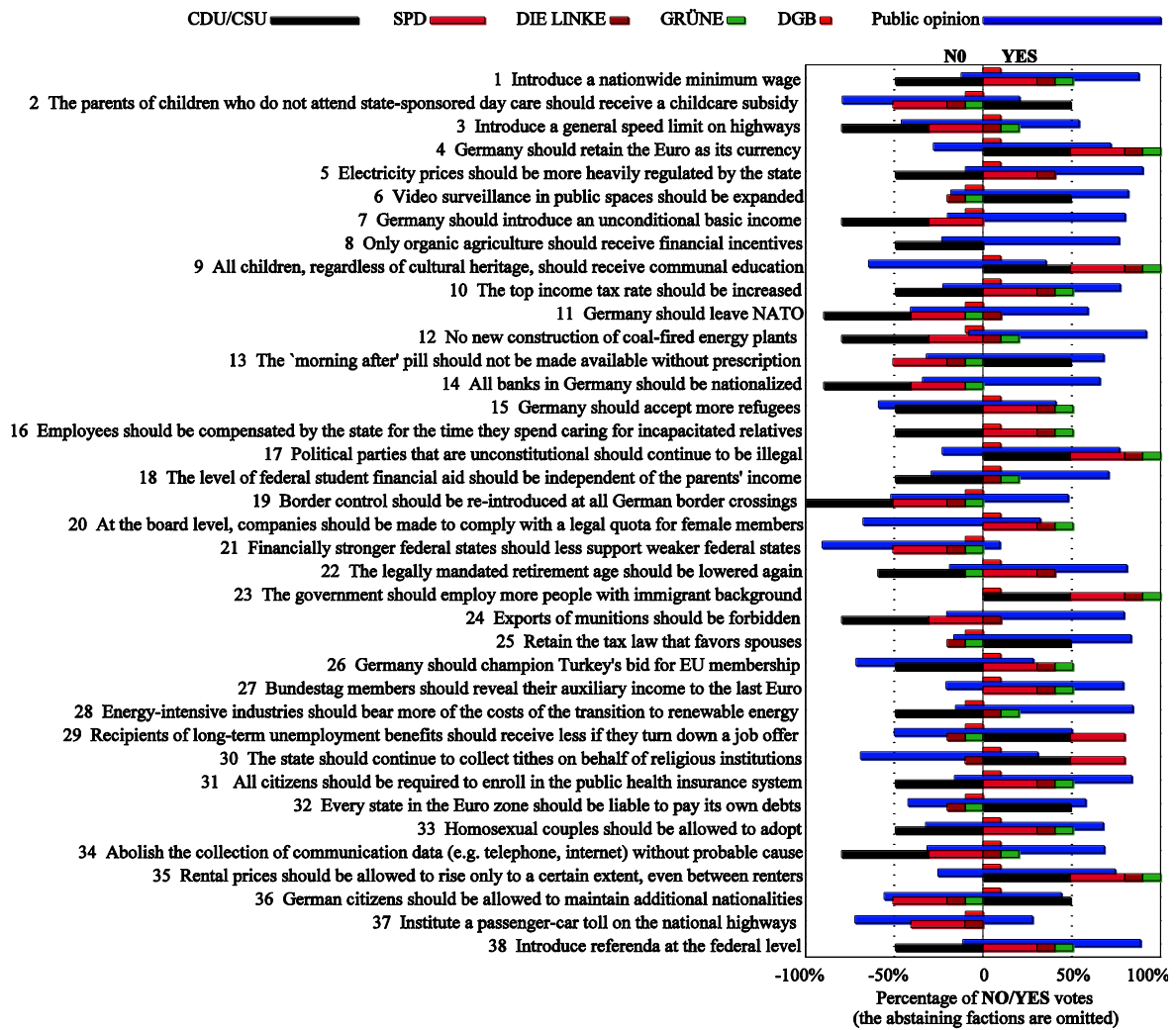


Figure 1. Public opinion and representation thereof by parties in the 2013 German Bundestag and the DGB

Table 2 displays the indices of popularity  $P$  and universality  $U$  for 28 German parties, DGB and Bundestag (whose position on every issue is the position of the Bundestag majority) in four versions each: for unweighted questions (marked in Table 2 by 'u'), for questions weighted by the logarithm with base 2 of thousand Google hits for the questions' keywords (marked by 'g'), assuming that the number of relevant documents in the Internet reflects the coalition's importance of the question, and questions weighted by two experts—the director of the Institute of Economic and Social Research in the Hans-Böckler-Foundation, Professor Brigitte Unger, and the editor-in-chief of the DGB info-service *Einblick*, Anne Graef (marked by 'b' and 'a', respectively). The parties are ordered by votes received. As one can see, the election winner, the CDU/CSU has the lowest representativeness and is ranked 28 among the 28 parties. Generally, the votes received by the parties negatively correlate with the indices of representativeness, with the correlation coefficients  $-0.33 < \rho < -0.26$ , depending on the index weighting.

### 3. COALITIONS' INDICES

To rule, a coalition must have > 50% of the Bundestag seats. In real politics, coalitions are usually minimal, because the more parties, the more complex the negotiations and the less power enjoyed by each coalition member; cf. with minimum winning coalitions (Riker 1962). For instance, the coalition CDU/CSU–SPD–

GRÜNE is eligible to rule but not minimal eligible, because CDU/CSU and SPD do not need GRÜNE to get 50% of the Bundestag seats. A high degree of unanimity (measured by % of questions with equal positions of the coalition members) facilitates coalition formation, because parties with close positions cooperate more easily.

Table 2. Party popularity and universality indices, each in four versions: ‘u’ — unweighted, ‘g’—weighted with log2 of thousand Google hits of the question keywords, ‘b’—with Brigitte Unger’s weights, and ‘a’— with Anne Graef’s weights

Party	Votes %	Popularity (4 weighting)				Universality (4 weighting)				Mean index	Index rank
		u	g	b	a	u	g	b	a		
CDU/CSU	41.550	40	38	40	38	34	32	36	33	36	28
SPD	25.737	56	57	57	61	57	58	56	66	59	19
DIE LINKE	8.587	64	65	64	66	76	77	74	78	70	6
GRÜNE	8.445	58	59	57	60	63	64	61	66	61	18
FDP	4.765	45	45	42	43	47	47	42	46	44	24
AfD	4.696	42	41	40	39	38	37	37	34	39	27
PIRATEN	2.193	63	65	62	63	72	75	70	72	68	12
NPD	1.283	65	66	64	65	75	77	75	76	70	7
FREIE WÄHLER	0.968	53	53	52	55	59	59	57	64	56	20
Tierschutzpartei	0.321	64	64	64	63	74	74	73	69	68	10
ÖDP	0.291	59	59	57	58	69	70	66	67	63	16
REP	0.210	43	41	42	39	41	38	40	36	40	25
Die PARTEI	0.179	65	66	65	66	76	77	75	77	71	5
pro Deutschland	0.170	60	61	62	60	68	70	72	69	65	14
BP	0.131	49	49	47	49	49	49	48	49	49	22
Volksabstimmung	0.066	65	65	66	66	81	80	81	82	73	2
MLPD	0.058	62	63	63	65	74	75	74	78	69	8
RENTNER	0.058	59	60	61	64	65	67	68	73	65	15
Partei der Vernunft	0.057	40	40	36	38	42	41	33	41	39	26
PBC	0.042	52	51	51	52	52	52	50	53	52	21
BIG	0.041	58	60	60	63	60	62	65	69	62	17
BüSo	0.030	49	48	49	46	48	47	47	45	47	23
DIE FRAUEN	0.029	65	66	66	67	79	80	78	79	72	4
Nichtwähler	0.026	66	67	66	65	80	81	80	77	73	3
Bündnis 21/RRP	0.020	66	67	66	68	79	81	78	82	74	1
DIE VIOLETTEN	0.019	62	61	60	60	74	73	70	71	66	13
FAMILIE	0.017	63	63	62	62	75	76	72	72	68	11
PSG	0.011	62	64	62	64	74	77	73	76	69	9
DGB	—	55	56	58	58	58	60	64	61	59	—
Bundestag	—	51	51	52	53	50	49	50	56	51	—

If coalition members have controversial opinions then the probabilities of the Yes/No answer to this question could be assumed proportional to the protagonist-to-antagonist ratio within the coalition. As evidenced by politicians, reality is even more uncertain. To deal with the uncertainty, we introduce the parameter  $p$  — proportionality of influence to size of the faction,  $0 \leq p \leq 1$ , which we explain here with an example.

Suppose that the protagonist-to-antagonist ratio within a coalition is 3 : 1. The  $p = 1$  denotes the exact proportionality of influence to size, that is, the larger faction determines  $3 / (3 + 1) = 3/4$  of the coalition’s answers and the smaller one determines  $1/4$  of the answers. The  $p = 0$  denotes no proportionality of influence to size, that is, the coalition adopts each alternative opinion with equal chances  $1/2$ . The  $p = 1/2$ , which we always assume in the sequel, means that the influence of faction sizes on the coalition answer is a mix of the two extreme cases in proportion  $p = 1/2$  and  $1 - p = 1/2$ :

$$\text{Prob (Yes)} = p \times \frac{3}{4} + (1 - p) \times \frac{1}{2} = 5/8$$

$$\text{Prob (No)} = p \times \frac{1}{4} + (1 - p) \times \frac{1}{2} = 3/8 .$$

Under uncertainty, the indices of popularity and universality of a coalition are random variables. The coalition's popularity is understood as the *expected* size of the group represented, and universality — as the *expected* frequency in representing a majority. Therefore, the indices of popularity and universality of coalitions are not exact magnitudes but rather estimates (expected magnitudes), with their standard deviation regarded as the estimation accuracy. The computational formulas for the coalition indices are derived in (Tangian 2014, p. 338).

Table 3 shows the minimum eligible coalitions characterized by indices Unanimity, unweighted Popularity and unweighted Universality (since weighting plays a negligible role in party rankings, we refer here to the unweighted indices). The most unanimous and at the same time the most representative minimum eligible coalition, SPD–LINKE–GRÜNE, failed because of personal tensions between SPD and DIE LINKE after the exit of DIE LINKE politicians from the SPD in 1997. Among other minimum eligible coalitions, CDU/CSU–SPD has the highest unanimity and the highest representativeness. This coalition is currently governing.

Table 3. Indices of minimal eligible coalitions and of that for the Bundestag seats redistributed

Minimal eligible coalition	Parliament seats, %	Unanimity	Popularity	Universality
CDU/CSU–SPD	79.8	66.7	46.5	45.0
CDU/CSU–DIE LINKE	59.5	33.3	43.0	40.1
CDU/CSU–GRÜNE	59.3	45.7	44.1	42.1
SPD–DIE LINKE–GRÜNE	50.7	77.1	54.4	56.8
Minimal eligible coalition for the Bundestag seats redistributed according to the party indices				
SPD–DIE LINKE	56.3	80.0	56.2	61.5
DIE LINKE–GRÜNE	58.3	94.1	55.3	60.4
SPD–GRÜNE	52.3	85.7	54.3	57.3

## 4. CONCLUSIONS

*a) Inconsistency of election results with public opinion:* As one can see, the winner of the 2013 Bundestag election, the conservative union CDU/CSU with 41.6% of the votes, has the lowest ranking among all the 28 parties considered, and it ranks lowest among the four eligible parties. The most representative among the eligible parties is DIE LINKE, which received only 8.6% of the votes. The negative correlations between the party ranks with respect to the votes received and the indices of representativeness show that most electors vote inconsistently with their own political profiles. A possible explanation of this inconsistency is the significant shift of the German (and world) political spectrum to the right after the 1990 German reunification and collapse of communism, although voters still believe that the parties represent the same values as before.

*b) Weak dependence between public opinion and the Bundestag position:* Note that the Bundestag's representative capacity is estimated at about 50%. It should be realized that 50% of representativeness is expected when, for every issue, a coin is tossed whose sides indicate the decisions in favor of either the majority or the minority in the society. Therefore, the index values of about 50% can be interpreted as the lack of dependence between public opinion and the Bundestag position.

*c) Warning for policymakers:* All of these constitute a serious warning against the use of traditional voting methods. Among other things, 'wrong voting' gives faulty feedback to policymakers about the policies they pursue. Already now, both extreme right and extreme left parties rank much higher than the moderate parties currently elected to the Bundestag. This cannot last forever, and if the discrepancy between the population and the government becomes critical, an extremist government can be elected.

*d) Secondary role of weighting:* As one can show, all the rank correlations between the indices of representativeness are very close to one. Even the correlation between the unweighted and the Google-weighted indices — with the extremes in weight ranging from 42,900 (for Question 9 about separate school lessons for children with different cultural background) to 31,600,000 (for Question 31 about merging statutory and private health insurances) — is 0.99 or 0.98, depending on weighting. This means that the party

ranks are not very sensitive to the question weighting. The similarity in index orders can be explained as follows. The responses of a given party are backed up by the party ideology, which determines the high intra-question correlations of party answers. Therefore, ‘erroneous’ weighting and even omission of some questions play a rather negligible role, because other questions carry superfluous information on the party political profile. Hence, we can evaluate the parties by the mean of its eight indices shown in the next to last column of Table 2, or by the most ‘impartial’ unweighted indices marked with ‘u’.

*e) Evaluation of representatives without election:* The known DGB position on the policy issues allows us to evaluate its popularity and universality, although the DGB does not participate in elections. In the same way, the representativeness of any political body can be evaluated without elections, just by comparing its position with the balance of public opinion.

*f) The size of coalition is not a criterion of its representativeness:* According to computations, the most representative coalition, DIE LINKE/GRÜNE, has the unweighted Popularity 55.1% and unweighted Universality 60.0%. This coalition is, however, too small to rule. Therefore, the coalition representativeness is not characterized by its size.

*g) Coalition formation can reduce parliament representativeness:* The actual practice of coalition formation aimed at attaining a parliamentary majority can decrease the representativeness of the parliament. Indeed, before the coalition formation, the Bundestag unweighted Popularity and Universality in Table 2 are 51% and 50%, respectively, whereas these indices for actually governing coalition CDU/CSU–SPD in Table 3 are only of 46.5% and 45.0%, i.e., they are rather non-representative than representative. This shows that the practice of coalition formation can contradict the objectives of representative democracy.

## 5. DISCUSSION: HOW TO IMPROVE ELECTION

Currently the German Bundestag is elected with two votes, the first (*Erststimme*) for a person and the second (*Zweitstimme*) for a party. The first 299 Bundestag members are elected through the first vote by simple plurality within 299 constituencies. The second vote is used (1) to determine the eligible party factions (with > 5% of the second national votes) and (2) to make their size proportional to the second vote, including the party members already elected by the first vote. For this purpose, another 299 Bundestag seats are distributed among the eligible parties. If the proportion to votes is not accurate enough, some extra seats are added. The 2013 Bundestag has 631 seats, including 598 basic and 33 extra seats. Obviously, the second vote is decisive, because it determines the size of the party factions.

One can complement the German election procedure with the third vote (*Drittstimme*) asking for the elector’s political profile, as in the Wahl-O-Mat. The first vote, as before, is cast for a local candidate by name. The second vote — for a party — is used only to filter out non-trustworthy parties that receive fewer than 5% of the votes. Thereby the second vote retains only its first function, and its second function — distribution of the Bundestag seats among eligible parties — is given to the third vote. The third vote is imagined in the form of a brief survey on the most topical policy issues (Introduce nationwide minimum wage? Yes/No; Introduce a general speed limit on Autobahnen? Yes/No; etc.). To avoid manipulations, the questions can be formulated and answered by a party themselves and addressed to all other parties. Since party political profiles are backed up by certain ideologies, the answers to different questions are strongly interdependent; therefore, a few questions suffice to specify the political profiles of both candidates and voters. In the course of election, the political profile of the electorate is defined by the balance of public opinion on the issues, and the parties get the Bundestag seats in proportion to the degree to which their political profiles match with the political profile of the electorate (for instance, measured by the indices of representativeness introduced). Thereby, the third vote is a ‘direct democracy test’— a competitive public examination of the parties evaluated through the election procedure. The bottom section of Table 3 shows that a hypothetical redistribution of the Bundestag seats proportionally to the parties’ unweighted Popularity or Universality results in a new set of minimum eligible coalitions, which are all more representative than the ones obtained by the actual election procedure. Correspondingly, there is a gain in the representativeness of the Bundestag.

The focus on policies rather than on personal images or party ideologies makes elections more rational. The actual German system with its two votes tends to overcome the electors’ subjectivity, and the method outlined follows this logic of increasing vote impartiality. The first vote allows electors to choose their

favorites by name, but the partiality of the vote by name is overridden by rearranging the Bundestag factions according to the more conceptual and less personified vote for a party. In our procedure, the third vote is linked neither to candidates, nor to parties. It allows the electorate to objectively test them ‘anonymously’.

It should be noted that parties may attempt to gain votes by attractive electoral pledges. To discourage parties from unenforceable promises, the party index computed from the third vote can be discounted if the party did not keep its word given in the previous campaign.

A practical implementation of this method should not exclude traditional ways of expressing opinions, because some voters would prefer to vote with the first two votes only. This means that votes for a person and for a party without using the third vote must remain an option. Not to consider the missed third vote as abstention, the second vote in this case should be given the full weight, for instance, by ascribing the elector the virtual third vote with the position of the party selected. If desired, the electors’ party identification can be enhanced by a certain second vote’s impact, instead of seeing it solely as a filter that discards parties with few votes. Furthermore, voting for a party makes sense to express trust in creditable parties. For this purpose, the second and third votes can be counted in a weighted combination.

Voters may also be granted the right to specify the important and unimportant questions with including this information in the calculation of the party indices, thereby reflecting the degree of individual preferences. It is also possible to take into account the degree of public preferences measured by the degree of bias of public opinion on every question — the greater the imbalance, the stronger the public preference; the zero imbalance means indifference. There are plenty of other options which we do not discuss here.

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# TOWARDS A NEW GENERATION OF MOBILE GOVERNMENT

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## ABSTRACT

Facilitated by the recent emergence of mobile technologies, mobile government (m-government) has evolved as relevant sub-discipline of e-government during the past years. While m-government provides various new opportunities, dynamic mobile markets and fast changing mobile technologies raise also several challenges for providers of m-government solutions. To assure the sustainable success of m-government, upcoming trends in m-government and mobile computing need to be recognized early. This paper facilitates an early recognition of future trends by surveying the state of the art and analyzing currently deployed solutions. From the identified trends, a set of actions that need to be taken to assure the future success of m-government is proposed. Taking these actions paves the way for transactional m-government services, whose development is identified as next mandatory step in the further development of m-government. This way, this paper contributes to the future success of m-government.

## KEYWORDS

Mobile Government, Mobile Technologies, E-Government, Smartphones, Survey.

## 1. INTRODUCTION

Powered by the emergence of information and communication technologies (ICTs), electronic government (e-government) has significantly gained relevance in modern societies during the past few decades. The provision of governmental and administrative procedures by means of electronic services is advantageous for both public administrations and citizens. In contrast to classical administrative procedures, e-government services can be accessed 24/7. This applies to both, informational e-government services that provide citizens with relevant information, and transactional e-government services that enable citizens to carry out entire procedures electronically. In addition, electronic processes are typically more cost efficient and help public bodies to save money. It is hence unsurprising that e-government solutions have had an influence on the societies of many countries and have changed the interaction between governments and citizens.

From a technical perspective, ICTs must be regarded as the key enablers of e-government. Accordingly, provided e-government solutions have always been influenced by available technologies and the current state of the art. For many years, e-government solutions have mainly relied on web technologies. Accordingly, e-government services have been provided in the form of static websites or interactive web applications. Nowadays, web-based e-government solutions can be found all over the world (United Nations 2014).

During the past few years, mobile computing has emerged as new predominating computing paradigm. Enabled by the availability of powerful mobile end-user devices and communication networks, mobile computing is gradually replacing the classical computing paradigm. The trend towards mobile computing has also affected the field of e-government. During the past years, mobile government (m-government) has emerged as a sub-discipline of e-government. The term m-government subsumes initiatives and solutions that employ of mobile technologies to provide governmental services (Kushchu and Kuscu 2004).

Compared to classical e-government, m-government raises various additional opportunities. First and foremost, m-government perfectly fits the always-on mentality of modern societies, where information, services, and resources are expected to be available everywhere and any time. By relying on mobile technologies, governmental services can be made accessible 24/7 and independent from the citizen's current context. Second, modern mobile end-user devices feature various technologies that are typically not available

on classical end-user devices. This enables completely new use cases and application scenarios. Finally, m-government can also be advantageous in regions that suffer from a lack of reliable wire-based communication infrastructures. This applies to several developing countries in Africa, where mobile communication networks are often more developed than wire-based infrastructures. There, m-government services are often the only opportunity for public administrations to efficiently communicate with citizens.

Unfortunately, the emergence and growing popularity of m-government raises several issues too. For instance, the plurality of mobile end-user devices and mobile operating systems increases the costs for the development of reliable client software based on mobile apps. Furthermore, dynamic markets and frequent technological improvements render the development of sustainable m-government solutions difficult (MobiForge 2014). In general, mobile computing is often driven by ephemeral trends, which requires fast decisions, short release cycles, and flexible solutions. To enable fast decision-making processes and the development of appropriate m-government solutions, awareness of current trends and the early perception of future directions in mobile computing is essential.

This paper addresses this problem and facilitates fast and correct decisions with regard to m-government by surveying and analyzing the current state of the art. Concretely, this paper surveys current m-government solutions, identifies relevant trends, and determines necessary actions to be taken. This way, this paper paves the way for successful future m-government solutions.

The remainder of this paper is structured as follows. In Section 2, the followed methodology is introduced. Subsequently, m-government solutions from all over the world are surveyed in Section 3. In Section 4, the surveyed m-government solutions are analyzed by means of five criteria. Subsequently, Section 5 discusses obtained results, identifies current trends, and derives necessary future actions to be taken. Finally, conclusions are drawn in Section 6.

## **2. METHODOLOGY**

To identify current m-government trends and to derive necessary future actions, a thorough methodology has been followed. This is necessary, as current developments in m-government undergo frequent changes and are heavily influenced by dynamic markets and continuously changing circumstances. To deal with this situation, several consecutive steps have been carried out to systematically achieve the goals of this work.

The identification of relevant trends and the derivation of necessary actions to be taken have been based on a thorough survey of existing m-government solutions. The surveyed solutions are subsequently assessed by means of different criteria. From the results of this assessment, current trends are identified. Finally, necessary actions to be taken to pave the way for successful future m-government solutions are derived.

According to this methodology, the conducted survey represents the basis of all subsequent steps. The quality of this survey is hence of central relevance. Ideally, this survey should comprise all existing m-government solutions, in order to draw a complete picture of the current state of the art. Due to the growing popularity of m-government, the number of available m-government solutions has however reached a level that renders a complete survey impossible. Only in the US, public administrations offer already more than 200 m-government services and applications (U.S. Government 2014).

As a complete survey of all existing m-government solutions would go beyond the scope of this paper, focus is put on a selected subset of m-government solutions. This subset is selected such that a representative picture of the current state of the art is drawn. Selected m-government solutions have been collected from m-government portals (U.S. Government 2014), respective surveys and studies (Mobi Solutions Ltd. 2010), as well as from related scientific work (Zefferer and Teufl 2011). From these sources, 25 m-government sample services from all over the world have been selected and analyzed in detail. The selected solutions are briefly introduced in the following section.

## **3. MOBILE GOVERNMENT AROUND THE WORLD**

During the past years, m-government has evolved to a global phenomenon. Respective solutions can be found in both developed and developing countries. In this section, a representative subset of m-government solutions from different countries and regions is surveyed to draw a picture of the current state of the art.



Especially in developing countries, m-government has early evolved to a popular alternative to classical e-government, as mobile communication networks are often better developed than wire-based communication infrastructures. Most services that have been deployed in these countries during the past years are related to the topics health care, education, and electronic payment. A representative example for an m-government service from the health-care sector is BloodbankSMS<sup>1</sup>. BloodbankSMS has been deployed in Kenya and assists hospitals in rural areas to report the current status of their blood repositories to national blood banks. This assures that hospitals are supplied with blood bottles in time. Another m-government solution related to health care is mPedigree<sup>2</sup>, which addresses the counterfeit of legal drugs and medicine in Ghana. Consumers can send serial numbers printed on bought medicines to a central service via SMS. Based on this serial number, information about the authenticity of the bought drug or medicine is retrieved and returned to the consumer via SMS.

Health care related m-government services have also been rolled out in Uganda. For instance, Text2Change<sup>3</sup> is an SMS-based health-education program, which aims to inform people in developing countries about relevant health-related topics. Due to its success, Text2Change has already been ported to other countries as well. Improving health-care services in developing countries is also the basic goal of the African non-profit company Cell-Life<sup>4</sup>. During the past years, Cell-Life has started several health-related projects that make use of mobile technologies. Examples are the projects ICAP or MAMA. A complete list of all projects initiated by Cell-Life is provided on their website<sup>4</sup>.

In addition to the improvement of health-care services, developing countries also make use of m-government services and solutions to enhance the education of children. A representative example is Text2Teach<sup>5</sup>. According to the project website, the mission of Text2Teach is to make a significant contribution to the quality of teaching and learning in underserved schools and communities in the Philippines. Text2Teach enables teachers in underdeveloped regions to order and obtain electronic teaching material such as video clips that can be shown in class.

Recently, mobile technologies have also been used to enable financial transactions in developing countries, where people often cannot afford own bank accounts. The mobile-money solution mPesa<sup>6</sup> is a popular example for a mobile money-transfer solution that enables people to carry out non-cash transactions using simple mobile technologies. It has been developed by the Kenyan mobile-network operator Safaricom and by Vodafone in 2007. Each mPesa user has an own virtual account. So-called mPesa agents act as interface between users and their accounts. In many cases, gas stations or supermarkets assume the role of mPesa agents. By means of these agents, users can deposit or withdraw money from their accounts. In addition, mPesa also enables direct money transfers between users, supports the payment of bills, and allows users to purchase prepaid airtime. From a technical perspective, transactions are carried out by exchanging SMS messages between users or between users and agents. Another example for a mobile payment solution is G-Cash<sup>7</sup>. Having its roots in the Philippines, G-Cash also aims to provide a mobile alternative to established non-cash payment systems.

The m-government solutions surveyed so far show that beside education and payment solutions, especially the health-care sector benefits significantly from mobile technologies in developing countries. To a certain degree, this also applies to developed countries. During the past years, health care related solutions relying on mobile technologies have been deployed in various developed countries in Asia, Europe, and America. A representative example is the service AskBrook<sup>8</sup>, which has been rolled out in the UK. According to its website, the project AskBrook has the goal to promote the health of young people and those most vulnerable to sexual ill through providing information, education and outreach, counseling, confidential clinical and medical services, professional advice, and training. To achieve this goal, AskBrook enables young people to make use of counseling services using SMS messages. Reliance on this mobile communication technology enables those seeking for advice to avoid direct personal contact and to remain

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<sup>1</sup> <http://www.media.mit.edu/ventures/EPROM/research.html#bloodbank>

<sup>2</sup> <http://mpedigree.net/about-us>

<sup>3</sup> <http://www.tcmobile.com>

<sup>4</sup> <http://www.cell-life.org>

<sup>5</sup> <http://www.text2teach.org.ph>

<sup>6</sup> <https://www.mpesa.in/portal/>

<sup>7</sup> <http://www.globe.com.ph/gcash>

<sup>8</sup> <http://www.askbrook.org.uk>

anonymous. Other health care related services from developed countries are HELP4BABY<sup>9</sup> or Text4Baby<sup>10</sup>, which both support expectant mothers by providing relevant information via mobile communication channels. Especially in the US, governmental agencies additionally provide citizens a selection of tools based on mobile apps to improve health care. For instance, there are mobile apps that help citizens to calculate their body-mass index (BMI)<sup>11</sup> and to practice breathing exercises in order to cope with stressful situations<sup>12</sup>.

In addition to health care related use cases, mobile technologies are also frequently used in developed countries for security-related application scenarios. Mobile solutions related to security cover several different aspects. For instance, the US Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) provides a mobile app with relevant information on weapons<sup>13</sup>. Protection against threats caused by forces of nature is for instance improved by the mobile app Hurricane, which supplies citizens with relevant and timely information on hurricanes<sup>14</sup>. Mobile services have recently also turned out to be perfectly suitable for the implementation and provision of disaster-warning solutions. As mobile end-user devices are usually always carried, they can be used to deliver warnings of natural disasters in time. For instance, the service SMS Tsunami Warning<sup>15</sup> makes use of SMS technology in order to warn people in case of approaching tsunamis. Mobile technologies are also employed in the UK to improve the security of citizens. There, the SMS-based service EmergencySMS<sup>16</sup> enables citizens to contact emergency numbers by means of SMS. This is especially useful for deaf and dumb people, who are unable to rely on voice-based communication. Another application scenario, where mobile technologies are frequently used to improve security, is the communication between parents, teachers, and students. For instance, the service School News Channel<sup>17</sup> makes use of mobile technologies to inform parents of absenteeism and changed timetables, or to deliver emergency messages. Finally, also the Canadian government relies on mobile technologies, in order to improve the security of their citizens. Concretely, they provide a mobile app called Learn to Camp<sup>18</sup>, which supplies users with relevant information regarding secure stays in national parks.

Health care and security are however only two out of many use cases and application scenarios, in which reliance on mobile technologies can be useful. Further examples that illustrate the usefulness of m-government in developed countries are the Austrian solution RIS:App<sup>19</sup>, which provides Austrian citizens instant mobile access to relevant laws and regulations. In Canada, mobile apps are provided and frequently used to support citizens in filling forms in order to apply for grants<sup>20</sup>. Finally, mobile apps are also frequently used to facilitate the reporting between citizens and public administrations. For instance, the Dutch solution Buitenbeter<sup>21</sup> and the US solution iBurgh<sup>22</sup> enable citizens to efficiently report issues in public space by means of mobile apps.

Especially in Europe, mobile technologies are also frequently used to implement solutions related to electronic identities (eIDs) and electronic signatures. Respective solutions have for instance been deployed in Austria, Estonia, Finland, or Turkey. During the past years, two basic approaches to realize eID and electronic-signature functionality with the help of mobile technologies have evolved. So called SIM-based solutions make use of the user's SIM for this purpose. Relevant eID data and cryptographic keys for the creation of electronic signatures are stored on the user's SIM. A SIM-based eID and electronic-signature solution called Mobiil-ID<sup>23</sup> has for instance been rolled out in Estonia. As an alternative to SIM-based solutions, server-based solutions have emerged during the past years. These solutions render the use of SIMs unnecessary, as they store and process relevant data in a secure central hardware module. Mobile technologies are used to authenticate users and to authorize access to centrally stored eID and electronic-

<sup>9</sup> [http://www.bundeskanzleramt.at/site/cob\\_52664/currentpage\\_0/6490/default.aspx](http://www.bundeskanzleramt.at/site/cob_52664/currentpage_0/6490/default.aspx)

<sup>10</sup> <https://www.text4baby.org/>

<sup>11</sup> <https://itunes.apple.com/us/app/bmi-calculator/id292796789?mt=8>

<sup>12</sup> <http://itunes.apple.com/app/tactical-breather/id445893881?mt=8#>

<sup>13</sup> <https://itunes.apple.com/us/app/atf/id408467237?mt=8>

<sup>14</sup> <https://play.google.com/store/apps/details?id=com.cube.arc.hfa>

<sup>15</sup> <http://www.sms-tsunami-warning.com/pages/contact-us#.VKj6n3vis7E>

<sup>16</sup> <http://www.emergencysms.org.uk/index.php>

<sup>17</sup> <http://schoolnewschannel.com.au/snc.php>

<sup>18</sup> <http://open.canada.ca/en/apps/learn-camp>

<sup>19</sup> [https://www.bka.gv.at/site/cob\\_52564/currentpage\\_0/6490/default.aspx](https://www.bka.gv.at/site/cob_52564/currentpage_0/6490/default.aspx)

<sup>20</sup> <http://open.canada.ca/en/apps/how-apply-grant>

<sup>21</sup> <http://www.buitenbeter.nl/english>

<sup>22</sup> <https://play.google.com/store/apps/details?id=com.yinzcam.iburgh>

<sup>23</sup> <http://www.id.ee/index.php?id=36881>

signature data. A prime example of a server-based eID and electronic-signature solution is the Austrian Mobile Phone Signature<sup>24</sup>, which has been in productive operation in Austria since 2010.

In general, it can be observed that the number of provided m-government solutions is steadily increasing. This applies to both developing and developed regions of the world. Although the provided survey covers only a subset of all existing m-government solutions, it still draws a representative picture of the current state of the art. In order to systematically identify current trends and to derive necessary future actions, the surveyed solutions are systematically analyzed in the following section.

## 4. ANALYSIS

The conducted survey of current m-government solutions shows that the term m-government actually covers a broad spectrum of services and applications. Depending on the respective use case, provided services and employed technologies differ significantly from each other. In order to enable the identification of commonalities and the derivation of relevant trends, the 25 surveyed m-government solutions are analyzed in this section according to the following five criteria.

- **Country:** The context, in which an m-government solution is deployed and provided, typically influences its goals, functionalities, and employed technologies. Hence, its origin country is a relevant criterion of each m-government solution.
- **Information Flow:** Similar to e-government services, also m-government solutions implement some kind of information exchange between citizens (C), governmental agencies (G), and non-governmental organizations (N). Accordingly, m-government solutions can also be classified and analyzed by means of their implemented information flow.
- **Provider:** Even though the term m-government implies that services are provided by governmental agencies, this is often not the case in practice. Especially in developing countries, services are often also provided by non-governmental organizations. The provider of and driver behind an m-government service is hence another interesting classification criterion.
- **Field:** As the term m-government is quite abstract, it covers solutions from various fields of application including health care, payment, or justice. Hence, the concrete field, to which an m-government solution can be assigned, is another relevant classification criterion.
- **Client Technology:** All m-government solutions have in common that they rely on some kind of mobile client technology. In most cases, they make use of the user's mobile phone and employ technologies featured by this device. With the emergence of smartphones, the set of available technologies that can be used to implement m-government services has significantly increased. The concrete technology used for the provision of m-government services is hence a relevant classification criterion that can be used to systematically analyze surveyed solutions.

Based on these criteria, all 25 surveyed m-government solutions are systematically analyzed and compared with each other. For each solution, the five criteria are assessed separately. Obtained results of this assessment are illustrated in Table 1. Based on the comparisons provided in Table 1, current trends in m-government can be derived. This is detailed in the following section, where basic findings are discussed and necessary future actions are derived.

Table 1. Comparison and analysis of surveyed m-government solutions.

Service Name	Country	Information Flow	Provider	Field	Client Technology
AskBrook	UK	N2C	N	mHealth	SMS
ATF	US	G2C	G	mSecurity	Mobile App
BloodbankSMS	KE	G2G	G	mHealth	SMS
BMI Calculator	US	N/A	G	mHealth	Mobile App
Buitenbeter	NL	C2G	G	mAdministration	Mobile App
EmergencySMS	UK	C2G	G	mSecurity	SMS
G-Cash	PH	C2C	N	mPayment	SMS/Mobile App
HELP4BABY	AT	G2C	G	mHealth	Mobile App
How to Apply for a Grant	CA	G2C	G	mAdministration	Mobile App

<sup>24</sup> <https://www.handy-signatur.at/>

Hurricane	US	N2C	N	mSecurity	Mobile App
iBurgh	US	C2G	G	mAdministration	Mobile App
ICAP	ZA	N2C	N	mHealth	SMS
Learn to Camp	CA	G2C	G	mSecurity	Mobile App
MAMA	ZA	N2C	N	mHealth	SMS/Voice
Mobiil-ID	EE	N/A	N	Infrastructure	SIM Application Toolkit
Mobile Phone Signature	AT	N/A	N	Infrastructure	SMS
mPedigree	GH	C2N/N2C	N	mHealth	SMS
mPesa	KE	C2C	N	mPayment	SMS
RIS:App	AT	G2C	G	mJustice	Mobile App
School News Channel	AU	N2C	N	mSecurity	SMS
SMS Tsunami Warning	Global	N2C	N	mSecurity	SMS
Tactical Breather	US	N/A	G	mHealth	Mobile App
Text2Change	UG	N2C	N	mHealth	SMS
Text2Teach	PH	C2N/N2C	N	mEducation	Various
Text4Baby	US	G2C	G	mHealth	SMS/Mobile App

## 5. DISCUSSION

Table 1 shows a direct comparison of the 25 surveyed m-government solutions with regard to the five identified relevant criteria. From this comparison, several findings can be derived. These findings are discussed in the following subsection in more detail. Subsequently, current trends and future actions to be taken are derived from these findings.

### 5.1 Findings

By analyzing the surveyed m-government services and comparing them by means of the identified criteria, the following findings can be derived.

- Mobile government is especially popular and frequently used in the health-care sector. From the 25 surveyed solutions, 10 solutions can be assigned to the field of mobile health (mHealth). Respective services can be found in both developing and developed countries.
- Especially in developing countries, mobile solutions are also frequently used for education. There, mobile technologies are used to compensate shortcomings of wire-based ICT infrastructures.
- In developing countries, mobile technologies are frequently used to provide cash-less payment systems, in order to offer a cheap alternative for those, who cannot afford an own bank account.
- In developed countries, mobile technologies are increasingly used to implement and provide eID and electronic-signature functionality. This especially applies to Europe, where electronic signatures have a strong legal basis (The European Parliament and the Council of the European Union 1999).
- Security-related services often make use of mobile technologies, e.g. to notify citizens about natural disasters in time or to provide users with security-relevant information in specific situations. For these solutions, the always-on characteristic of mobile end-user devices is crucial.
- From a technical perspective, SMS is still one of the predominating technologies. This especially applies to services in developing countries, where mobile broadband communication networks are sometimes still rare in rural areas. However, there are also several services in developed countries that still rely on the rather old SMS technology.
- In developed countries, m-government services based on mobile apps are on the rise and are frequently used to provide citizens with simple but useful tools.
- Surveyed services are provided by both governmental agencies and NGOs. This especially applies to developing countries, where governments and public administrations often do not have the resources to deploy m-government services on a large scale.
- Most of the surveyed services are rather simple, unidirectional, and purely informational. This means that provided services either enable citizens to send information to public organizations or enable a

governmental agency to deliver information to citizens. Services supporting a bidirectional communication and implementing full transactional procedures are still rare. This applies to both developing and to developed countries.

- The few bidirectional services that have been surveyed do neither include a reliable user authentication nor the provision of written consent based on legally binding electronic-signature schemes. Both concepts are usually required in classical transactional e-government services. However, these concepts have not been found in any of the surveyed m-government solutions.

## 5.2 Current Trends

From the obtained findings, several current trends in m-government can be derived.

- Similar to the popularity of mobile technologies, m-government is a global phenomenon and enjoying an increasing popularity in many countries all over the world.
- Due to the increasing spread of smartphones in developed countries, there is currently a trend towards solutions based on mobile apps. Legacy technologies such as SMS are still used but replaced or complemented by cutting-edge technologies, as soon as these technologies are sufficiently spread in the target group.
- Especially in developed countries, m-government is increasingly used rather as a complement than as a replacement for classical e-government services. M-government solutions based on mobile apps employ cutting-edge technologies to provide services with additional benefits.
- In Europe, mobile technologies gradually replace established technologies such as smart cards for the realization of eID and electronic-signature functionality. Interestingly, m-government services that include eID or electronic-signature functionality are still rare.

## 5.3 Future Actions to Be Taken

The findings obtained from the conducted survey draw a representative picture of the state of the art of m-government. At the same time, the derived trends in m-government indicate possible future directions and developments. Without doubt, m-government will continue to play an important role in many countries all over the world. However, the obtained findings and identified trends show that m-government does still not employ the full potential of mobile technologies. Many services still rely on rather old technologies such as SMS and are hence extremely limited. Even those solutions that make use of cutting-edge technologies and that are based on mobile apps are in most cases limited to the provision of simple tools and unidirectional informational services. The lack of m-government services that implement full transactional services and include a reliable user authentication based on national eID infrastructures as well as a provision of written consent by means of legally binding electronic signatures can hence be identified as main issue and shortcoming of current m-government.

Accordingly, the further development of m-government solutions towards transactional services can be identified as most relevant challenge that needs to be overcome in the near future. Only if full transactional procedures can be realized and used on mobile end-user devices, m-government will become a serious alternative to classical e-government. To accomplish the transition to transactional m-government, we hence propose the following future actions to be taken.

- **Action 1:** Existing eID and electronic-signature solutions that are already integrated into and used by transactional e-government solutions need to be adapted such that they can also be used on mobile end-user devices. In their current form, these solutions are usually not applicable on mobile end-user devices, as their underlying security concepts have been designed for classical devices such as desktop computers and laptops.
- **Action 2:** To keep track of ongoing developments and improvements, upcoming mobile technologies need to be continuously assessed and evaluated. This way, new approaches to implement transactional m-government services with the help of mobile cutting-edge technologies can be identified early.
- **Action 3:** For many years, mobile end-user devices have been legitimately assumed to be secure. This situation has changed with the introduction of smartphones and powerful mobile operating systems such as Android, which are prone to malware and popular targets for attacks (Enck and Octeau 2011).

As transactional m-government services potentially process security-critical data, the development of transactional m-government solutions must go hand in hand with continuous security assessments and the development of appropriate security concepts.

The three proposed actions define the next necessary steps towards the provision of transactional m-government solutions. If these actions are adequately taken, current restrictions to unidirectional and informational mobile services can be released. This way, m-government can be taken to the next stage of development and can finally evolve to a serious alternative to classical e-government.

## 6. CONCLUSIONS

During the past years, m-government has evolved to a relevant sub-discipline of e-government. As it enables the integration of additional technologies, m-government provides various opportunities. At the same time, m-government also raises several new issues that need to be addressed adequately.

In this paper, we have contributed to the positive development of m-government by surveying its current state of the art and by proposing future actions to be taken. The conducted survey has shown that m-government is on the rise all over the world but still suffers from several limitations. Due to these limitations, most current m-government solutions are still rather simple, unidirectional, and purely informational. The lack of appropriate eID and electronic-signature solutions that can be applied on mobile end-user devices has been identified as main barrier for transactional m-government services. Accordingly, the development of eID and electronic-signature solutions that comply with the specifics of mobile end-user devices has been identified as relevant future action to be taken. The continuous assessment of upcoming mobile technologies and the development of suitable security concepts have been proposed as accompanying actions.

By analyzing the current state of the art and by proposing concrete actions to be taken, this paper represents a first step towards transactional m-government. Taking the proposed actions and developing concrete solutions that further pave the way for transactional m-government solutions are continuative tasks that are regarded as future work. Although this paper defines a first important step only, it already contributes to the necessary emancipation of m-government from classical e-government.

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# **E-GOVERNMENT IMPACT ON BUSINESS AND ENTREPRENEURSHIP: DYNAMICS IN HIGH, UPPER MIDDLE AND LOWER INCOME COUNTRIES FROM 2008 TO 2014**

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## **ABSTRACT**

Most e-government initiatives have as its objective the improvement business atmosphere and the creation of new business. This papers aims to measure the impact of change of e-government index (and its composing sub-indexes) in the ease of doing business and the rate creation of new business in high, middle and low income countries, seeking to test if there is a difference in the effects. The study used a panel data design, with four points (years 2008, 2010, 2012 and 2014), in three change periods (2008/2010, 2010/2012 and 2012/2014), collecting data from various databases: Doing Business Report by World Bank, United Nations E-Government Survey, Corruption Perception Index by Transparency International and World Bank Entrepreneurship Survey. The data was joined and analyzed with non-parametric correlation and stepwise regression. Data suggests that different models should be applied to understand e-government relationship with outcome variables, according to the income level and e-government development level. Suggestions for future research are also presented.

## **KEYWORDS**

Electronic Government; Starting Business; Corruption; Impact Evaluation;

## **1. INTRODUCTION**

Many authors point out that research on e-government is growing, but not mature. Although the volume of publications is growing, the first relevant articles only appeared in the 90's, and did not receive much importance until the early 2000's (Almeida et. al, 2014). However, with the consolidation of the Internet and its widespread use to conduct business, and to provide contact between government and the taxpayers and citizens, the e-government became a very important topic, both in theory and in government policy (Morgesson & Mithas, 2009; West, 2000).

E-Government is much more than the simple use of information technology (IT) in the government. Much before the "invention" of Internet in the late 1980s, various governments were already using IT systems (Norris and Kraemer 1996; Brown 1999). Nevertheless, the consolidation of the World Wide Web, and its associated technologies and tools, made possible for the government to connect with its citizens in a new manner. More recent e-Government technologies are also able to provide a more through contact between business and the government (Moon, 2002).

The implementation of e-government has been widely defended in most of the world, since it allows transparency in government acts and spending, and also may reduce total costs, and even provides more services, which can be made available even away from official government buildings (Brunetti & Weder, 2003). In addition, the sharing of governmental information could potentially improve the perception of corruption, contributing also to a more interesting atmosphere to conduct business. This was the objective of the original work of Andersen (2009) using a panel of 149 countries with two data points when he used secondary data to compare the e-Government improvement and the result on control of corruption.

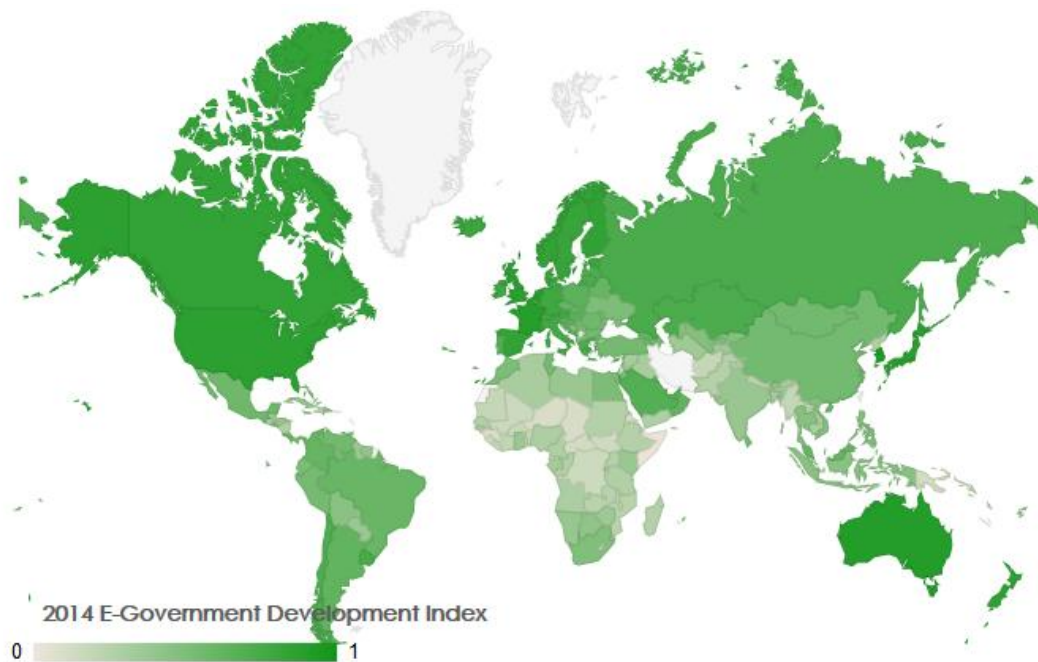
Nevertheless, although widely assumed to be a positive effort, the extent of success in the implementations of e-government have always been very different in the globe. Therefore, the e-readiness

concept was created to provide a unified framework to evaluate the breadth and depth of the digital divide between more and less developed or developing countries during the late 1990s (Hanafizadeh et al, 2009). Nevertheless, with the initial intent of providing a single framework, in the following years a great number of e-readiness measures have been developed (Grigorovici et al., 2003).

Hanafizadeh et al (2009) proposed a model of e-readiness measurement, based on the convergence of several e-readiness assessments composed of the following dimensions: infrastructure and access; access to and use of ICT by households and individuals; e-businesses; e-education; e-Government and basic enabling indicators. Also, as an initiative to measure the progress of the adoption of the electronic government solutions in different countries the United Nations has created an index known as E-Government Readiness Index composed by the The Human Capital Index, The Telecommunication Infrastructure Index and the Web Measure Index.

The Human Capital Index is a composite of the adult literacy rate and the combined primary, secondary and tertiary gross enrolment ratio, with two thirds weight given to the adult literacy rate and one third to the gross enrolment ratio (UN, 2009). The Infrastructure Index 2008 is a composite index of five primary indices relating to a country’s infrastructure capacity as they relate to the delivery of e-Government services. The Web Measure Index 2008 is based upon a five-stage model (Andersen & Henriksen, 2006), which builds upon the previous levels of sophistication of a UN Member State’s online presence.

Most developed nations have made greater progress in this area, especially most developed Europe, US, and South Korea and Japan, letting most of the world in a more modest state of adoption of more sophisticated e-Government. As a result, the implementation of e-Government varies across the globe, with substantial investment made to give enhancement to infrastructures as well as services to citizens (Ebrahim & Irani, 2005).



Source: E-government Development Index – U.N Data Center Tool - Chart

Figure 1. E-Government Development Index 2014 data – All 193 countries

The difference between the countries capacity of investment is usually explained by the income of the country. Higher income countries tend to invest more in e-government and also to be easier to do business than countries on low income. In addition, corruption tends to be higher on poorer countries. Therefore, the present article hopes to shed some light on the relationship between e-government and some variables, in different contexts. We have used the U.N classification of countries in high income, upper middle income, lower middle and low income groups to test the difference between relationships between groups, and test for differences on the impact of e-government improvement in each group of countries.



## 2. METHOD

This study used a panel data design. Panel data means that a variable is measured more than once for the same subject, in different time periods. Hsiao (2003) indicates that panel data have been increasing popular due to a greater availability of data in this format, which is more able to answer substantial questions than a single set of indicators measured in a single point time that is usually found in cross sectional data. Although the use of panel data does not support the implication of causality, it certainly gives a stronger support in making assumptions about causality and directions of observed effects in many research areas.

The study can be classified as a non-experimental, since it uses survey data. The data used in this study is secondary, that is, other researchers or organizations collected it. All data and databases selected in this study are widely employed in many researches and were collected and compiled by internationally recognized institutions, such as World Bank, United Nations and others, which contribute to the validity and reliability of the data.

In addition, the study can be classified as a correlational study, since it is conducted to determine the relationship between variables (MARCZYK et al, 2005) The statistical analysis were performed with the software: SPSS 20.0 (IBM), employed to compute non-parametric correlations, data input, analysis and treatment.

Data was obtained for four nonconsecutive years (2008, 2010, 2012 and 2014). The databases used were Doing Business Report in the years 2008, 2010, 2012 and 2014, compiled by the World Bank (World Bank, 2014), UN e-government survey 2008, 2010, 2012 and 2014 (UN, 2014) and GEM 2008, 2010, 2012 and 2013(2014 report was not available by the date of collection). All data were imported and treated in Microsoft Excel 2010.

The Doing Business Report provides a quantitative measure of regulations for starting a business, dealing with construction permits, employing workers, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and closing a business—as they apply to domestic small and medium-size enterprises (World Bank, 2009). The indicators are usually composed by a combination between number of procedures, time needed to perform some business crucial tasks like registering a business, closing it, exporting and importing, income tax rate, access to credit, labor costs and many other indicators. Most of those indicators, in theory, could benefit from a well-developed e-govern strategy mainly in reducing time required, and the overall cost (Gil-Garcia & Pardo, 2005).

Also from World Bank, another database used in the analysis, the World Bank Group Entrepreneurship Survey measures entrepreneurial activity in over 100 developing and industrial countries over the period 2000-2014. The database includes cross-country, time-series data on the number of total and newly registered businesses, collected directly from Registrar of Companies around the world.

Finally, the last report utilized was the Corruption Perception Index (CPI), published since 1995 by Transparency International, ordering the countries of the world according to "the degree to which corruption is perceived to exist among public officials and politicians". The Corruption Perceptions Index (CPI) measures the perceived level of public-sector corruption in 180 countries and territories around the world (Transparency International, 2010).

It is very important to note that this article starts from a different perspective as adopted by previous works by Zouain & Almeida (2012; 2013). While in these articles the relative position of the country in the e-government rankings were compared with the entrepreneurial rate, the ease of doing business and other indicators, this article follows a different approach, trying to quantify the change (improvement/decline) of the indicators, and positions of the countries on the ranking, to predict the improvement on the dependent variables.

That is, does the improvement on the level of e-government also improves the ranking on the doing business dimensions, or any of the other dependent variables as corruption perception, or the creation of new business? Even though the concepts are related, they are different, since the first example does look at the relative position, while the second examines if a change (improvement) does also improve other indicators, suggesting a causation effect.

It is important to note that to establish causality is not impossible, in non-experimental designs, but this approach tries to deal with this limitation, by quantifying the change of the variable, instead of using the actual values. In theory, this model tries to measure a change in the ranking, as an improvement or decline, and by measuring/defining a series of outcome variable, attributing the change on the dependent variable on the change of the e-government ranking.

### 3. ANALYSIS

After the consolidation, test for errors, and visual inspection, the distribution of the data was tested by the Kolmogorov-Smirnov one-sample test. The null hypothesis of this procedure states that the distribution is normal, and p-values higher than 0.05 indicate that the data has an approximately normal distribution, and therefore suited to undergo tests and procedures that require the normality to provide adequate results (HAIR et al, 2010).

The results indicate that the majority of the variables tested do not have a normal distribution. The descriptive statistics for all time intervals, 2008/2010, 2010/2012 and 2012/2014 divided by country groups are presented in the table 1:

Table 1. Descriptive Statistics of change statistics of the main variables of the study

	Income Group		
	Low and Lower middle income	Upper middle income	Higher Income
	Mean	Mean	Mean
Ease of Doing Business Rank	140,73	85,80	30,76
E gov ranking	131,86	85,55	40,91
Egov Index	,30	,48	,70
Human Capital Index	,57	,79	,90
E Participation Index	,14	,24	,49
Online service index	,23	,38	,63
InfraStructure Index	,10	,27	,58
Corruption Perception Index	2,84	3,63	6,65
Total early-stage Entrepreneurial Activity (TEA)	19,89	14,36	7,69
Established Business Ownership Rate	13,63	8,09	6,40
New Business Ownership Rate	11,54	6,54	3,32

**NOTE: All variables show difference on a p=0.005 – ANOVA**

The results presented in table 1 are useful for understanding the dynamics of e-government and Doing Business Dimensions and how the variables are different depending on the country income level. Most variable are not favorable for lower income countries, with exception of new and stablished business ownership, and entrepreneurship rate. On the other side, the rankings of Doing Business is on average is 140 for poorer countries, while move developed countries have in average the 30<sup>th</sup> position on the rank. Human Capital, E-participation, online services, follow this trend showing an important gap on the implementation of e-government and its composing indexes between the three groups.

Table 2 contains the best and worst performers in e-government ranking in the period 2012 to 2014:

Table 2. Best and Worst Performers on E-Government Ranking 2008/2014

10 Best Performers (Improvement in E-government ranking 2012 to 2014)								
Country	2008/2010		2010/2012		2012/2014		Average for the Period	
	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank
Russian Federation	3	-1	-3	-32	-58	0	-19,3	-11,00
Ukraine	3	13	7	14	-56	19	-15,3	15,33
Kosovo	6		-2		-42		-12,7	
Philippines	4	12	-12	10	-41	7	-16,3	9,67
Greece	0	-3	-9	-4	-39	-3	-16,0	-3,33
Costa Rica	4	12	-4	6	-38	-23	-12,7	-1,67
Italy	2	11	7	-6	-31	-9	-7,3	-1,33
Jamaica	6	4	7	19	-30	1	-5,7	8,00
Poland	-2	12	-8	2	-30	-5	-13,3	3,00
Uzbekistan	0	-22	16	4	-25	9	-3,0	-3,00
	Mean Rank Displacement (negative values mean improvement)							
	2,6	4,2	-0,1	1,4	-39,0	-0,4	-12,2	1,7
10 Worst Performers (Decline in E-government ranking 2012 to 2014)								
Country	2008/2010		2010/2012		2012/2014		Average for the Period	
	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank	$\Delta$ in E-Government Ranking	$\Delta$ in Easy of Doing Business Rank
Grenada	1	7	-19	-24	53	3	9,5	-35
Bangladesh	-12	-8	15	16	51	-2	6,5	8
St. Lucia	17	8	-1	2	48		3	-0,5
Syrian Arab Republic	1	14	-10	-6	41	8	8	5
Maldives	-2	-3	-6	3	37	-1	8	9
Nigeria	12	14	-4	12	37	-21	-6,5	6,5
Saudi Arabia	-2	-12	1	-17	37	-5	14	3,5
Marshall Islands	10	1	-2	-38	33	-4	-6,5	-16,5
Antigua and Barbuda	14	-41	-7	-6	32	11	18	-17
Dominica	5	-11	-23	-32	32	37	N/A	-28,5
	Mean Rank Displacement (negative values mean improvement)							
	4,4	-3,1	-5,6	-9,0	40,1	2,9	6,0	-6,6

Table 2 allows us to understand the behavior of the top ten performers in regards to improvement in e-government ranking and for the ten worst performers. The results do not indicate, at least on a qualitative basis, a support for the improvement of the doing business dimensions on those countries, when the e-government ranking (EoDB) also improves.

Actually, the results show a different trend. For the 10 worst performing countries, which in average, lost 17 positions in the e-government ranking, they have improved 4,7 positions in 2010/2008 on the Doing Business ranking, and in average 8,4 positions, on the period of 2010/2012. For the average of this timeframe, they lost in average six positions, while increasing their average ranking on EoDB in 6.6

positions. From the worst performers two were from high income countries, four from upper middle income countries and three from lower mid and low income countries.

For the top performers, the story is somewhat different. Although the top performers have reached an impressive 40 position average improvement in rankings in 2012/2014 for E-GovRank, in the same period the position on EoDB only improved positions 2.9, while in the 2010/2012 the same countries have in average lost 5.6 positions on the E-GovRank, and lowered in average nine positions on EoDB ranking.

The Spearman’s correlation coefficient was used to compute the relationship between the variables for all the countries in the database. Usually when the relationship between two variables is not normal bi-variate or when one is measured at a ordinal level the more widely used Pearson coefficient may not be the best estimative of the correlation of the variables (Miles & Shevlin, 2001). The table 3 contains the analysis:

Table 3. Spearman correlation between variables

Income Group			ΔEase of Doing Business Rank	ΔE gov ranking	Δ Corruption Perception Index	Δ New Business Ownership Rate
Low and Lower middle income	Spearman corr.	ΔEase of Doing Business Rank	1,000	-,103	-,096	-,103
		ΔE gov ranking		1,000	-,133	-,060
		Δ Corruption Perception Index			1,000	-,150
Upper middle income	Spearman corr.	Δ Ease of Doing Business Rank	1,000	-,008	-,093	-,054
		Δ E gov ranking		1,000	-,087	-,037
		Δ Corruption Perception Index			1,000	,069
Higher Income	Spearman corr.	Δ Ease of Doing Business Rank	1,000	,030	,112	,211 *
		Δ E gov ranking		1,000	-,044	,011
		Δ Corruption Perception Index				,059

\*\* sign. correlation at 0.01 level

\* sign. correlation at 0.05 level.

The non-parametric correlation analysis indicate that there is no correlation between the improvement (or decline) of the position of doing business dimensions and the improvement (or decline) of e-government ranking or entrepreneurial outcomes for most countries. The change of e-government ranking did not correlate with any outcome variable, the same being with the perception index. The only statistically significant correlation was found between the change in the easy of doing business rank variable and the new business ownership rate, and only for higher income countries. In all other countries, the same effect was not found. The change in the perception of corruption did not seem to be related to any changes in the levels of e-government indexes, ranking position or doing business position either.

Given the correlations found, the next step was to regress the variables against two main dependent variables of the study, to assess how much of the dependent variable could be explained by the change in the independent variables. The first model, to explain the new business change, could not retain any predictor, explaining less than 5% of the variance of the new business, with the e-government index, and its sub-indexes and the corruption perception for all the three groups (high income, upper middle, lower middle and low income).

The second model, tried to explain the variation in the EoDB ranking, using the e-government sub-indexes. We used a stepwise procedure, where the predictors are included one at a time, until they cannot be added anymore, using a criteria of F. We used the defaults 0.05 to enter and 0.10 to remove for the stepwise procedure, as implemented in SPSS. Four models were generated and are displayed in the table 4:

Table 4. Explicative Models for Doing Business Ranking

Income Group		R	R <sup>2</sup>	R <sup>2</sup> Adjusted	Std. Estimate Error
Low and Lower middle income	1	,182 <sup>a</sup>	,033	,029	27,74752
	2	,251 <sup>b</sup>	,063	,054	27,38615
	3	,284 <sup>c</sup>	,081	,067	27,18788
Upper middle income	1	,437 <sup>d</sup>	,191	,185	15,08754
	2	,665 <sup>e</sup>	,443	,435	12,56408
	3	,730 <sup>f</sup>	,532	,522	11,55499
	4	,776 <sup>g</sup>	,603	,591	10,69116
Higher Income	1	,540 <sup>a</sup>	,292	,287	8,98298
	2	,608 <sup>h</sup>	,370	,360	8,50580

a. Predictors: (Constant), Online service index

b. Predictors: (Constant), Online service index, Human Capital Index

c. Predictors: (Constant), Online service index, Human Capital Index, InfraStructure Index

d. Predictors: (Constant), Human Capital Index

e. Predictors: (Constant), Human Capital Index, Online service index

f. Predictors: (Constant), Human Capital Index, Online service index, E Participation Index

g. Predictors: (Constant), Human Cap Ind, Online Serv ind, E Participation Ind, InfraStructure Ind

h. Predictors: (Constant), Online service index, InfraStructure Index

The results of the regression analysis provide some empirical support to indicate that this model may be adequate and in fact account for a good explanation of the impact of the improvement of e-government on the doing business dimensions for upper and higher income countries, but not for low and lower middle income. For the latter the model 3 could explain only 6.7 % of variation in doing business ranking, using the change in the e-government indexes. For this mode, online service, human capital and infrastructure indexes were correlated, and had a negative signal, meaning that an improvement on any index would render a lower position on ranking (better). For upper middle countries, the improvement on model is evident. The model 4 explains about 52.2 % of variation in CHANGE of Doing Business Ranking, in addition in this model the e-participation index also is a significative predictor. In this model, all predictors are negative, with human capital being the strongest. For upper income countries, the model explanation was lower than previous, but still managed to explain 36% of the variation in doing business ranking, in the considered years.

#### 4. CONCLUSION

The data and analysis showed that improvements in e-Government and its composing indexes have enough predictive power to explain the change of positions of a given country in Doing Business Ranking, but not for all countries. The Online services and Human Capital improvements were the variable that had the most impact in the doing business ranking changes. The perception of corruption change between all periods considered (2008 to 2014) was not statistically associated with change in any other variable.

This study extends previous research by using the concept of change between periods (gap years) instead of raw data and actual rank position to calculate relationship between variables. In addition, the division of countries based on their income level seemed fruitful, and more research should be done to understand why e-government improve more doing business dimensions in upper middle countries. For future research we recommend that more databases be analyzed, we also suggest more multi-country research conducted to measure directly the impacts of e-Government on a series of indicators, and challenges to the implementation and the citizens' perception of e-Government. These researches could provide a better understanding of how e-Government is changing governments, societies and business around the world.

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# A MODULAR AND FLEXIBLE ATTRIBUTE MAPPING SERVICE TO MEET NATIONAL REQUIREMENTS IN CROSS-BORDER eID FEDERATIONS

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## ABSTRACT

Identification and authentication are essential processes in various areas of applications where access to sensitive data needs to be protected and regulated. This identification and authentication process meets legal and technical requirements, which are specified in many European countries. Due the mobility of citizens, cross-border interoperability of national electronic identity systems in the European eID landscape becomes more and more important. If cross-border interoperability comes into play, it becomes difficult to accomplish national legal and technical requirements for identification and authentication, because identification and authentication information must be mapped into national eID characteristics to perform national legal requirements. In this paper, we present a new modular and flexible architecture of an attribute mapping service, which establish an interoperation layer on cross-border identification and authentication attributes to meet national legal and technical requirements. The proposed architecture follows a plug-in based approach that eases the integration of new attributes, or national legal or technical requirements. We illustrate the practical applicability of the proposed architecture by implementing a foreign identity attribute mapping service for the Austrian eID infrastructure. This attribute mapping service meets all national legal and technical requirements of the Austrian eID infrastructure, which are necessary to use foreign identities in the national infrastructure.

## KEYWORDS

Identification, Authentication, cross-border Interoperability, Legal requirements, Attribute mapping

## 1. INTRODUCTION

Electronic identity (eID) is indispensable for a verity of Internet services and online applications. Such Internet services or online applications could be social network interactions, for example, but also are more security-sensitive services such as tax declarations or an eHealth application that protects personal medical data. The more transactions are performed by using online applications processing sensitive data, the higher is the importance for a high level of assurance into a qualified identity and a secure authentication of citizens, according to national legal requirements. E-Government is such an area, where high assurance in the citizen's identity is needed. With respect to eGovernment, several countries have already developed and deployed electronic identity systems since the beginning of the 21<sup>st</sup> century. Such of these national electronic identity systems could not only provide personal information of the citizen, like the given name, the surname, or a unique identifier, but also are some additional authentication information, like an electronic mandate or the notification if the citizen is a medical scientist, an advocate or public servant.

Due the mobility of citizens, cross border interoperability of national electronic identity systems in the European eID landscape has become more and more important in the last couple of years. In the case of cross-border eID, the European Commission has recently published the EU regulation on Internal Market electronic identification and trust services (eIDAS) [European Union, 2014], which builds the legal framework for cross-border eID acceptance within the EU. However, the eIDAS regulation is currently only the latest step towards the implementation of a pan-European eID federation. The aim on cross-border eID recognition dates already back to 2005, as the aim was mentioned in the Manchester Ministerial Declaration [European Union, 2005], followed by the EU Service Directive [European Union, 2006] in 2006 and the eID

large scale pilot projects STORK<sup>1</sup> and STORK 2.0<sup>2</sup>. These large scale pilot projects treaded with an interoperability framework, which can be used to couple different national eID solutions by using well defined service models [Leithold, H. and Zwattendorfer, B., 2010].

The STORK service models define the infrastructure and the communication protocols between the different national electronic identity systems. But many countries have national legal requirements that had to be complied with or they use proprietary authentication attributes in there national eID infrastructure. Consequently, it is not enough to specify the communication channel between national eID systems only, but also cross-border identification and authentication data has to be mapped to the national eID characteristics and requirements. In practice, this mapping of cross-border eID information is actually not a trivial task since national regulations and attribute definitions in the citizen’s country could be disparate to regulations and definitions in the service provider country. For example, there are differences in the legal scope of mandates between countries, or the legal form of a company has a different coverage in respect to the law. However, there are also challenges in the cross-border interoperability, which are not recognizable at first view. As an example for such an interoperability challenge the surname can be mentioned. In many countries the legal requirements of a minimal personal data-set consists of a given name, a data of birth and the surname, but there are also some countries like Island, where there data set does not contain a surname. Therefore, some additional national infrastructure is required to facilitate cross-border eID interoperability.

As a first solution to this problem, Stranacher have proposed an approach for the integration of foreign eIDs into the Austrian eGovernment [Stranacher, K., 2010]. However, this proposal lacks in terms of adaptability, flexibility and modularity to comply new legal requirements or to offer new attribute mapping functionality, which are part of the STORK 2.0 pilot or the eIDAS regulation. To overcome this issue, we present improved architecture of a national attribute mapping service, which can be used in combination with the STORK 2.0 interoperability framework.

The paper is structured as follows. Section 2 gives a short introduction into the STORK interoperability framework and the models, which are in use there. In Section 3 the architectural design of our attribute mapping service is explained. In Section 4 we give details on the implementation of our architecture, by implementing an attribute mapping service for the Austrian cross-border eID implementation. Finally, in Section 5 we draw a conclusion.

## 2. STORK INTEROPERABILITY FRAMEWORK

The STORK large scale pilots treated with an interoperability framework which can be used to couple a heterogeneous set of national identity management infrastructures. To perform this challenge, the STORK interoperability framework defines two different service models, which can be used to build up an interoperability layer between national eID solutions.

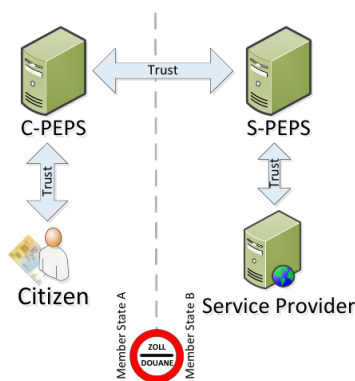


Figure 1. STORK PEPS model

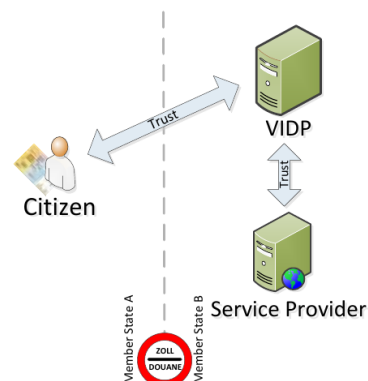


Figure 2. STORK middleware model

<sup>1</sup> <https://www.eid-stork.eu/>

<sup>2</sup> <https://www.eid-stork2.eu/>



These models are the Pan European Proxy Service (PEPS) model, which are shown in Figure 1 and den middleware (MW) model illustrated in Figure 2 [Zwattendorfer, B., et al., 2013]. Both models use a well-defined communication protocol to interconnect national deployed eID services.

The PEPS model uses a proxy-based approach to encapsulate specifics of the national eID infrastructure. In this model, a PEPS is a single point of contact for other countries, which implements a gateway to use the national eID infrastructure cross-border. In contrast to the PEPS model, in the middleware model citizens are directly authenticated at the service provider. Therefore, a service provider has to deploy a so-called V-IDP in the service provider infrastructure, which provides all necessary functionality for citizen identification and authentication. Actually, STORK implements both models and all possible combinations between them, because there are advantages and drawbacks in both interoperability models [Zwattendorfer, B., et al., 2013].

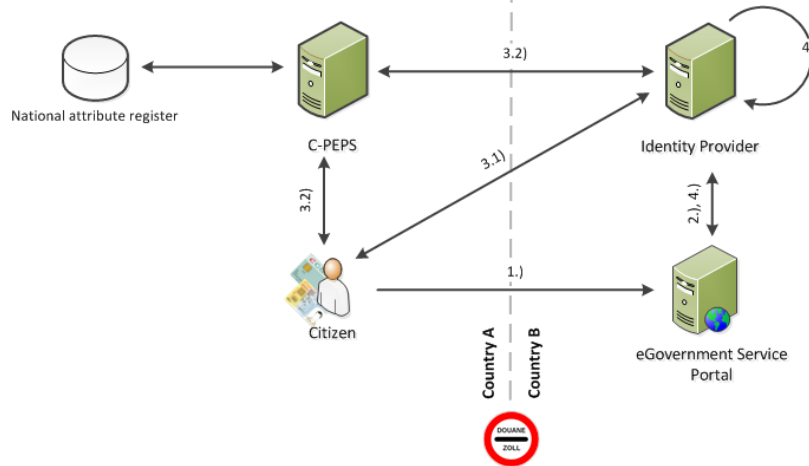


Figure 3. Process flow of a cross-border identification and authentication process by using the STORK framework.

Figure 3 illustrates the identification and authentication process flow, in which a citizen of a country A would use an eGovernment portal, which is deployed in a country B, by using its national eID. This process flow consists of the following steps.

1. A citizen of country A wants to access a protected area at an eGovernment portal in country B.
2. The citizen is redirected to an identity provider and there the citizen has to select its favored identification and authentication model.
3. After selection, one of the STORK service models is used to identify and authenticate the citizen. This identification and authentication process generates identification and authentication attributes, which are received from the identity provider, by using the STORK communication protocol. If the PEPS model is used, also some additional attributes could be generated by using a national attribute register. Such an additional attribute could be an electronic mandate for example.
4. To fulfill national legal requirements and to make the received authentication attributes interoperable with the national eID infrastructure an attribute mapping process is required. This attribute mapping process could be performed by using the attribute mapping service, which we present in this paper.
5. At last, the identification and authentication information is transmitted to the eGovernment service provider and the citizen can access the protected resource.

The STORK communication protocol defines a set of authentication attributes, which are used to transfer identification and authentication information across borders. Table 1 illustrates some important attributes, which are in use for cross-border identification and authentication. This identification and authentication attributes, which are illustration in Table 1 as example, has to be mapped to national legal and technical requirements. Consequently, a semantic attribute mapping service, which builds up an interoperation layer on identification and authentication attribute values, has to map all attributes, which are defined by the STORK interoperability framework. In the next section, we present the architecture of an attribute mapping service, which can be used in both STORK models.

Table 1. A selection of STORK authentication attributes.

Attribute Category	Attribute Name	Description
Natural person	eIdentifier	Unique identifier of a natural person
	givenName	Given name of a natural person
	surname	Surname of a natural person
	dateOfBirth	Date of birth of a natural person
Legal person	eIdentifier	Unique identifier of a legal person
	commonName	Name of a legal person
	address	Postal address of this legal person
Mandate	mandateContent	Scope of an electronic mandate in respect to validity period and legal scope.
	representative	Description of natural person which represents another person.
	represented	Description of natural person or legal person, which is represented

### 3. ARCHITECTURAL DESIGN

The proposed architecture of an attribute mapping service is based on a sophisticated modular architecture to get a flexible solution for attribute mapping in respect to their legal meaning and situational meaning. Figure 4 illustrates the general architecture of our attribute mapping service.

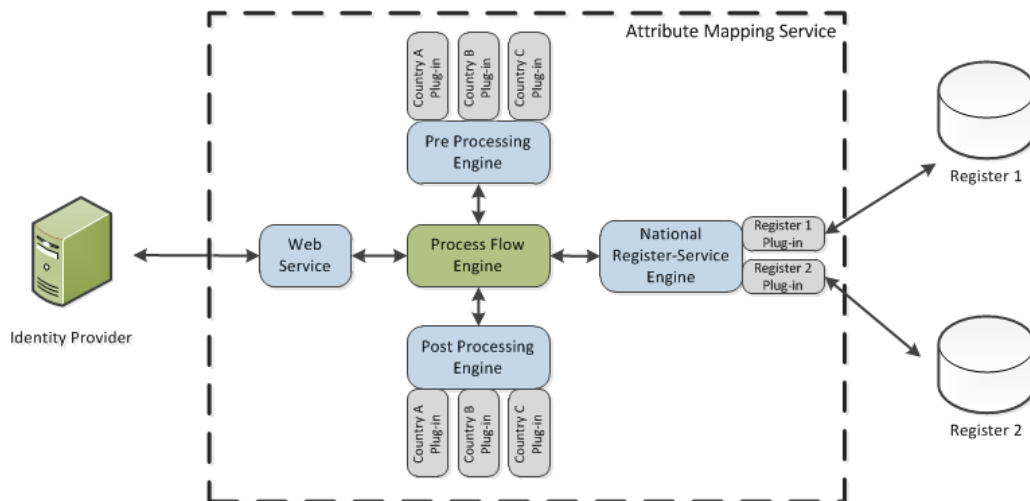


Figure 4. Architecture of the attribute mapping service.

The key component of the entire solution is the *Process Flow Engine*, which coordinates the different steps of an attribute mapping process. An attribute mapping process can be divided into three steps. In the first step, the attribute values, which should be mapped from one national representation to another national representation, are processed by using the *Pre Processing Engine*. For each supported source country, an appropriate *Country Plug-in* can be implemented. Every *Country Plug-in* implements the mapping from the national attribute representation to a generic attribute representation, which are used in the next steps. The advantage of this modular preprocessing approach is the generalization of the input data to a well-defined data set for the next processing steps.

In the second step, the *National Register-Service Engine* is used to fulfill national legal requirements or to generate proprietary national identification and authentication datasets. Every national register interaction is implemented as a *Register Plug-in*, which use the generalized input data to interact with the register. By using this flexible approach, a multitude of national register services could be used during the mapping process to comply all national requirements.

In the last step, the *Post Processing Engine* is involved, which generates destination country specific authentication information by using the data which are processed before. We also used a modular approach, which use *Country Plug-ins* for every destination country, to perform this last step. This modular post

processing approach facilitates the usage of our solution in different countries and makes it adaptable to new national requirements.

An additional advantage of these modular preprocessing and post processing is, that it allows to minimize the implementation effort for new countries, because a specific mapping operation could be implemented into Pre Processing Engine or into the Post-Processing Engine depending on national attribute value characteristic. For example, if a source country has a proprietary attribute value, which has to be mapped for every destination country, the mapping could be performed in the preprocessing step, easily. In contrast, an attribute mapping should be performed by the post processing step, if the destination country requires a special proprietary attribute value. The communication between an identity provider and our proposed attribute mapping service is done by using a Web-service, which is realized in the *Web Service* module.

We have evaluated the practical applicability of the proposed architectural design by implementing an attribute mapping service for the Austrian eID infrastructure to facilitate cross-border eID interoperability with respect to the STORK 2.0 pilot, which is still running.

## 4. AUSTRIAN FOREIGN-IDENTITY ATTRIBUTE MAPPING SERVICE

The practical applicability of our proposed architectural design has been evaluated by realizing and implementing an attribute mapping service in practice. To illustrate that, we have implemented an attribute mapping service for the Austrian eGovernment, which fulfill all national legal and technical requirements to use foreign identities in the Austrian eID infrastructure. This new and advanced solutions enhanced the implantation, descript by Stranacher [Stranacher, K., 2010] by using our proposed architectural design. In Subsection 0 we shortly describe the legal requirements for foreign identities in Austria. In Subsection 0 we present the implementation of the advanced Austrian foreign identity attribute mapping service.

### 4.1 Legal Requirements

The legal requirements to use foreign identities in the Austrian eGovernment infrastructure, which is the Austrian eGovernment Act [Austrian Federal Law Gazette (BGBl) part 1 Nr. 10/2004, 2008], have been amended in the year 2008. As a result foreign electronic identities fully integrated in the Austrian eGovernment in case they are associated with qualified electronic signatures (a qualified electronic signature requires the usage of a secure signature creation device (SSCD), like a smart card, to generate the electronic signature). A legal requirement of this Austrian eGovernment Act is that if the citizen is not already registered in the Austrian Central Register of Residents, which is the case if the person has a registered residence in Austria, the foreign citizen must be registered in the Supplementary Register. With §6(5) of the Austrian eGovernment Act the possibility to register a person electronically has been given. This is done by the so called eGovernment Equivalence Decree [Austrian Federal Law Gazette (BGBl) Nr. 170/2010, 2010], which determined the identification attributes from a foreign identity must be used. Usually this identification attributes are stored in the subject name of the certificate, which the foreign citizen has used during the identification and authentication process. But in some cases, the certificate does not include all required identification attributes. Therefore, an additional national register query must be performed to get all required national identification attributes. Consequently, the eGovernment Equivalence Decree define those countries, which provide electronic identities by using a qualified electronic signature for authentication purpose and specifies the identification attributes, which are required for each county. Actually the following countries are defined to be equivalent: Belgium, Estonia, Finland, Iceland, Italy, Liechtenstein, Lithuania, Portugal, Sweden, Slovenia, and Spain. Consequently, citizens from these counties could use their national eID for login to an Austrian online application [ref].

There are also legal requirements in the Austrian eGovernment infrastructure, if electronic mandates are in use. These legal requirements are defined in the Austrian SourcePin Register Degree [Austrian Federal Law Gazette (BGBl) part II Nr. 57/2005, 2005.]. Additionally, there exist also some technical requirements for electronic mandates, which are defined in the specification of electronic mandate [Rössler, T., et al. 2006]. This technical specification defines the data content and the data structure of an electronic mandate, which is used by the Austrian eID infrastructure.

## 4.2 Implementation

We use our proposed architecture to implement an advanced attribute mapping servers to use foreign identities in the Austrian eGovernment infrastructure. Figure 5 illustrates this Austrian specific implementation of our proposed architecture.

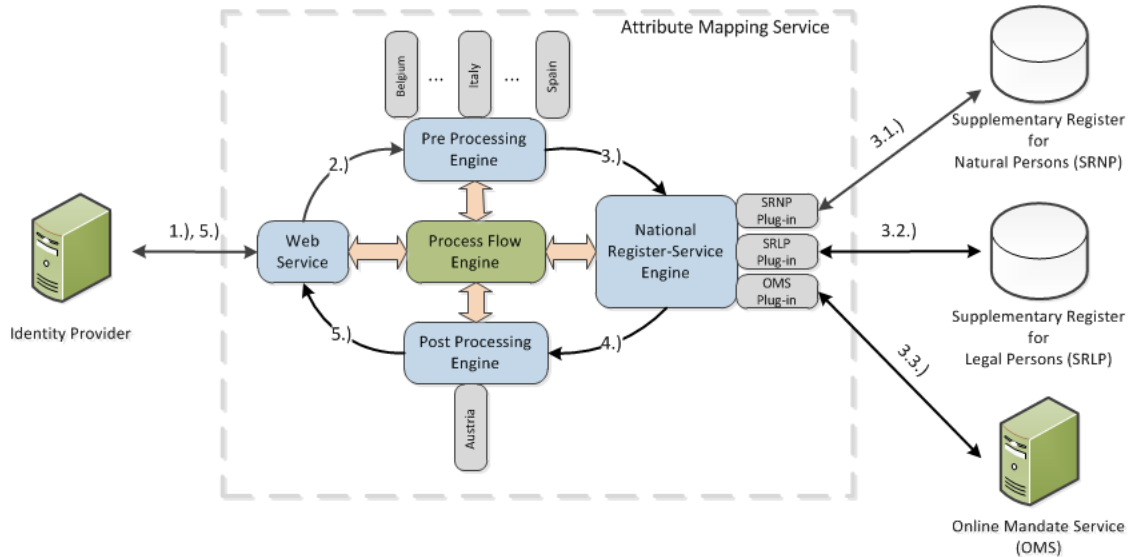


Figure 5. Implementation of the Austrian attribute mapping service.

To present our implementation in detail, we describe an attribute mapping process, which is based on an electronic mandate to represent a legal person, as an example. In this example, a foreign citizen wants to log in to an Austrian eGovernment application by using its national eID and an electronic mandate, which authorize the citizen to represent a legal person, like a company.

1. After identification and authentication is performed by using the STORK interoperability framework, the identification and authentication attributes, which the Austrian identity provider has collected, should be mapped to the Austrian legal and technical requirements. Therefore, the identity provider connects the attribute mapping service by using a SOAP [Gudgin, M., et al., 2007] based Web service. Beneath the SOAP protocol, the Hypertext Transfer Protocol (HTTP) [Fielding, R., et al., 1999] is used as carrier for the SOAP message. This is reasonable, because HTTP is popular, frequently used and widely supported. SOAP messages being exchanged over the implemented Web service rely on the Extensible Markup Language (XML) [Bray, T., et al., 2006]. The XML schema, which we have defined<sup>3</sup>, to exchange messages with the attribute mapping service is shown in Listening 1<sup>4</sup>

```
<xsd:element name= "AttributeMappingRequest " >
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name=" Signature" type=" xsd:base64Binary maxOccurs=" 1" />
      <xsd:element name=" STORK" type=" STORKAttributeType" minOccurs=" 0"
        maxOccurs=" unbound" />
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>
```

Listening 1. Attribute mapping request.

<sup>3</sup> We were forced to define an schema, since existing schemata were not able to meet the Austrian technical requirements.

According to the defined XML schema, an attribute mapping request consists of an electronic signature (*Signature* Element), which is mandatory, and a set of STORK attributes, which are located as child elements in the *STORK* element. We use the STORK attribute names to distinguish the single STORK attributes in the *STORK* element.

2. After receiving the attribute mapping request, the Pre Process Engine starts to process the received attributes. At first, the Pre Process Engine gets the foreign signature from the request and verifies it. Thereby, also the signature certificate is checked if it is qualified. In case the certificate is qualified, the Pre Process engine extracts the citizenship from the certificate by using the country element of the certificate's subject name and selects the corresponding country plug-in. After this general preprocessing, the country specific plug-in starts the country specific data extraction and mapping process, which consists of the following steps in our example.
  - 2.1. At first, the plug-in extracts identification information, which is available in the foreign certificate. This data could be the given name, the surname, a national eID number and information about the certificate. In this step, an additional register query is performed for some special countries, like Liechtenstein, to get additional information, which are not included in the certificate. After collection all required information from the citizen the next preprocess step is performed.
  - 2.2. In the second preprocess step, the STORK attributes, like an electronic mandate, are processed. In case of an electronic mandate to represent a legal person also some additional mappings are necessary. At first, the legal scope of the foreign mandate has to be mapped to an Austrian mandate legal scope, because Austrian online applications only support Austrian mandate scopes. At second, the legal corporate form of the legal person, which should be represented, has to be mapped to an Austrian legal corporate form. As example, a *Public Limited Company* has to be mapped to an Austria *Aktiengesellschaft*.

After these, all foreign identity attributes are mapped into a generic attribute dataset. This generic dataset serves as basis for all further steps in the attribute mapping process.

3. In this step, National Register-Service Engine is used to achieve legal and technical requirements, which are essential if a foreign identity should be used in Austria. To satisfy these requirements, we implement three plug-ins. These plug-ins implement the communication with national registers and national web services, which we will describe in detail in the next sub steps.
  - 3.1. At first, the *SRNP Plug-in* is used to check, if the foreign citizen is already registered in the Central Register of Residents or in the Supplementary Register for Natural Persons (SRNP). If the citizen is not registered, the SRNP plug-in sends a request to the Supplementary Register for Natural Persons to register the foreign citizen, by using the citizen identification attributes from the generic dataset.
  - 3.2. If an electronic mandate is in use, the represented person must also be registered in a national register. In case of a represented legal person, this legal person must be registered into the Supplementary Register for Legal Persons (SRLP), if this legal person is not already registered there. To perform this SRLP registration, the mapped legal corporate form and some other legal person identification attributes are used. If the represented person is also a natural person, the registration process is equivalent to the registration process of the foreign citizen described in step 3.1.
  - 3.3. The electronic mandate, which is used by the foreign citizen, must also be registered to the Austrian *Online Mandate Service* (OMS). This registration process uses the information from the SRNP, the SRLP and the mapped legal scope of the foreign mandate to generate an Austrian electronic mandate just-in-time. The generated electronic mandate is equivalent to electronic mandate, which is in use from Austrian citizens.

After this, all Austrian legal requirements are satisfied and the attribute mapping process switches to the next step.

4. The last attribute mapping step is performed by the Post Processing Engine, which generates Austrian specific identification and authentication attributes. Unique identification of Austrian citizen is done by using a special XML data structure, which is called identity link. Consequently, the plug-in generates an identity link for the foreign citizen, by using the information, which is stored in the SRNP.
5. In the last step, the identity link, which was generated on-the-fly for the foreign citizen, and the Austrian electronic mandate, if a foreign mandate was in use, is returned to the identity provider. After this, the identity provider could use the mapped identification and authentication attributes to transmit the information to the Austrian eGovernment service provider.

## 5. CONCLUSION

Identification and authentication of citizen is an integral component of a variety of Internet services and online applications. The capability for reliably identification and authentication according to national legal requirements is important for service providers, which process private and individual-related data, like eGovernment applications. If cross-border interoperability of national electronic identity systems comes into play, it becomes difficult to accomplish national legal and technical requirements for identification and authentication. It is not enough to define the communication channel between national eID solutions, because cross-border identification and authentication data must also be mapped to national eID characteristics and national requirements.

In this paper, we have presented a new architecture of an attribute mapping service, which establish an interoperation layer on cross-border identification and authentication attributes. Our solution relies on an adaptable and modular architecture that facilitates future extensions. We have demonstrated the practical applicability of our architectural design by implementing a foreign identity attribute mapping service for the Austrian eID infrastructure. The implemented solution meets special legal and technical requirements of the Austrian eGovernment, but its general architectural design is also applicable to other contexts.

The realization of further legal or technical requirements, which arise from the eIDAS regulation, that make use of the presented architecture is regarded as future work.

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# SOFTWARE STANDARDIZATION IN THE CONTEXT OF THE INNOVATIVENESS OF ENTERPRISE OPERATIONS

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## ABSTRACT

The paper discusses the issue of enterprise innovativeness associated with the implementation of Enterprise Systems. The popularity of standard software packages (i.e. ERP systems) can raise questions about their innovativeness. The paper contains the description of the standard software customization methods which are aimed at preserving the required individualization of business processes. It is particularly important in case of main processes which determine gaining or maintaining competitive advantage. In this case, it is a matter of innovation on an industry-level. At the same time standard software packages using pre-configured systems and reference processes are applicable for supporting processes. In such case in spite of imitation, the company can be innovative on its own level. The cited research results and the analysis presented in the article confirm organizational innovativeness of the Enterprise Systems implementations, as well as, to some degree, product and process innovativeness. The IT development, particularly within the field of management information systems, ensures that this situation will not change in years to come.

## KEYWORDS

Innovation, Enterprise Systems, Management Information Systems, Enterprise Resource Planning, Software customization, Software standardization.

## 1. INTRODUCTION

In today's world where providing simple services or manufacturing basic commodities is not sufficient for long-term economic success, innovativeness is the way to stay in business and to develop a competitive advantage. The information technology undeniably gives the possibility of implementing wide range of innovations, particularly in new production methods, technological solutions etc.

However the questions arise concerning the innovativeness of management processes: to what extent is information technology innovative in enterprise management? This domain is dominated by standard software packages. Can be the implementation of those packages considered innovative? What is the dependence between software standardization and innovation in business processes supported by Enterprise Systems? Is the possible innovative effect related to acquiring new Enterprise Systems up to date?

Innovation definitions are usually focused on products, technology and production processes. For example according to OECD Oslo Manual report (OECD 2005) technological products and process innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes. The product and process innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). A technologically new product is a product whose technological characteristics or intended uses differ significantly from those of previously produced products. According to Bullinger (2008) product innovations are traditionally at the core of the innovation strategy of a manufacturing company and they are also the most commonly identified type of innovation. They encompass the creation of radically new products (characterized by new functions, new functional principles, less functions, and additional functions) as well as the incremental change and/or the improvement of existing products. However, according to OECD classification, technological process innovation is the adoption of technologically new or significantly improved production methods, including product delivery methods.

At the same time, the organizational innovation can be distinguished. It can have only indirect influence on production processes. Many authors define organizational innovation. For example, organizational innovation corresponds to new organization methods of work and companies aiming at improving their efficiency (Mercier-Laurent 2011). It conveys the development or the adoption of new work organization. According to Ravidat (2008) organizational innovation refers to the new ways work can be organized and accomplished within an organization, in order to encourage and promote competitive advantage. It encompasses how organizations and individuals specifically manage work processes in areas such as customer relationships, employee performance and retention, and knowledge management. Furthermore, it should be noted that, other authors distinguish also various kinds of innovation, such as: marketing, cultural, social innovation, cognitive, economic, educational, innovation centered on the needs of the customer, eco-innovation (Mercier-Laurent 2011). In practice innovation process consists in subprocesses of technical, managerial and social character through which a new idea is implemented into practice for the first time (Quinn et al. 1996).

Considering the issues of innovation, it should be noted that the novelties on the one organization's scale can be considered innovations. For example, according to OECD report the minimum entry is that the product or process should be new (or significantly improved) to the firm (it does not have to be new to the world). Therefore, one can consider innovations on the branch scale, giving the organization significant competitive advantage. The activity of imitating competitive solutions can be also regarded as innovative. Thanks to the imitation, an organization adopts new solutions that help it to survive on the market.

The aim of the paper is to answer the questions posed at the beginning of the introduction section, considering the innovation in management processes in companies. The considerations are based on research results and the authors' analysis of the problem.

## **2. THE SCALE OF ENTERPRISE SYSTEMS CLASS SOFTWARE IMPLEMENTATION**

Enterprise Systems software seems to be strongly related to organizational innovations, especially when it influences productivity improvement or sales performance. This is especially the case of most processes supported by typical integrated Enterprise Resource Planning (ERP) systems. The ERP systems help to better organize work of many organizational units, integrate business processes between different departments, automate information flows and consecutively increase effectiveness of an organization.

The implementation of ERP class systems is connected with restructuring or at least improving business processes. Therefore, it can be considered an organizational innovation. The in-depth analysis allows to see the impact of software implementation on classical product and process innovation, for example PLM (Product Lifecycle Management) module of ERP class system. Such modules are indirectly related to product innovation by supporting the product portfolio management from generating idea through concept development and design to production, implementation, exploitation and utilization (Jurczyk-Bunkowska and Pawełoszek 2014).

The research on the role of IT in innovation processes management emphasizes the importance of communication tools between different units participating in this process (Song et al. 2007; Jelonek et al. 2014), particularly during the conceptual phase of product designing. The communication tools are usually part of advanced integrated standard software packages supporting management. However this paper emphasizes the organizational innovations being a result of implementation of some basic functions of standard integrated ERP class systems. To answer questions that have been posed at the beginning, relevant to innovations resulting from harnessing IT solutions in management, it is needed to estimate the scope of MIS (Management Information Systems) applications as standard software packages in the companies. The widest and most representative research is conducted by National Statistic Institutions, in case of Poland the Central Statistical Office. For the selected economic institutions it is obligatory to take part in the survey, therefore the acquired data are of high quality. Considering the size of the research sample and chosen methods it is practically not possible to acquire more reliable results. Therefore the authors decided to use the reports of the Central Statistical Office of Poland as the basis for the analysis. In recent years the only systematic surveys were conducted within research "Information Society in Poland" (GUS 2010, GUS 2013). The research has been focused on: the scope and activities of ICT sector, ICT products, ICT usage in



companies and households. The details of the research differ in subsequent years, but in spite of the differences there is a possibility to make some comparisons and trend analyses. One of the recurring questions in ICT domain in subsequent years relates to methods of electronic and automatic data exchange inside companies, in particular connected with using ERP systems. A summary comparison of survey results in this domain is presented in Table 1.

Table 1. The usage of ERP class systems in Polish companies

<b>Companies</b>	<b>2009</b>	<b>2010</b>	<b>2012</b>	<b>2013</b>
Total	9.3%	11.3%	13.5%	17.1%
Small (10-49 employees)	5.4%	6.6%	8.3%	10.8%
Medium (50-249 employees)	20.1%	22.0%	27.8%	37.8%
Large (250 and more employees)	53.8%	57.9%	69.0%	76.6%

Different methods of conducting survey do not allow for presenting comparison of results from the year 2011, because the questions were formulated in a different way that year. Nevertheless, the constant upward trend can be observed in using ERP class systems, also there are clear disproportions depending on the company size. The greatest number of ERP systems obviously are used by the large companies, the greatest dynamic of ERP usage can be observed in small and medium-sized organizations.

It is inevitably the result of the saturation of the large enterprises market. At the same time, there is a considerable potential among the small and medium-sized companies. In recent years, the number of ERP offers for that group of customers was increased. The data in the report are also presented broken down by branch of economic activity. The most intense saturation of ERP market was observed in the IT-related branches (which seems reasonable): information and communication (36.4% in 2013) as well as computer and communication equipment service (35.5%), and also in the sector of electricity, gas, steam and air conditioning supply (35.8%). The last case can be explained by domination of large companies in this sector. The research covers the enterprises registered in Poland, although similar surveys are conducted in other European Union countries. In Poland the ERP market saturation is rather low as compared to the remaining member states of the European Union – in 2012 r. 13.5% in Poland versus average 22% in the EU.

The number of ERP implementations is particularly interested in the context of using standard solutions for supporting management. In practice the market of the integrated systems for supporting business processes is dominated by standard software packages which can be adapted to the users' needs on different levels. The software of this kind was initially intended for large and very large manufacturing companies. In the evolution process, the systems of this kind had become almost a synonymous with the integrated management information systems and now are applied in the wide range of organizations of different branches and sizes – even in the small ones.

### **3. THE BASIC METHODS OF ACQUIRING SOFTWARE, SOFTWARE STANDARDIZATION**

According to the traditional view, there are two basic options of acquiring information system software for business organizations: made-to-measure custom software and COTS (Commercial Off The Shelf) software (called also a software package). In practice, the range of possible solutions laying between the two basic options, the custom software and the software package, is very broad and includes, for example, tailor-made software developed from scratch, systems using reusable software model, customized software packages, and closed software packages.

Software packages in classical form are those which are prepared in-house or by external organizations from scratch with exclusive use of design and programming tools. Such systems are not based on available software components adapted for the use in developed application. Custom systems in classical form, in the case of large integrated systems are rarely developed due to high costs and long development time.

In practice, the production of custom software often involves using earlier developed elements (modules, components, objects, code snippets). This method of creating a system is referred to as the reusable software model. This method decreases the system acquisition development and maintaining costs and reduces the development time. According to Sommerville (2011) benefits associated with the use of a reusable model include:

- increased reliability
- reduced risk of exceeding the assumed cost of system acquiring
- effective utilization of IT experts by reducing duplication of work
- the compliance of software with the standards developed for creating libraries
- the acceleration of software development.

The system acquisition by purchasing a closed fully finished software package is possible mostly in case of small organizations engaged in typical business or to support small functional area. According to Scheer (1990) software packages are programs aimed at solving users' problems, developed by software companies for anonymous market. In more detail, COTS class systems are characterized as software products offered in the form of a sale, a lease or other licensing to a wide audience. They are offered by a provider to make a profit, developed by the supplier, which retains intellectual property rights, available in many identical copies, used without modification by customers (Oberndorf et al. 2000).

Flasiński (2006) distinguishes two functional ranges related to the acquisition the closed software package: functional range expected by a customer and functional range of a solution offered by a vendor. In this case, it is only possible, as a part of the implementation, to modify the scope of the customer's expectations by reducing the unavailable expected range. The purchase of fully finished package aimed at the computerization of company's principal activity practically forces the organization to adapt existing information system and business processes to the software requirements. In fact, it is impossible to do, or at least undesirable, especially for large organizations. Another situation occurs in case of systems designed to improve supporting processes within an organization. These processes include typical activities, similarly performed in many organizations. In the absence of the need to integrate supporting processes with other processes it is possible to use closed software packages.

In the case of software packages supporting main business processes, attention is drawn to the risk of losing the original image of an organization resulting from using software application similar to the solutions used by competing organizations. This applies in particular to the abandonment of individualization main business processes, which can be the basis for competitive advantage.

It can be assumed that the main advantages of conventional software packages include:

- the low cost of a system
- the short time of system acquisition,
- the implementation of a well-tested solution,
- the high availability of a maintenance service and possible future development,

The main disadvantages of closed software packages include:

- limited ability to adapt the product to specific user requirements
- excessive package complexity in relation to the user's requirements, resulting from its universality,
- dependence on the vendor's ability to maintain the system,
- the potential danger of a partial loss of organization image,

A subgroup of software packages is formed by customized software packages. Such systems are not operational immediately after installation. First, they require the setting of appropriate operating parameters. They are characterized by the requirement to provide maximum flexibility, understood primarily as a possible use by a variety of organizations. Such systems provide the ability to set functional operating parameters. Moreover, they have usually a built-in integrated development environment which enables developing the extensions of the standard functionality (Niedzielska and Skwarnik 1993).

Customized software packages combine flexibility and standardization. They provide the ability to precisely adapt the application to the needs of the organization. This process is referred to as customization and can vary considerably, depending on built-in adjustment mechanisms.

The issue of software package adaptation methods to meet customer needs is multi-faceted. It can be viewed and discussed from a couple points of view known as (Wieczorkowski and Polak 2010):

- a technical perspective,
- a business process perspective,

- a vendor and provider perspective,
- a customer perspective.

From the point of view of this article, the technical and business processes perspectives seem to be particularly important. The first is characterized by technological methods of adaptation, including the possibility of parameterization of a system and access to the development environment giving the possibility of interference in software code. Systems built with advanced customization technology mechanisms are largely based on the parameters. Whereas, customization using pre-configured solutions is associated with the business process perspective. Reference national or industry solutions are based on pre-proposed process. For systems with extensive parameter customization capabilities, programming adaptive methods provide only the supplementary mechanism.

By purchasing a complex software package, such as ERP, an organization also receives in practice the knowledge in the form of an implementation methodology. Characterizing software packages often draws attention to aspects of management - acquiring management standards for the entire organization and for conducting the project. The system standardization means not only its use by many customers, but also the use of acquired commonly accepted organizational standards and project management methods.

According to the authors, the development of standard parameterized systems is determined by:

- the widespread use of information systems in particular industry (a well-developed demand side),
- the competition between suppliers of alternative solutions (a well-developed supply side),
- the similarity of the implementation process of such systems,
- the similarity of business processes in organizations that use systems from one vendor, along with their specificity excluding the possibility of using closed software packages.

#### **4. INNOVATIVENESS OF IT PROJECTS IN THE AREA OF MANAGEMENT**

The use of standard software packages is primarily due to desire to reduce system acquisition costs, as well as to benefit from implementing best practices. In the case of organizations belonging to the segment of small and medium-sized enterprises, which in contrast to large organizations usually do not have extensive IT departments, the cost is usually the main criterion. The development of custom software by external IT company is also often not possible for financial reasons.

It should also be noted that the highly individualized solution can be obtained by exploiting many standard systems. If, due to financial or organizational reasons, it is not possible to acquire the integrated system customized in appropriate level, this obstacle could be tackled by exploiting a few cooperating smaller systems. The appropriate choice of systems and infrastructure for integration is able to meet the business expectations and provide expected individualization of the solution. Such approach is also in line with the contemporary view on integration of large Enterprise Systems using integration platforms and providing open architecture for external components usage.

In order to understand the universality of software packages and custom software, as well as their impact on the market situation of enterprises using them, the key question is whether information technology, now and in the near future, is an important factor in the success of enterprises and the basis for building a sustainable competitive advantage. It is a common opinion that IT investments in many areas of activity are and will remain the permanent basis of market successes. Such strategic importance of information technology is emphasized repeatedly in the literature, inter alia by Goliński (2004). Similar opinions are also expressed for obvious reasons by IT companies. This approach treats IT projects as an innovation. The innovation in this sense may be interpreted as in the traditional approach by Schumpeter (1934) who, when describing its importance for the economic development, emphasized the assumption that the development of production means is discontinuous.

In this context, there are interesting results of a research on innovation management in Poland in the SME sector. According to research by Bojewska (2009) conducted among small and medium-sized enterprises, almost half of them identified management practices closely associated with the use of modern technology as crucial for their survival (30% indicated knowledge management and 19% information management). At the same time 41% of SMEs (but mostly the smallest) is characterized by innovation inertia. These results suggest that there is a free space in the market for the suppliers of IT solutions supporting management. On

the other hand, according to the SME sector study conducted by Vanson Bourne (MSI 2012) 68% of Polish respondents claim that the use of computer technology will be the key factor in the ability to achieve success in the SME sector. In this context, respondents often mention the cloud computing model as well adapted to the needs of companies in this sector. In comparison to other countries that participated in the study, Polish entrepreneurs who use the solutions implemented in the cloud, see clear benefits for their business: 58% believe that IT solutions in the cloud model allow to reduce costs, 55% consider them to be more flexible, and 50% declare that they provide greater productivity of their businesses. However, the data published by the Central Statistical Office of Poland in a recent study on the information society shows completely different picture (GUS 2013). According to it, in 2012, they only 6% of Polish companies applied cloud computing. Moreover, the business small was utilizing cloud computing least frequently (5% of responses).

Therefore, it seems reasonable to question whether in practice every new technology and management method should be considered as an innovation affecting the means of production. Does this apply, in particular, to every piece of newly implemented software? Schumpeter (1934) treats as an innovation, among others, an introduction of a new product, a new production method, and a new organization of an industry. Hence, the question arises whether, at the level of an individual company acquiring a new information system supporting the management of an organization and usually introducing changes in business processes is an innovation.

This approach, which considers the implementation of information systems as an innovation process, is rejected by opinions that undermine the importance of information technology for the enterprise market situation. An interesting, widely discussed theory was presented by Carr (2003). Information technology is regarded by him as a technology infrastructure. These technologies are characterized, at some point of time, by massive investments and very dynamic spreading, leading to their universality and commoditization. According to this approach, the source of competitive advantage is the limitation (not universal accessibility) of solutions. Therefore, IT investments are only commonly incurred costs, but gradually ceasing to be the source of a success. Information technology, especially the internet, is compared with electricity, the use of which is now common and necessary, but it is not a competitive factor. That quite controversial opinion leads to the conclusion that the priority of information technology usage should be the cost reduction and the minimization of risks associated with the technology. Therefore, it is reasonable to use a passive attitude, staying behind the competitors, and thus reducing the risk of buying poorly tested products.

According to the authors, now and in the foreseeable future, it is still too early to consider information technologies entirely as infrastructure technologies. Although in this way, it can be easy to explain the popularity of standard software packages. The argument about the innovative significance of investing in enterprise systems is supported by quoted above data on the use of ERP systems in Poland. According to them, still the vast majority of companies, particularly belonging to the SME sector, do not use this class of systems. Therefore, currently the thesis of the commoditization of IT in this area cannot be supported.

An interesting issue is an attempt to measure the innovation of enterprises resulting from the implementation of the software packages. Such a study was conducted a few years ago by Aral Brynjolfsson and Wu (2006). They studied US companies implementing ERP, CRM (Customer Relationship Management) and SCM (Supply Chain Management) systems. Research results based on econometric methods confirmed particularly strong correlation of the purchase and implementation of ERP system with the increase of company productivity and performance. A similar study was conducted later by Engelstätter (2009) on German companies. The study emphasized the impact of Enterprise Systems implementation on the different types of innovation. Apart from the typical organizational innovations, the results showed positive long-term impact of ERP and CRM implementation on process innovations. Moreover, positive influence on product innovations was proved in the case of CRM systems, but here the effect was short-lived. Despite the use in those studies of the statistical methods, there is always an element of subjectivity associated with data collection. There is also a question whether the innovative effect of Enterprise System implementations is not a phenomenon gradually fading along with the widespread use of IT solutions.

The authors believe that it is necessary to apply a clear distinction between systems performing activities within main business processes determining the competitiveness, and systems associated with supporting processes. In the second case, it is especially reasonable to use standard solutions. This applies both to the implementation of organizational solutions using the predefined models of reference business processes (restructuring supporting business processes) and IT solutions (the implementation of standard software packages). In both cases, the standardization leads to reduction of investment costs and risks. This view is

consistent with the concept presented by Carr and results from the maturity of this facet of information technologies.

In terms of software supporting the main business processes, it is obvious that dominates the pursue for individualization and, consequently, the larger use of custom software is observed. At the same time, however, also in this case, due to the adaptation possibilities of advanced customized packages to the needs of the users, the standard software is widely used. According to the authors, the proper use of the possibility of customizing the software can and should be the basis for the construction of a high position in the market, particularly in the case of processes critical to the organization. In this case, a well-developed software market must offer for individual industries a wide range of software packages offering extended customization features. Such a situation exists in the field of management information systems supporting businesses in most popular sectors. On the one hand, the similarity of operation of different organizations, on the other hand, the clear specificity of their business processes requiring the customization of software, are the foundation of the market development for this type of software.

At the same time, within management information systems can be distinguished tools that are, or will become, a significant factor in the functioning of an organization in a competitive market environment. This applies in particular to relatively new concepts in IT, as well as to those which are, due to financial or technological reasons, just becoming popular. One of those concepts is big data, offering previously unknown ability to process huge amounts of data in real time. The use of this technology makes it possible to apply completely innovative business processes particularly in marketing. At the moment, such solutions can be classified only as custom software, but this may change in the future. Also noteworthy are technologies that do not contribute so significantly to the creation of entirely new processes, but they significantly improve the organization in the IT area, for example by improving access to managerial information. The example of such technology is in-memory processing, also developed as a solution within standard software packages. This technology can lead to the elimination of the typical classification of software distinguishing transaction processing systems and separate analytical systems based on data warehouse technology. It can be argued that in the area of Enterprise Systems for long time will appear new breakthrough technologies that will become innovations on the level of an entire industry.

## 5. CONCLUSION

Applying information technologies in the domain of management may lead, most of all, to organizational innovations, but also, to some degree, to product and process innovations. It may concern also standard software packages. Standard solutions, for example pre-configured industry-specific applications, are particularly suitable for supporting business processes, at the same time they ensure that the costs are minimized and they simplify acquiring of systems. In case of main processes, which determine the competitive advantage, the custom software can be used along with standard software packages if they are properly customized. Therefore, the contradiction between standardization and innovativeness in case of standard Enterprise Systems is apparent because software of this kind may offer sufficient individualization of processes. Even the imitated solution can be innovative if considered on the level of an individual company. The commoditization of management information systems cannot be observed at the moment. New solutions continuously are developed. They can ensure the innovativeness of business processes on an industry level and, consequently, they are the source of competitive advantage.

Moreover, regarding the continuous development of technology and wide availability of software, there is a need for regular research on the influence of Enterprise Systems on innovativeness and effectiveness of the organizations. Such research should be conducted, on the one hand, considering the branches and size of enterprises (particularly separately for SME and large corporations). On the other hand, there is a need to distinguish between implementations characterized by the different levels of individualizations, particularly applying standard approach (standard software packages, preconfigured solutions, reference process business models, etc.).

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# PaaSPort – A UNIFIED PaaS-CLOUD MANAGEMENT APPLICATION AVOIDING VENDOR LOCK-IN

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## ABSTRACT

PaaS (Platform as a Service), a service model in the cloud computing service market, specializes in offering a preconfigured infrastructure for developers, enabling them to deploy, host and scale applications efficiently. As the PaaS market continues to grow, new providers and more sophisticated services emerge. The great variety of service-specific offerings complicates the customers' abilities to choose a fitting solution efficiently. It furthermore prevents the switching of providers when necessary, making customers dependent on particular vendors. This issue is known as a *vendor lock-in*, often caused by impractical and economically unviable provider switch. To address the particular issue on vendor lock-in, in this paper we introduce PaaSPort – a unified PaaS-Cloud management application that enables the transparent and unified management of cloud applications at different PaaS providers. PaaSPort acts as an interface for various PaaS providers, enabling cloud customers to monitor and modify their PaaS hosted applications independently. All functionality of this interface application is exposed through a REST web API that unifies the common operations of multiple providers and allows for provider specific extension.

## KEYWORDS

Platform as a Service, PaaS, cloud computing, management application, vendor lock-in, API

## 1. INTRODUCTION

In the last years different branches of the booming cloud computing service market have emerged, one of them being Platform as a Service (PaaS). PaaS primarily refers to a preconfigured and flexible computing platform environment. The goals of this technology are manifold and most focus on boosting the efficiency in the process of development, deployment and maintenance of applications in the cloud. This is accomplished by increasing programmer productivity, reducing costs, and generally allows for faster build and release cycles by stripping away low level infrastructure management and providing services as easily configurable and scalable components (Lawton, 2008) (Chieu et al, 2009).

As the cloud market continues to grow, with a prognosticated total worldwide revenue of \$2.9 billion in 2016 (Gartner, 2012), the number of PaaS vendors is constantly increasing as well. This development has led to a multitude of PaaS providers, with some specializing in particular technologies (e.g. Java, Ruby, and PHP), some supporting a broad range of technologies (e.g. Heroku<sup>1</sup>), and others allowing almost any composition of technologies by providing a configurable stack (e.g. Cloudfoundry<sup>2</sup>).

However, this large set of providers - with each having their own features, supported technologies, APIs and management approach - causes difficulties when customers have to choose the right vendor for their needs and especially when they need to switch vendors once the service is established and fully functional (Gibson et al. 2012). To reduce the impact of vendor lock-in<sup>3</sup> (Catteddu & Hogben, 2009) (Pearson & Benameur, 2010), in this paper we propose a PaaS-Cloud management application that allows the deployment of a cloud application at different PaaS providers through a unified API. It enables cloud customers to select their preferred provider, i.e. to easily switch providers concerning their needs and thus

<sup>1</sup> <https://www.heroku.com>

<sup>2</sup> <http://www.cloudfoundry.com/>

<sup>3</sup> A vendor lock-in occurs, when the configuration of a deployment at a certain PaaS provider varies heavily compared to other providers and thus renders the possibility of a provider switch highly impractical and uneconomic.

avoiding the issue of vendor lock-in. Furthermore, different means of PaaS application management will be discussed and evaluated, resulting in the creation of a proof-of-concept implementation of an application that provides an interface between a selected set of PaaS providers.

The paper is structured as follows. In Section 2 we describe related work with respect to the management of PaaS applications. In Section 3 different PaaS management possibilities are discussed. In Section 4 we present PaaSPort, our proof-of-concept PaaS cloud management implementation that prevents PaaS vendor lock-in through the use of a unified management API. Finally, in Section 5 we draw conclusions.

## 2. RELATED WORK

In the following related work with respect to the management of PaaS applications is described.

### 2.1 Cloud Application Management for Platforms (CAMP)

In August 2012 a workgroup, whose members stem from several companies active in the cloud environment (including CloudBees, Oracle, Red Hat and Rackspace), released an initial version 1.0 of a Cloud Application Management for Platforms (CAMP) specification (OASIS, 2014). In 2014, an extended version 1.1 of this specification has been published by OASIS.

This specification aims to provide an API for managing applications in a PaaS environment. Designed to be an open standard, it removes portability issues between different platforms. The general idea of this specification is to provide an API for PaaS systems that masks the underlying infrastructure, such as virtual machines, storage or network. Consequently, the focus of cloud resource access model is switched from low-level resources such as computing power or data storage to applications and their components. Users can access cloud resources and transfer them between providers irrespective to the underlying infrastructure.

The CAMP specification represents cloud applications with a resource-based model. It describes their components, properties (e.g., runtime, configuration, or metadata information) and relationships through a domain-specific language. Finally, CAMP offers a RESTful protocol to change resources or components and thus the state of the application. Although the development of CAMP was started in 2012, the specification is rather new. Hence, its adoption and acceptance is low with respect to cloud PaaS providers. Currently, only a few implementations of the CAMP specification exist, e.g., nCAMP<sup>4</sup> – the proof-of-concept implementation of CAMP 1.1 – or Solum<sup>5</sup>, which has just parts of CAMP realized.

### 2.2 PaaSage Project

The *PaaSage* project is an ongoing effort with the goal to address the findings of the EU Commission Cloud Computing Expert Working Group (Schubert & Jeffery, 2012). The project started in October 2012 under EU FP7-ICT support and is scheduled to be executed until September 2016. The aim of *PaaSage* is to deliver an open and integrated platform to support both design and deployment of cloud applications, together with an accompanying methodology that allows model-based development, configuration, optimization and deployment of existing and new applications, independently of the existing underlying cloud infrastructures (Bubak et al, 2013). As *PaaSage* focuses on model-based development, its approach relies on the definition of the cloud modeling language (CML), which is applied during application configuration and development lifecycles. The further evaluation of modeling requirements at system level enables dynamic application management, including the selection of proper target deployment infrastructure that satisfies criteria defined in the configuration models provided at design-time (Ferry et al, 2013).

Although it promises to deliver valuable results, this project is still in an early execution phase and is expected to complete in 2016. Therefore, its results cannot be assessed and compared at the moment.

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<sup>4</sup> <http://ec2-107-20-16-71.compute-1.amazonaws.com/campSrv/>

<sup>5</sup> <https://wiki.openstack.org/wiki/Solum>



### 3. PaaS APPLICATION MANAGEMENT POSSIBILITIES

In this section several methods of managing an application hosted in a PaaS environment are discussed. The conclusion will focus on the optimal choice for realizing the unified PaaS management application, which will further be discussed in Section 4.

#### 3.1 Operating System Shell

Using the operating system (OS) shell as an environment for an application management tool can basically be done in one of the following ways:

##### Pure Source Code Management (SCM):

With this method, the PaaS provider simply offers one or multiple SCM repositories (e.g. GIT, CVS or SVN) for hosted applications. Whenever new changes are committed to the repository, a new build and update of the hosted application will be triggered on the provider's server. Additional lifecycle management options can be offered in various kinds, e.g. builds are only triggered by pushing on a specific branch.

##### Pure console application:

A pure console application is most commonly implemented through the use of a scripting language such as Python or Ruby. Such an application will usually communicate with the PaaS provider by using web service calls. It offers commands for managing the application state, scaling options, and deployment.

##### Hybrid:

This approach combines both of the previous techniques and typically employs a console application. It provides application lifecycle management methods as well as a variety of other configuration options such as scaling, testing and an SCM repository. Several PaaS providers use such tools either as a supplement to their other application management offerings (as described in the following sections) or as a core technology for using their services. Examples are Heroku Tool-belt, OpenShift client tools, or Cloudfoundry CLI.

Advantages of console applications are a concise interface to the functionalities of the PaaS service and the possibility to incorporate them into scripts, which might be useful in more advanced development workflows. On the other hand, console applications might be cumbersome from the point of usability. In comparison to other GUI tools, the tasks like setting up a new application environment (selecting hosting location, application server or other services) could require additional user effort. Furthermore, dependency on various environments, such as operating system and installed scripting language interpreter, could be an issue.

#### 3.2 IDE Extension

This approach pursues the idea of minimizing the amount of separate tools/environments needed for application lifecycle management by integrating the PaaS functionality into commonly used IDEs (integrated development environments) such as Eclipse or Visual Studio. The most basic functionality provided by such plug-ins is creating a project with its settings adjusted for the PaaS environment as well as the deployment to a remote server. The potential extensiveness of a plug-in is on par with that of console applications. In comparison to other management alternatives, the IDE extension approach has advantages when it comes to usability and efficiency, as it avoids frequent switching of the user environment between IDE, browser, and a console. A possible disadvantage is, from a vendor's perspective, higher maintenance effort, since supporting various IDE versions requires adjustments in the plug-in. Real world examples of this approach are e.g. the Heroku Eclipse plug-in, the Cloudbees toolkit for Eclipse, and the Google Web Toolkit plug-in for Eclipse.

### 3.3 Web Application

Web applications (or web consoles) are the basic application management utility for almost all PaaS providers. They are commonly used to create a basic environment for new applications (e.g. setting up a Java application server) as well as to manage settings for already deployed applications. Many vendors implement application updates not only through the use of console applications, SCM integration, or IDE plug-ins, but also by providing upload sections in their web consoles (e.g. uploading a .war file). Since the appearance of a web application is - in comparison to the previous approaches - highly customizable, they could potentially range from basic command line emulations to fully-fledged IDEs. This approach prevents dependency issues with operating systems or required frameworks and does not require local software installation, and consequently its update and maintenance for various systems. The only compatibility factor is the type of browser used by the client, which might force compromises, as the feature set of browsers of different vendors might diverge considerably. Furthermore, JavaScript code still does not run as fast as a native code. However, its speed is comparable to those of other interpreter languages such as Python or Ruby, and an argument can be made that typical PaaS management tasks are not computationally intensive.

### 3.4 Discussion

All of the above methods should be adequate for managing applications hosted on a specific PaaS provider. As our unifying PaaS management application should be able to handle multiple applications hosted on various providers, the complexity and set of constraints increase. A clear view on the state of an application across multiple providers and instances can be achieved more easily using a graphical interface, which rules out the console application approach. As there are many different IDEs for all technologies supported by PaaS providers, a unifying PaaS management application either would have to be implemented for the majority of them, or users will be forced to possibly use an IDE solely for this purpose. The web-based approach avoids the aforementioned drawback, while still offering a comparable set of features. Thus, in the scope of this paper, a web-based approach is the optimal choice for a unified PaaS management application.

## 4. PaaSPort – PaaS MANAGEMENT APPLICATION

The PaaSPort application aims to offer a platform for developers, allowing them to manage and distribute their applications on a variety of PaaS providers. PaaSPort serves as a proof-of-concept implementation for the use-case of hosting an application at different providers and using their APIs for application management. The functionality offered by PaaSPort is accessible both through a web-based interface as well as a REST API. In the following sections we will discuss the selection of supported PaaS providers and the APIs published by them, the architecture of the application itself, as well as its feature set and REST API.

### 4.1 Requirements and Feature Set

PaaSPort was designed to offer the functionality of application deployment to selected providers in an easy, accessible and extensible manner. To achieve this, the application was built upon the following cornerstones:

*User based:* A user may login to PaaSPort and register her credentials to a set of PaaS providers in the system. PaaSPort will then use this information to offer deployments to the specified providers.

*Manage user applications:* A user manages a set of applications that are registered in PaaSPort, defined by their name and a related .war file. The user can create, read, update, and delete (CRUD) applications.

*Manage hosted applications:* Each application that a user registers in PaaSPort is eligible for deployment to a specified PaaS provider, thus becoming a “hosted application”. To do so, the user has to adjust provider specific settings (i.e. framework version of the PaaS stack, allocated memory or hosting location). Afterwards, the state of the hosted application can be observed and altered through PaaSPort (i.e. scale up/down, set allocated memory, or start/stop the application).

*Web Console and RESTful API:* All of the above functionality is accessible through both a web console interface as well as a RESTful API.

## 4.2 Architecture

In this section the basic architecture of the PaaSPort management application and its components is described. Figure 1 illustrates this basic architecture.

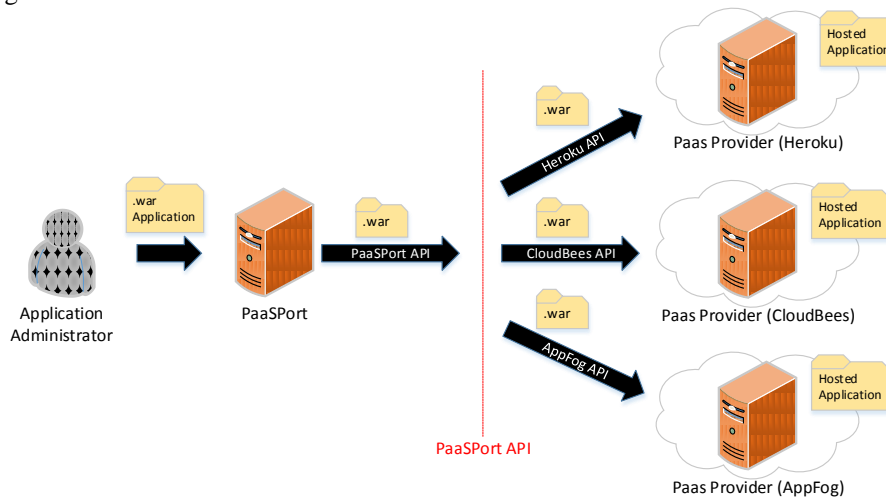


Figure 1. PaaSPort Architecture

The following components are part of the PaaSPort architecture:

- *Application Administrator (User)*: The application administrator (user) is registered with PaaSPort. A user can have multiple applications assigned to administer.
- *PaaSPort*: The unified cloud PaaS management application supporting .war application deployment at multiple cloud PaaS providers.
- *PaaSPort API*: A unified PaaS API facilitating access to different PaaS provider APIs through a single interface. The PaaSPort API is REST-based.
- *PaaS Provider*: A particular PaaS provider/vendor which can deploy and host .war file applications.
- *.war Application*: An application registered with PaaSPort. Each application has a Java .war file connected to it and is assigned to a specific user.
- *Hosted Application*: A hosted application is an application, which has been deployed to a specific PaaS provider. It is assigned to a .war application and a PaaS provider.

## 4.3 Implementation

Technically, the main aspect of this implementation is consuming web services of different PaaS providers and exposing their combined functionality through a single web service. Although many providers offer similar functionalities, the manner, in which their services are accessed, often varies. The web services offered by the PaaS providers are often the backbone for their other management tools, since they act as a central access point for all of the providers' services. For example, all CLI (command line interface) tools offered by various providers function as an easy-to-use interface for accessing the providers' web service.

For the prototypical implementation and illustration of PaaSPort applicability, three PaaS providers were selected. The main criterion for the selection of a provider was the possibility to deploy an application easily by uploading a Java .war file. Thus, the following providers were selected: Heroku, CloudBees, and AppFog. Heroku offers a REST API as well as the possibility of deploying an application by uploading it as a .war file. CloudBees offers an extensive Java library that encapsulates the functionality of its web API. AppFog offers a REST API covering all basic actions for managing the application and its services.

The web console of PaaSPort was implemented using JSF<sup>6</sup>. Each web page has a JSF bean assigned to it, providing all necessary data and operations. The JSF beans communicate with the data access layer, which in

<sup>6</sup> Java Server Faces, <http://www.oracle.com/technetwork/java/javasee/javaserverfaces-139869.html>

turn accesses a Derby database<sup>7</sup>. This database stores relevant information for the following architectural components: Application Administrator (User), .war Application, Hosted Application, and PaaS Provider.

The RESTful PaaSPort API was implemented using the Jersey library<sup>8</sup>, designed as a separate layer in the application that communicates with the data access layer. The data format for all information transmitted by the web service is JSON. The RESTful API of PaaSPort is designed to expose the data components of interest. Table 1 shows details on the RESTful PaaSPort API.

Table 1. RESTful PaaSPort API

URL endpoint	HTTP Method	Description
/apps	GET	Returns a list of applications registered by the user.
/app/<appname>	POST	Creates a new application.
/app/<appid>	DELETE	Deletes an application.
/app/<appid>	GET	Retrieves information about a specific application.
/app/<appid>/<hostedappname>	POST	Deploys an application to a provider and thus creates a new hosted application.
/app/<appid>/<hostedappid>	PUT	Updates settings for a hosted application.
/app/<appid>/<hostedappid>	DELETE	Undeploys and deletes a hosted application.

In order to secure the API and provide a means of authentication, HTTP Basic Authentication has been implemented. Any user accessing the API has to set the proper HTTP header, thus providing her credentials in every request. This simple mechanism has been implemented to provide a basic access control. However, more advanced authentication mechanisms (e.g., two-factor based) can be easily integrated.

#### 4.4 Workflow

This section will demonstrate some of the actions that can be performed using the PaaSPort web console. It is assumed that the user is already registered with the system and authenticated for this session.

Figure 2 depicts all currently registered .war Applications. The associated file can be downloaded by clicking on it. The button “Create New App” redirects to the Add Application page (Figure 3). By clicking the name of the Application, the user is redirected to the Hosted Application overview (Figure 6).

In Figure 3 a new Application with the name “Test Application” is created. Required fields are the name of the Application and the associated .war file. Upon completing the creation, the user is redirected back to the Application overview (Figure 2).

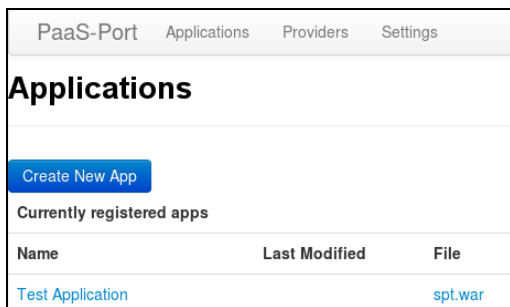


Figure 2. PaasPort .war Application Overview

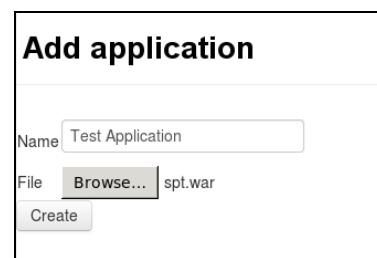


Figure 3. Adding a .war Application to PaaSPort

Figure 4 depicts the Hosted Application overview. In this screenshot, the Application “Test Application” has not yet been deployed to any PaaS Provider. To do so, the user has to select a provider from the dropdown-menu and click the button “Deploy to provider”. This will redirect the user to the “Deploy to Provider” page (Figure 5).

<sup>7</sup> <http://db.apache.org/derby/>

<sup>8</sup> <https://jersey.java.net/>

If the user chooses to deploy to Heroku, she will be redirected to this provider specific deploy page (Figure 5). Required fields for this provider are the name of the Hosted Application, the region for the infrastructure to which the Application will be deployed and the Stack (the setup of the underlying system). Upon completing the deploy operation, the user will be redirected back to the Hosted Application overview (Figure 6), which now lists the newly created Hosted Application.

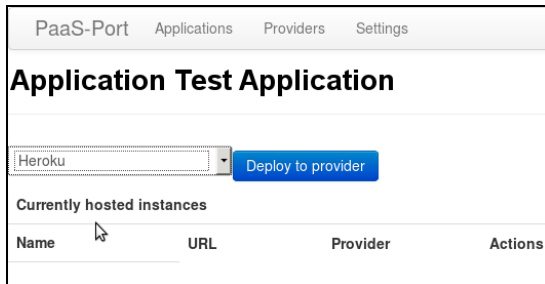


Figure 4. Choosing the PaaS Provider to which the .war application will be deployed

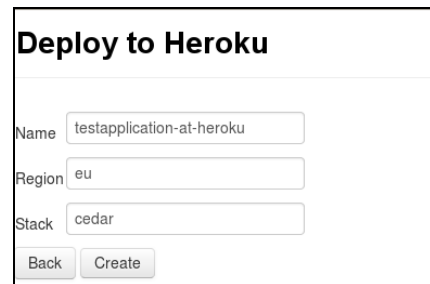


Figure 5. Providing provider-specific deployment information

By clicking the name of the Hosted Application, the user will be redirected to a provider specific settings page (Figure 7). The URL field links to the public page of the now deployed and running Application. By pressing the “Delete” button, the Hosted Application will be deleted both at the PaaS provider it was deployed to and in PaaSPort.

The provider specific Hosted Application settings page (Figure 7) offers information about the current state of the deployed Application. Additionally, it is also possible to change provider specific settings. In the case of Heroku, the user is able to increase or decrease the number of currently allocated Dynos (Heroku-defined container).

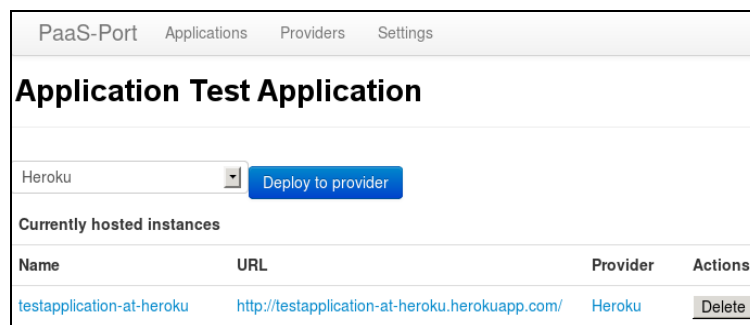


Figure 6. Overview of all Hosted Application instances

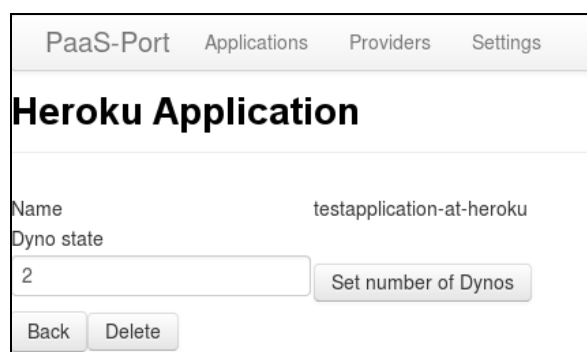


Figure 7. Monitoring and updating a Hosted Application

## 5. CONCLUSIONS

As the PaaS landscape has been steadily growing for the last few years, more and more providers emerge. Meanwhile, the existing providers and early adopters are constantly upgrading and refining their products. PaaS has established itself for a wide variety of customers, from companies, often using private PaaS as an easily manageable and scaling infrastructure, to independent developers, who get a competitive application environment with minimal configuration overhead.

However, by comparing some of the predominant PaaS providers, it becomes apparent that there are substantial differences in many aspects of the offered functionality. Each provider caters to slightly different needs and thus finding the right PaaS provider requires extensive research and analysis. Furthermore, the task of changing PaaS providers proves to be difficult, as there is no common implemented standard for cloud environments, and hence a provider switch might be impractical or uneconomic (vendor lock-in effect).

As a proof-of-concept implementation effort, PaaSPort was created with the aim to eliminate vendor lock-in by providing an abstracted and consolidated management interface. PaaSPort aims furthermore to enable users to manage uploaded applications transparently and efficiently using a unified web interface. PaaSPort allows users to upload a Java web application, packed as a .war file, and deploy and manage that application on AppFog, Cloudbees, and Heroku. Moreover, all functionality is exposed through a REST web API, which standardizes operations that are common across all providers, while leaving room for provider-specific operations. PaaSPort therefore functions as a single interface for the basic management of applications on three different PaaS providers.

PaaSPort currently demonstrates the support for three different PaaS providers. Support for additional providers could be implemented, if they expose their functionality through a web API and accept .war file uploads. Furthermore, the application can be extended to support SCM systems, such as GIT, to not only rely on file upload for application deployment.

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# Short Papers





# THE FOLLY GUARD – A PERSONAL AND SOCIAL COMMUNICATION PROTECTION SYSTEM

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## ABSTRACT

The society has irrevocably changed. Just walking around a city makes this apparent. Single or in a group, people are accompanied by at least one electronic device which is able to communicate. The communication on the fly is intense and the communication industry is a multi-billion dollar marketplace ranging from tele communication infrastructure, communication products and services (e.g. social networks, mails and blogs). Information is produced at a rapid rate resulting in information overload. Because of the abundance of information, it becomes paramount that individuals find the right information at the right time. It's the relevance and salience of the information that makes it precious. Location based services or more general context based services are a means to find the relevant and salient information easier, with a higher degree of trust. At the same time the chances to get infected by malware is omnipresent. Most information systems are complemented by security modules that try to isolate different types of malware and to identify spam. The better the protection gets the less cautious the users become. They don't seem to realize that they expose themselves to these risks by using all the different communication means available. Even though the range of technologies used for communication has rapidly evolved, what has little changed is the psychology of the users. The evolution of human kind to use modern ICT technology took not just dozens of years but thousands. Hence, our brain may adapt on a rational and cognitive level to a certain degree but on a subconscious level we still react how we would have reacted hundreds of years ago. Psychologists' experiments show good examples like the priming effect or framing effect where individuals react instantly without deeper thought and regret the folly later. This instinctual subconscious behavior gains more relevance in a highly digital society where information is received and sent easily and quickly. The Folly Guard system presented here aims at identifying subconscious behavior as evident in the communication medium (emails, chat logs etc.) and warning users about the adverse effects which a user might not be aware of. The Folly Guard thus operates at a psychological level to extract pitfalls in communication and expose those to the users. Thus, the system is meant to complement other IT security and protection systems, by operating in a domain that has not been previously explored. By potentially guarding against the follies of individuals, the system creates a social protection (i.e. minimizes the impact of follies at a societal level).

## KEYWORDS

Security, Psychology, Information

## 1. INTRODUCTION

Imagine a project manager in his daily routine work. He will receive many mails, at the same time hurrying from one meeting to another (Carr, 2010). He receives a lot of information and disseminates quite as much. The time pressure is omnipresent and the goal must be to answer most mails within a tight time frame in order to keep to the various project time lines. The more stressed and emotional the work gets there are more chances of communication mistakes to happen. Looking back at the emails, sometimes one may shake ones head in disbelief. Let's now have a look at the psychological side. Stanovic (2007) came up with a model of a human being consisting of two systems. System 1 represents our unconsciousness and intuitive abilities and system 2 stands for our rational and cognitive side. Generally, system 1 runs all the time. There is nothing like an on/off switch. System 2 on the contrary is potentially lazy and is triggered by system 1 when it comes to difficult situations where it needs system 2.

The efficiency of both system 1 and 2 is high and they normally produce an optimized performance which should make the *homo economicus* happy. The cooperation between the two systems works well most of the time. However, system 1 has its limitations. To overcome these limitations, system 2 needs to come into action. However, since it is lazy it must be actively triggered by system 1 and this doesn't happen all the time. Especially at special situations with a high emotional pressure, with a depleted system 2 or with a high time pressure situation, system 2 may not be able to reflect on the doings of system 1.

System 2 complements system 1 with its ability regarding logic and statistic. Under normal conditions it will wake up whenever it detects that system 1 requires support. System 2 has a natural speed. If it is forced to work above that its abilities are impaired. For instance, logical considerations are not coherent anymore. An example for system 2's laziness is the following puzzle (Kahneman, 2012):

*A bat and ball cost \$1.10.  
The bat costs one dollar more than the ball.  
How much does the ball cost?*

The correct answer is 5¢. However, intuitively you may have come up with the solution 10¢. If so, your system 2 was just too lazy to come into action and to reflect on the intuitive reasoning of system 1. This may have happened at the end of a long and hectic day. The above puzzle might have been the last e-mail you just wanted to answer. Your depleted system 2 was not able anymore to react on system 1's intuitive answer. Once the mail has been sent, the wrong answer is already disseminated amongst your project members.

According (Kahneman, 2012) "...many thousands of university students have answered the bat-and-ball puzzle, and the results are shocking. More than 50% of students at Harvard, MIT, and Princeton gave the intuitive—incorrect—answer. At less selective universities, the rate of demonstrable failure to check was in excess of 80%. The bat-and-ball problem is our first encounter with an observation that will be a recurrent theme of this book: many people are overconfident, prone to place too much faith in their intuitions. They apparently find cognitive effort at least mildly unpleasant and avoid it as much as possible."

Let us perform another check on your system 2's alertness. Given the first two premises below, will the conclusion in the third sentence hold?

*All roses are flowers.  
Some flowers fade quickly.  
Therefore some roses fade quickly.*

Most certainly your system 2 was alert after the bat-and-ball example and found out where the flaw is. System 2 would have argued that roses may not belong to the set of flowers that fade quickly since only some flowers fade. System 2 in this case has overridden the intuitive answer from system 1 that states that the conclusion is correct. But again, imagine a special situation where you are under time pressure or depleted. In that case, it could be possible that your system 2 hasn't reacted on system 1's answer. According to Kahneman (2012) a large majority of college students endorse this syllogism as valid. And to be honest, after two premises which are obviously true and probably resemble our own experience it is hard declining the following conclusion. It definitely needs the logical reasoning of system 2.

Some people are more like system 1, e.g., impulsive and intuitive; others are more like system 2, e.g., capable of reasoning and are cautious. But the behavior is also dependent on the context and personal situation. These examples are situations where information systems can support the user by identifying a potential critical situation and provide a warning together with some useful hints.

## **2. PROPOSED USE CASES**

The following sub-sections outline four possible uses cases for the application of a social protection system that monitors communication of an individual user (both received and composed messages) and warns of potential pitfalls from a psychological stand point (i.e. and possible pitfalls of system 1). More examples can be found in Kahneman's book (Kahneman, 2012).

## 2.1 Priming

Making a suggestion in a conversation is an example of priming. For instance if you are asked to guess the average cost of a car, e.g., in Germany, along with a suggestion of a high average cost you end up remembering luxury brands (Strack, 1997). Another example is the following two questions (Kahneman, 2012): “Is the height of the tallest redwood more or less than 1,200 feet? What is your best guess about the height of the tallest redwood?”

The suggestion of 1200 feet is ridiculously high. Even if this obviously wrong suggestion is identified as implausible, it has an influence on your answer for the second question. Experiments have shown that different groups of people which have been offered different suggestions for the height for the first question came up with considerably different guesses for the second question.

An excerpt from an email from someone in the project management office may read: “...usually the test phase of a project of such limited complexity does not take more than 8 days. What is your best guess of the test duration?”

It is apparent that the sender of this mail is determined to set an anchor for the duration of the test phase. Usually there is always little time left for testing purposes. So, it is most likely that the proposed 8 days are insufficient for a decent test procedure. Galinsky (2001) has proposed subtle ways to resist the anchoring effect. It mainly requires system 2 to come up with arguments against the anchor. In the context of the email example, the receiver of the mail would need to come up with examples of projects with considerably longer test durations to counter the proposed duration.

This is the place where information systems can help. A social protection system that operates on top of an email client can point out that the numbers mentioned in the communication thread must be verified against some statistical data. To do so, the protection system needs to have access to additional data stores to retrieve adequate information.

## 2.2 A Bias to Believe and Confirm

According to Gilbert (2007), the understanding of a statement must begin with an attempt to believe it. You must first know what the idea would mean if it were true. This approach is automatically performed by system 1 and it comes up with a construction of a well-fitting interpretation of the story or of a possible cause and effect. If system 2 doesn't come into action now the statement is taken as true. It needs system 2 challenging the statement and constructing a cause-effect that opposes the statement. Gilbert (2007) sees unbelieving as an operation of System 2 which may be supported by additional information offered by ICT systems. The additional information might be needed to construct different cause and effect and is a means to get system 2 to reason.

## 2.3 What You See Is All There Is (WYSIATI)

An essential design feature of the associative machine (system 1) is that it represents only activated ideas. Information that is not retrieved (even unconsciously) from memory might as well not exist. System 1 excels at constructing the best possible story that incorporates ideas currently activated, but it does not (cannot) allow for information it does not have. The measure of success for system 1 is the coherence of the story it manages to create. The amount and quality of the data on which the story is based are largely irrelevant. When information is scarce, which is a common occurrence, system 1 operates as a machine for jumping to conclusions.

As the WYSIATI rule implies, neither the quantity nor the quality of the evidence counts for much in subjective confidence. The confidence that individuals have in their beliefs depends mostly on the quality of the story they can tell about what they see, even if they see little. We often fail to allow for the possibility that evidence that should be critical to our judgment is missing—what we see is all there is. Furthermore, our associative system tends to settle on a coherent pattern of activation and suppresses doubt and ambiguity.

Here again information systems can be of help. If a social protection system has the ability to identify situations featuring limited information it could come up with some additional context information that may have an impact on the coherence of the story produced by system 1, thus thwarting premature conclusions.

## 2.4 Framing

A framing effect refers to situations where the same information can be presented in different ways evoking different emotions. The statement that “the odds of survival one month after surgery are 90%” is more reassuring than the equivalent statement that “mortality within one month of surgery is 10%.” (Kahneman, 2012). Similarly, a project manager pointing out that “95% of the goals have been achieved” is generally taken as a positive message. The equivalent formulation “5% of the goals have not been reached” contains a negative message and will presumably invoke rather negative feelings. The equivalence of the alternative formulations is transparent, but an individual normally sees only one formulation, and what he sees is all there is.

This is again a perfect scenario for the use of social protection system. To provide a balanced view to the user about an issue, as a first step, the protection system might not even need to come up with the equivalent formulations. Just pointing out that there is an equivalent formulation will help to realize the framing effect.

## 3. THE SOCIAL PROTECTION SYSTEM

In this section, we outline a possible design of the Folly Guard system and also point to the architectural options. The Folly Guard is a software component that has the ability to identify situations where system 2 should have been activated but for whatever reason has not come into action. The basic functionality of Folly Guard is the analysis of a thread of communication and the provision of warnings and useful hints with the aim to activate system 2 of the concerned user.

### 3.1 Folly Guard Design

The design of the Folly Guard is depicted in Figure 1. The core element of the system is a natural language processor (Jurafsky and Martin, 2008; Baldrige, 2005; Bird, 2006) that takes as input one or several communication threads and analyzes it accordingly (Manning et al, 2014). The results are then sent to the plugins which try to identify potential psychological pitfalls. The produced outputs are warnings and hints about possible pitfalls which should be scrutinized by the user. The overall functionality is defined by the amount and type of plugins available for the processor. It is assumed that for each psychological pitfall a separate plugin takes responsibility (e.g. plugin 1 for identifying priming and plugin 2 for identifying framing). This approach makes the system flexible and adaptable for future enhancements.

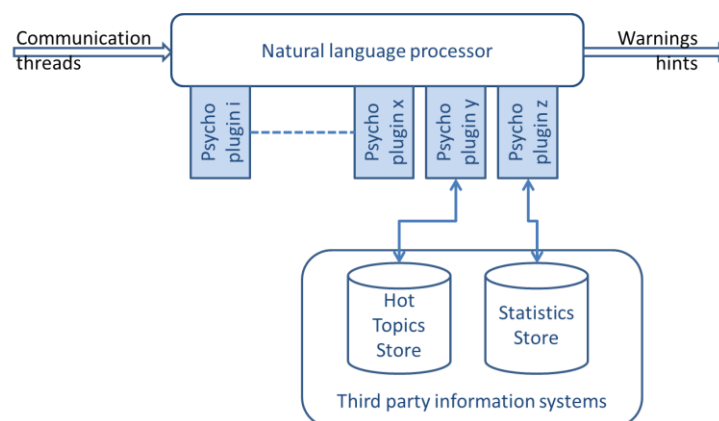


Figure 1. Design proposal for the Folly Guard including possible 3<sup>rd</sup> party datastores

For instance for the affect heuristic (Slovic et al., 2007) it may be necessary to have more information than is available within the communication thread. Therefore, there must be data stores accessible to query for more information based on the current context of the communication thread under analysis. Figure 1 gives two examples for possible external data stores. We note that the Folly Guard system’s design allows for

personalization. That means the Folly Guard could maintain a history of detected pitfalls, associate it to a specific user and learn from them by inferring norms.

### 3.2 Architectural Options

Architecturally, the Folly Guard system can be developed as a client-server system as shown in Figure 2, where the Folly Guard module (referred to as Psycho Guard in Figure 2) can be placed on the client side or the server side. In the client side, the module for Folly Guard can be delivered as a plugin (e.g. plugin for the email client to analyze emails) or a client side proxy or a wrapper to a legacy client. At the server side, it can be a pure server module or a proxy.

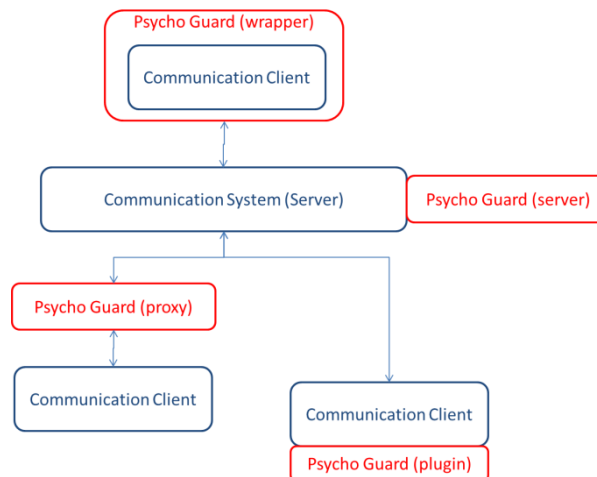


Figure 2. Architectural options for the Folly Guard system

## 4. DISCUSSION

To date, prior research hasn't addressed the need for guarding individuals against follies when they communicate. Marketing researchers have studied how traditional media primes people (Roskos-Ewoldsen et al., 2000). Recently, the nature of priming in online social media has also been studied (Doyle, 2015). Researchers have investigated how priming can be inferred from presented sentences (McKoon and Ratcliff, 1984). However, there hasn't been an attempt to design a system that can help in the identification of several aspects of communication (e.g. priming and framing) that contain potential psychological pitfalls. Upon identification, these can then be presented to the user so as to minimize harmful impact.

Based on the premises of a human being consisting of the two systems 1 and 2, an omnipresent work pressure and an increasingly faster digital communication there is a demand for some support to avoid some common psychological pitfalls. A solution to this is the Folly Guard system. The system identifies potential pitfalls from communication channels and presents those to the users, thus acting as a proxy for human's system 2.

The technological cycles are much faster than our human brain can adapt to. Since the Folly Guard is not meant to alter any information there is no danger of potential changes to communication content without prompting the user to acknowledge it. Rather, Folly Guard comes up with some hints the user may take serious or not. But, in the end there is hope to improve communication and to lessen communication mistakes.

To the best of our knowledge there haven't been surveys of requirements of potential users for such a system. An interesting cohort to consider for eliciting requirements would be members participating in a professional project (e.g. a distributed software development project that requires extensive communication). Also lower management and HR would be good user groups to consult to obtain requirements as they are likely to have experienced common follies associated with communication. Based on the requirements

collected, a first draft of the design will be worked out. We currently envisage the development of prototype Folly Guard for an email system since it might be the easiest to implement. A good choice for the first psychological construct to extract from free text is the priming effect. Subsequent to the construction of the plugin, efficiency of identification (e.g. using precision and recall metrics) must be measured and also a field test must be carried out to assess the usefulness of the system. Other potential applications where the Folly Guard module can be integrated are a) app clients for Twitter b) SMS clients c) and clients of social networking applications such as Facebook. This will help avoid common psychological pitfalls in communication, both for individuals and organizations. We believe such a system when adopted *en masse*, will help reduce the amount of psychological pitfalls encountered by the whole society.

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# THE MONSTERS OF DIGITAL COMMUNICATION: ADVANCED MARGINALIZATION IN DIGITAL SOCIETIES

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## ABSTRACT

This work-in-progress paper reports on preliminary findings from 15 interviews with so called “non-digital” Danish citizens to address and problematize this classification as a social category. In linking classification theory (the categories used in the digital post system) to a notion of advanced digital marginalization (to portray the path dependency of those who struggle to maintain links to societal membership) the paper expose the complexity of the “non-digital” and discusses how the assembling and connection of certain people, as a starting point for governmental strategies, might distort and prevent insights into how individuals and social groups are (re)-produced into new socio-technical configurations. The paper presents preliminary findings that suggest that “non-digitals” are in fact digital users but not in a way that allows them to be categorised as such. Finally the paper outline how further work will use the concept of advanced digital marginalization, to elaborate on these findings.

## KEYWORDS

Advanced digital marginality, Classification, Digital communication

## 1. INTRODUCTION

*“Assembling and targeting those people as homogeneous in their inability to participate also has the effect of accentuating dispossession” (Bourdieu 1999).*

In 2014, the law of *digital post* was affirmed. This regulation declared that all citizens in Denmark with a social security number must oblige to conduct all communication, in the citizen/state relation, digitally by logging into the “digital post” system. This represents a fundamental shift in the more than 350-year Danish history of national registration, administration and communication. From public sector institutions holding the jurisdictional responsibility to facilitate communication and protect the data of the citizen, to citizens individually representing themselves digitally and thereby holding the full jurisdictional responsibility to act/react and facilitate the communication. The mandatory digital communication system additionally derives from an attempt to dissolve spatial and temporal dimensions of the citizen/state relationship. Physically placed citizen-service centres have been closed down as main entry points, as the “digital post” system provide secure communication through a centralised mailbox. As this entrance is made mandatory for all citizens huge efforts have been made to target those who are considered non-digital. This study considers these efforts and portrays how new spatial and geocentric categories of territorial fixation and stigmatization are re-introduced in new socio-technical configurations. The *monsters* of a mandatory digital communication system, to use Donna Haraway’s notion of the exceptions that cannot be fitted into the category of the ordinary, are the people deprived of all the assets necessary to participate in various social games. Their common lot consists only in their common ex-communication (Wacquant 2007).

In the “digital post” system these people are marked in a field as “non-digital user”. However findings in this study show that people classified as such are in fact often users of digital communication tools as well as primary users of various public institution services. In the state/citizen relationship they have been historically dependent on a linkage – a translator of institutional lingua and logics - to become *civilized* (users) in Norbert Elias vocabulary. By digitally removing this link the “digital post” system symbolically reconfigures social orders, embodying malfunctioning automation and digitalisation into strict categories of users/non-users.

This work-in-progress paper reports on preliminary findings from 15 interviews with “non-users” and observations in Danish citizen service centres to address and problematize the classification of the “non-user” as a social category. In linking classification theory (the categories used in the digital post system) to a notion of advanced digital marginalization (to portray the path dependency of those who struggle to maintain links to societal membership) the paper exposes the complexity of the so-called non-user and discuss how the assembling and connection of non-users, as a starting point for governmental strategies, might distort and prevent insights into how individuals and social groups are (re)-produced into new socio-technical configurations.

## 2. E- SOCIETAL BACKGROUND

For centuries civil registration has been an integral part of being a legitimate and legal Danish citizen. Since 1645 civic registration has systematically been conducted by injunction in official church books. Initially the books were kept locally with the priest in charge of what should be noted as relevant. From 1812 and onwards official schemes were mandatory but they entailed a “margin”, a blank field, where the priest could note additional information. In 1924 the National Register of Danish citizens was established as local municipalities manually registered information on index cards (Pedersen et al. 2006). This system was used until 1968 where the Central Civil Registration System (CCRS) was established and all persons alive and living in Denmark were registered centrally (Pedersen 2011). The register included individual information on a unique personal identification number, name, gender, date of birth, place of birth, citizenship, identity of parents and continuously updated information on vital status, place of residence and spouses. From 2004 all civic registration has been digitalized. Church representatives conduct the registration of birth, name and death directly in the CCRS, other religious communities maintain handwritten protocols, but they are digitally reproduced in the CCRS. In 2014, the *law of digital post* was affirmed. This regulation declared that all citizens in Denmark who has a CCRS number oblige to update key information in the register by themselves alongside conducting all communication, in the state-citizen relation, digitally by logging into the system using a unique code tied to the personal CCRS number. This represents a fundamental shift in the more than 350-year history of Danish civic registration. From a system of numeric representation controlled and legitimized directly by authorities to mandatory digital self-representation.

As codes, algorithms and networks increasingly shape social positions an ethical examination of digital classification work is vital for future societal and cultural priorities. Inescapably every classification system functions by inclusion and exclusion practices in its margins. The Danish CCRS system and the mandatory “digital post” system are built as main infrastructural elements in the relationship between the citizen and the state. In its appearance and strategic formulation it might seem at a neutral and straight forward way of making a nation more digital however as this work highlights; build spaces always represent control rights, as they belong to someone and not others (Bowker & Star 1999, Joerges 1999).

This study suggests contemporary digital *classification* work to be portrayed in the light of what, in urban studies, has been called *advanced marginality* (Wacquant 2007, 2008, 2009). New forms of exclusionary social closure and peripheralization have arisen, as a result of the uneven, disarticulating, mutations of the most advanced sectors in the western societies and economies (Wacquant 1996). Represented silently in the digital registers are the mutations of otherwise distinct administrative fields. A clash between, what Pierre Bourdieu (1999b) would call the right and the left hand of the state, where the penal state, efficiency and neo-liberal governance become an integral part of welfare support functions for those living in the margins of the wage labour relationship (1999a).



### 3. RESEARCH APPROACH

The theme of this work-in-progress paper is to investigate how classification takes formal shape and become standardized in commercial and bureaucratic products. Over time the processes of civil registration in Denmark has transferred various institutional responsibilities to machine technologies and so removed these responsibilities from everyday and made the margins unreadable/invisible (Star & Strauss 1999). *“Norms and practices of registering and organising people progressively devolve into society’s material basis: Inscribed in machines, institutions are literally black boxed”* (Joerges & Czarniawska 1998)

This study reports on an on-going 5-year research project concerning digitalization in Denmark. The research project consists of 14 researchers investigating from different perspectives of national digitalization and marginalization. This particular paper builds on 15 interviews with citizens defined to be in the margins of the systems and participatory observation of learning initiatives on libraries across Denmark. A focus is held on the margins arising at a temporal interval as digital representation become mandatory. This part of the research is informed by citizens targeted as being non-digital to spotlights how the historical path dependency of digital registration systems is interwoven with contemporary hidden specificities and modes of appropriation (Durkheim 1982, Star & Ruhleder 1996).

### 4. PRELIMINARY REFLECTIONS AND FINDINGS

The preliminary findings show four types of “non-digital” citizens. Type A who has not signed up for “digital post” but in various ways uses digital media. This type represented more than half of the interviewees. Type B who actually was using the digital post system without knowing it as someone has (family members, case workers etc.) had signed them up. This meant that they were not aware of their own digital classification and potentially would not receive important information. Type C who did use neither “digital post” system nor digital media in general. This type represented only 6% of the interviewees. Type D was a user who actually used both “digital post” and digital media in general. The reason for this type to show up in the sample is that these people originally had signed up for courses learning how to use “digital post” and initially applied to be allowed not to use the “digital post” system. In this process this type had signed up for the “digital post” system and were now using it.

Table 1. “Digital post and digital media users”

	“Digital Post” user	Digital media user	Percent
<b>A</b>		X	61%
<b>B</b>	X		19%
<b>C</b>			6%
<b>D</b>	X	X	14%

The preliminary results show that being non-digital is not a simple category. As the “digital post” system classifies citizens as such raises questions both concerning how to “be digital” as well as how the system marginalized certain citizens by reproducing certain societal patterns in the system. The marginalisation occurs not only as a result of access/non-access to the Internet. Preliminary findings suggest that a certain kind of digital behaviour is promoted to differentiate between how people are seen in the “digital post” system.

ICT practices by the interviewees regarded as “non-digital” differ according to, amongst other things, their habitus. Habitus produces practices that are patterned on, or connected to, past conditions. Even if we think that a practice is geared towards a future outcome, it is predicated on what has happened in the past. Practice is not a mechanical reaction (Bourdieu 1977, p. 73). Consequently the respondents mirror their life practices and existing communication patterns in their use of ICT. While people with a strong cultural understanding of the public sector logic feel their habitus fits the social structures in place in the “digital post” system. As such they feel like a fish in the water (Wacquant 1996) they don’t feel the weight of the water and take the world about them granted. The cultural understanding of how to navigate in the categories provided in the public sector sites proves a vital ability that is primarily learned through education and social background including parent’s level of education, occupation and geographic location. However, as the

public sector lingua, seems to be difficult without an interpreter, other digital medias provide new connections for communication or leisure: “I don’t want to use the system as I don’t know what it means. Normally I have had a caseworker who would do these things for me – but I still skype a lot with my son” (interview 12, respondent 8)

The preliminary findings suggest how behaviour might be “regulated without being the product of obedience to rules” (Bourdieu 1990). As the law on “digital post” regulates how communication between the state and the citizen should occur certain people are classified as “non-digital”. This classification neglects the social background and cultural forms not obedient to public sector lingua. This however, does not mean that people in this category are non-digital users. New technologies is constantly a part of shaping new cultural forms but the forms that dominate are those that fit a certain habitus. Consequently people are digitally marginalized from societal and cultural structures that make it very challenging for people without the correct training and education to apply for membership in the digital society.

## 5. FUTURE WORK

As more interviews and data are collected this work will start with a more elaborate introduction of the dominant literature on which the article builds its theoretical argument is offered. A combination of literature on *classification* and the notion of *advanced marginalization* are presented. This combination is suggested to capture both the path dependency and historicity of digital registers as well as to understand the social re-configurations that result in a multifaceted pressure on digitally marginalized individuals. Second, a detailed presentation of the data collection method and ethnographic approach will be offered. Next, the theoretical construct and methodological approach will be utilized to present and analyse the case of the Danish digital post system. The future work will then use the notion of *advanced digital marginality* to discuss what “mediating institutions” needs to be invented to overcome future margins of digital registration and communication.

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# DESIGNED PROGRAM FOR A VISUALLY IMPAIRED INDIVIDUAL TO CONSTRUCT GEOMETRIC FIGURES USING A BRAILLE PRINTER

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## ABSTRACT

This paper builds on the review of related work, methodology and partial results presented in a previous work for presents the final results obtained of an innovator program designed primarily aiming at people with visual impairments in the development of geometric figures, as well as a simple example of its use.

The geometry is very likely to challenge not only students with visual impairments, but also sighted students and their teachers in the approach of teaching them. As this area of mathematics is crucial in most disciplines of science, this limited study options and future job opportunities. However, it can be said that there is not any reason why the geometry cannot be understood because of blindness, but the biggest barrier is access to geometric content.

The development of skills and understanding in many topics depend upon on their spatial sense/perception. Spatial properties and relations include shape, size, distance, orientation and relative location. Manipulation of objects in space also provides background for understanding algebra, trigonometry, calculus and many other topics in higher mathematics that require spatial thinking. Spatial sense is an intuitive feel for shape and space. It involves the concepts of traditional geometry, including an ability to recognize, visualize, represent, and transform geometric shapes.

This application was created to supply the needs required by visually impaired about designing, drawing and printing of geometric figures in Braille, with reliefs independently. The program allows access to create and print geometric designs, tasks that until now were not available to visual impairments people. The application treats the creation of projection and geometric wizards from own parameters using a speech synthesizer and wizards or special menus oriented to visually impaired individual. Subsequently, the application enables easy printing from geometrical shapes on the same sheet just in Braille, as in reliefs.

## KEYWORDS

Accessibility, Braille, Geometric Figures, Printing Tactile, Relief Braille, Visually Impaired.

## 1. INTRODUCTION

The world is evolving everyday toward the information age where manipulation and understanding of tasks by electronic media have a larger significance. However, progress in modernizing tasks does not linearly include developing focused applications for people with visual disabilities that hinders the inclusion of these users to access new technologies.

The program developed "GEOMETRIC VOICE" focuses on the analysis, processing and generation of geometric figures, with the help of a properly installed and programmed braille printer. The results are shown by a tactile description for the visually impaired can complement the study. By having a perspective into relief the user can follow the contours of the geometric figure, locating, sensing and identifying it by touch the evolution of the design. The tactile printing allows the recognition of geometric positions of its vertices, apogee, perigee and spatial behavior among others.

The visually impaired user, having installed the computer application program along with the drivers of the Braille printer to initialize the program, has the possibility for designing in a simple and flexible way many geometric figures. The different geometric designs are accessible through a table available in the

program, and specialized menus for people with disabilities; this will enable them to adjust the relevant parameters for each geometric design.

Once agreeing with the values and characteristics, the visually impaired may activate a subroutine for printing. In this subroutine, the user determines any desired formatting and activates the Braille printer, that prints with reliefs to the visually impaired user be able to complement their study of geometric figures through a tactile visualization. Importantly, the program execution can be done entirely through the keyboard without the use of the mouse; this allows the use of the program by users with total or partial lack of vision.

This paper presents a complete example of the projection, creation and design of a circumference from recent studies, methodology and partial results presented in Moreno-Chaparro et al, 2010.

## 2. “GEOMETRIC VOICE” DESCRIPTION

The “GEOMETRIC VOICE” was developed in object-oriented programming language C# (C Sharp) using own libraries for drawing geometric figures in the Cartesian plane. The reader's own program screens allow the user to insert functions in plain text, and create text files and run the job.

The developed software performs its communication with the user via speech synthesis. Voice synthesis is made through the artificial production of human voice, with the ability to convert text to sound. The program allows the interaction of the visually impaired with the computer and its peripherals in an easy and fast way.

In the program only the graphic interpretation of geometrical figures need to be made by a tactile visualization, this it being possible by the interaction with a braille printer that provides embossed by points.

It's believed that the “GEOMETRIC VOICE” is a potential resource that enables the visually impaired to glimpse an approximation of equality with people who can see, useful in understanding geometric figures in various sciences.

## 3. PROJECTION, CREATING AND PRINTING A CIRCUMFERENCE

This section presents a complete use case step by step, starting from the start of the program until obtains a print in Braille and with reliefs. This use case contains the projection, creating and printing of a circumference in “GEOMETRIC VOICE”. The circumference is one of the simplest geometric figures, but requires special care when entering it parameters, as may be seen in this example.

Immediately after the program is executed is shown the “*Home Screen*” of the “GEOMETRIC VOICE”. The “*Home Screen*” has different options available, as the creation and loading of files, the explorer and the settings wizard that allow select the voice and synthesizer speed, among other options.

Within the “*Home Screen*” is possible to access the different options, if the user presses the “*Ctrl*” and “*Space*” keys; the program will display the “*Main Menu*”. The “*Main Menu*” contains the basic functions for creating and formatting text files.

If on the “*Main Menu*” is selected the option “*New File*” using the “*Enter*” and arrow keys will be show the correspondent wizard. The wizard “*New File*” will prompt the user to insert the name of the new file to create, checking on me that is not null value or contains invalid characters (\/: \*? "<> /?).

In this case will insert the file name “*Circumference1*”, later to press the “*Enter*” key, thus creating a text file with the name entered. Then, the application takes the user to the “*Main Interface*”. The “*Main Interface*” contains the “*Text Editor*” and “*Area of Geometric Design*”.

The simplest way to create a circumference is open “*Menu Selection of Geometric Figures*” pressing “*CTRL*” plus “*N*” keys the “*Main Interface*”. Thus the “*Menu Selection Geometric Figures*” (Fig. 1) will appear. The “*Menu Selection of Geometric Figures*” allows the user to choose from a table the different geometric shapes. For the particular case of the creation of the circumference, the user may choose the option with the same name as well be using the arrow keys or by pressing the “*C*” key to go to the geometric figures option that begin with that letter.

If the user presses the "Enter" key on the "Circumference" option on the "Menu Selection of Geometric Figures", the program will open the wizard for entering the parameters of the circumference (Fig. 2). This example was created a circumference with a medium texture (2), an intermediate line width (10), with a distance value of 3 and center at the origin.

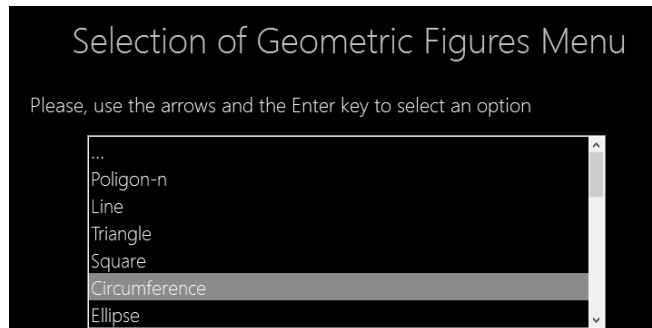


Figure 1. Selection of Geometric Figures Menu.

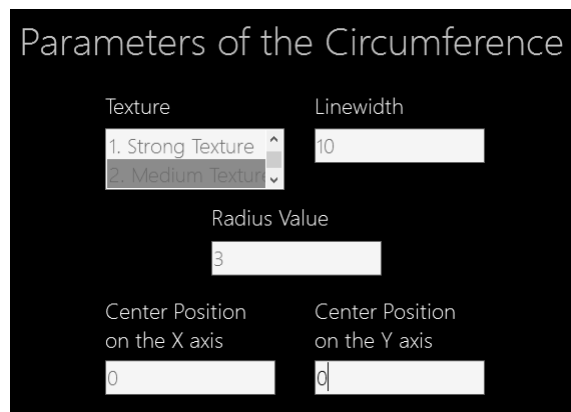


Figure 2. Wizard for Entering the Circumference Parameters Filled.

The wizard with the circumference's parameters shown in Figure 3, it has both a list for selecting the texture, how different spaces for numerical information. In the case of lists, the user may choose among a set of options; while for the case of labels the user must enter numeric values and later the "Enter" key.

The "GEOMETRIC VOICE" will give sound support to the user both in the selection as insertion of values, performing a validation of the case and stating there is an error, moreover providing the solution as appropriate.

Once completed the wizard correctly, the user must press the "Enter" key to enter the parameters of the circumference of the window to "Text Editor" located in the "Main Interface". The result of the insertion of the function that creates the circumference is shown in Figure 3.

It's now necessary to perform the validation and subsequent design of geometric wizard by pressing the "F5" key. After pressing the "F5" key, the program will issue the audible feedback "Compilation Started" and then validate each and every one of the command lines, for subsequent design.

After drawing only miss their print and Braille embossing. To enable printing routine, one should press the "Ctrl" + "P" keys in the "Main Interface" showing thus the "Print Menu" (Fig. 4). The "Print Menu" print allows the user to choose between printing the "Area of Geometric Design", or the "Text Editor".

In this is chosen the first option "Print Area Geometric Design", and is pressed the "Enter" key. The computer program immediately display the "Number of Copies" wizard, the last one before obtain printing Braille and with reliefs (Fig. 5).

In the "Number of Copies" wizard the user should be inserted an integer value bigger or equal to one, followed by the "Enter" key. If the user enter the value "1" for example, and then press the "Enter" key, automatically "GEOMETRIC VOICE" will provide a connection to the embosser to perform a tactile representation of one copy.

A scanned image of the final result of the circumference Braille and reliefs design printed is presented in Figure 10. It may be appreciated that the design circumference of the paper is equivalent to drawing projected on the screen. However, printing ink numbering of the axes presents a variation due to numeric Braille conversion.

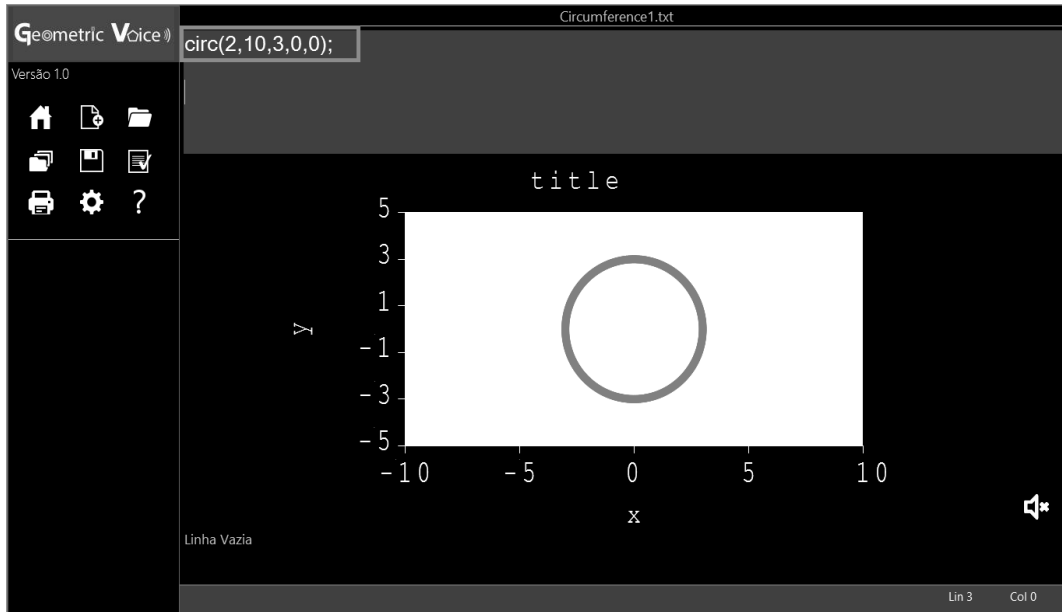


Figure 3. Insertion of the Circumference Parameters in the Text Editor.



Figure 4. Print Menu.

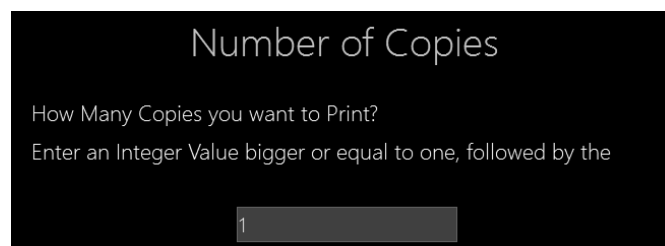


Figure 5. Number of Copies Menu.

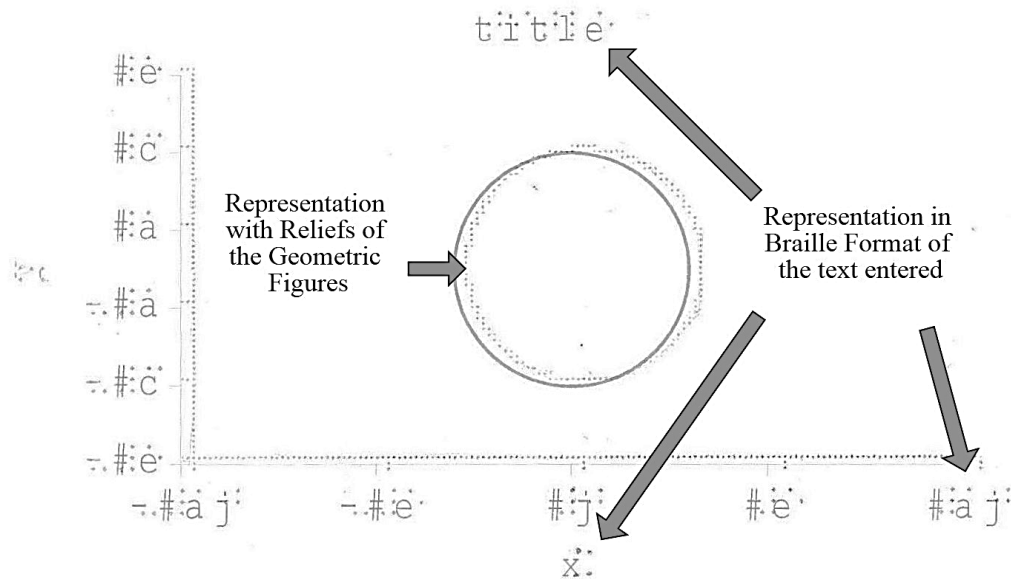


Figure 6. Scanned Image of Circumference Printed in Braille and Reliefs.

#### 4. CONCLUSIONS

In developing this software, it made the necessary considerations for the use of a new application in computing for visually impaired individual. It were considered determinant factors, such as ease the user will have to insert, use and obtaining geometric designs.

The “GEOMETRIC VOICE” was created to supply the needs required by visually impaired about designing, drawing and printing of geometric figures in Braille, with reliefs independently. The program developed performs a speech synthesis and use your computer keyboard as a means of data entry without the use of mouse, help the interaction with the visually impaired.

The generator of geometric figures “GEOMETRIC VOICE” is an educational software tool for easy access for the visually impaired. The developed software enables in a targeted manner, design, drawing and printing reliefs of a diverse set of geometric figures in two and three dimensions. Printing with reliefs also contains a common representation in ink and Braille description of the texts in the title and axes.

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# DESIGNING DIGITAL URBAN INTERACTIONS INDUSTRY LANDSCAPE AND MARKET ANALYSIS

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## ABSTRACT

Urban Interaction Design addresses the question of how we, as physical beings, will interact with the technologically augmented, data-rich urban environments that increasingly characterize cities. As an emergent field very little analysis has been conducted so far from the point of view of the Industry on this topic. In the present work we describe the Industry landscape, briefly introducing the current design approaches to the Smart Cities and discussing the need for a new wave. Moreover we present the results of a survey we conducted making direct contact to over 100 experts worldwide, aimed at assessing their opinion on the introduction of Interaction Design for innovating the urban context. The outcome represents the first to our knowledge market analysis of this field, covering challenges and opportunities, and describing the most successful best cases already drawing upon it.

## KEYWORDS

Smart Cities, User-centric approach, Interaction design, e-Citizen, Urban computing.

## 1. INTRODUCTION

The trend towards urbanization is well documented: more than two-thirds of the global population is expected to live in urban areas by 2050. The World Bank estimations are saying that 80% of global GDP is generated in cities. Market revenues from technologies and services needed to make Cities "Smart" are expected to grow from \$8.8 billion annually in 2014 to \$27.5 billion in 2023 [Woods, 2013]. Smart Cities are a complex organism addressing several functional areas, touching governance, living, environment, mobility, people and the economy.

The global trends for making Smart Cities a reality differ across geographical areas. In North America, projects have mainly a fragmented approach driven by big industrial players such as IBM, Cisco and Siemens and being focused on specific functional areas [Woods, 2013]. Currently this is the market generating more revenues. In Europe, the focus is on energy and entrepreneurship and human capital policies; a market growth after recession is expected with slowly increasing investments in infrastructures to improve public facilities. In Asia Pacific and Middle-East/Africa, projects are creating Smart Cities from scratch rather than retrofitting the legacy systems, which represents the most attractive market because of the high infrastructure investments flowing to the Smart Cities projects.

## 2. THE NEED FOR URBAN INTERACTION DESIGN

As discussed in the former paragraph, the approach to the Smart Cities is weakly addressing the whole wicked problem [Rittel & Webber, 1973], as it commonly is a consequence of either a technological improvement, a policy recommendation, or a large infrastructure project that is not carefully involving the user of the city. The spread of ICT is adding a layer of complexity to the city, everything is digitally interconnected and interdependent, and following the notion of wicked problems, nothing can be addressed in isolation or without regarding the implications. Urban Interaction Design can explore what is needed from

the user point of view, which technologies can be used, how to “humanize” their impact, and finally how to design an answer to a need.

Urban Interaction Design is a field of research composed of three elements; technology, urban space and people. Cities are increasingly characterized by urban environments permeated with data and augmented by technology. How interactions between city users and these environments are taking place is the central question to this emerging field. To better understand it, it is first necessary to unpick the three separate terms that make up Urban Interaction Design. It’s about the interaction between humans and their urban surroundings where technology is involved. The ‘urban’ in urban interaction design signifies the emphasis on spatial aspects that affect human relationships, drawing on approaches from the social sciences. ‘Interaction’ refers to technology, particularly communication and networked technologies that convert the raw material of data into meaning that informs our decisions, at scales that range from citywide solutions to grassroots hacking and tinkering. ‘Design’, the last part of the trilogy, draws on an interdisciplinary arts tradition, bringing critique and creativity into the mix, with an emphasis on both theory and practice [Mitrovic, Smyth & Helgason, 2014]. More generally, Urban Interaction Design can be seen as being grounded in the traditions of the Arts, Society and Technology [Brynskov, 2014]. The intersection of these fields produces results in the interaction, urban and design domains: the overall process of the interplay between these domains must follow a user centric approach. This principle is depicted in Figure 1.

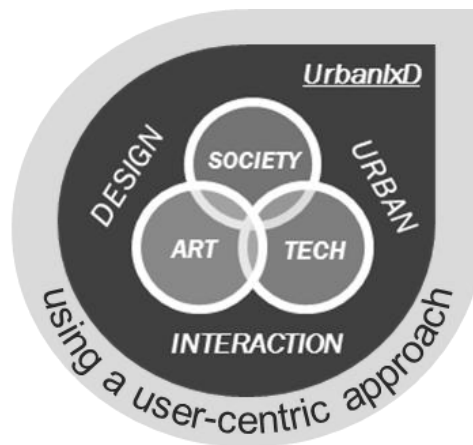


Figure 1. Urban Interaction Design approach based on Arts, Society and Technology

### 3. URBAN INTERACTION DESIGN BRINGS DISRUPTION

After having studied the current landscape for technologically augmented, data-rich urban environments and how they develop, and defined the emerging field of Urban Interaction Design, we aimed to identifying and which challenges and opportunities arise when applying practice of this field to the Smart City innovation, especially from the point of view of the Industry. We therefore instrumented an online survey which was deployed in two phases.

The first one was conceptualized as an exploration phase to assess the general opinions in the subjects of interests. The survey consisted of nine open-questions plus a section for free comments, aiming at:

- 1) collecting basic information about the respondents;
- 2) assessing the respondents’ opinion about the Industry, Innovation and Interaction Design;
- 3) identifying challenges, future opportunities, best practices and players for Urban Interaction Design.

The second one, which was based on the information derived from the first stage, was aimed at adding an important non-probabilistic but quantitative sense to the consultation, increasing the survey samples and converging the wider ideas gathered in the former phase. The survey was simplified to five multiple-choices questions and two open-questions, plus a section for free comments, and a specific question was added to assess the respondent’s familiarity with the term Urban Interaction Design.

The survey reached in total 122 respondents worldwide, mainly based in Europe (70%) and almost evenly split between Industry (57%) and University/Research (43%). The survey run between February and May 2014 [Bracuto & Zaffiro, 2014].

### 3.1 Survey Outcomes

As a result of our research, Urban Interaction Design is definitely perceived as an emerging field, currently more acknowledged in the academic & research ambit than in the industry one, which emphasizes as it is still relatively little communicated and known outside the specialist areas. From our survey we learned that about 25% of the consulted respondents affirmed to be familiar with the term Urban Interaction Design, but without being sure of the exact meaning.

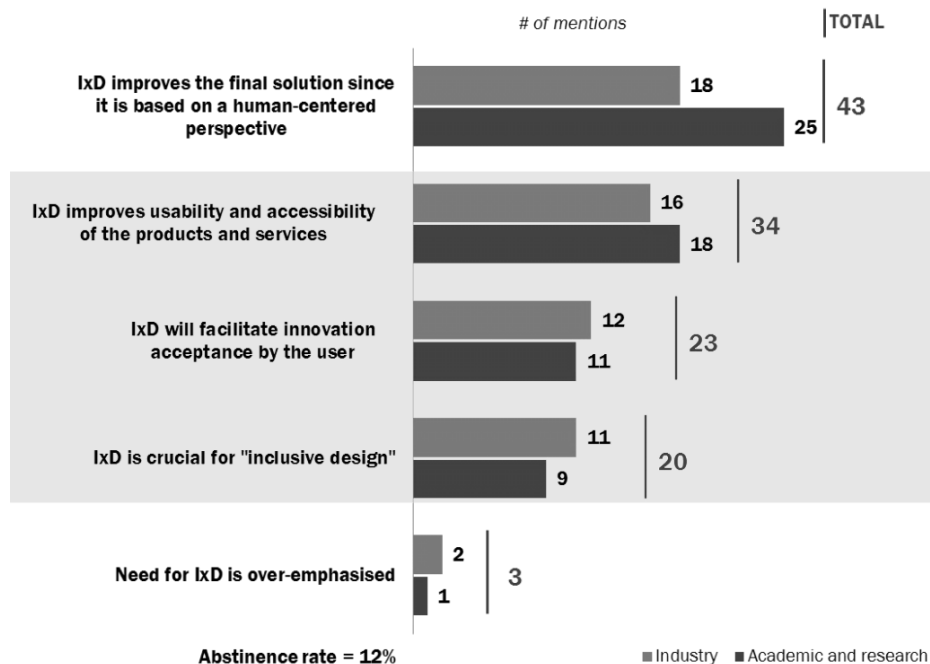


Figure 2. Why Urban Interaction Design is perceived as important or not to the development of urban services

#### 3.1.1 Concerns and Challenges

The main concern for driving innovation in the Smart City expressed by the Industry respondents in the survey is associated to the smart governance, characterized by informing, empowering and engaging citizens in the public decision making. Academics & researchers are mostly concerned about technology and how it interacts with humans. Both communities agree that improving the quality of life (smart living) is one of the most important issues. These statements highlight the relevance of the Urban Interaction Design in creating a Smart City since they insist on the three main components of this field: society, technology, design & art.

It is a common thought that the major challenge today for Urban Interaction Design is the lack of information, knowledge and trainings available. It is key for the development of this field to really understand it and make it understandable for others, aiming at transforming it as a concept that instinctively everybody could get on the urban life.

From the point of view of the perception of the field in the Industry, a shift of mentality is required. The lack of awareness of the value and contributions that Interaction Design can bring in different sectors and the difficulty to prove the financial benefits early in the project stage, are two key factors to overcome for its wider implementation. Urban Interaction Design is often considered a "nice to have" but not a "must have".

Table 1. Best cases of projects which comply with the Urban Interaction Design approach

Application areas		Best case	Description
Civic gamification	Environment, facility maintenance & cleaning	<b>Bottle Bank</b>	To promote recycling by rewarding with game points (*)
		<b>Arcade Machine</b>	To cheer people to clean their shoes on a music player mat (*)
		<b>Scratch Mat</b>	To promote bin use by adding a falling sound to thrown trash (*)
	Road security & monitoring	<b>The Deepest Bin</b>	To keep the streets cleaner after street parties with a jukebox that accepts trash as a payment (*)
		<b>Garbage Jukebox</b>	To get more people to obey the speed limit by entering a lottery for those who kept the limits (*)
		<b>Speed Camera Lottery</b>	To ensure everyone keeps their safety belt on by switching car entertainment system off if they don't (*)
ICT development	Development of new services & apps	<b>Play Belt</b>	To get more drivers to respect a red light by adding fun messages on it (*)
		<b>Wiki Traffic Light</b>	Citizen participation platform with development of low-cost sensors for creating productive and open indicators in the cities
		<b>Smart Citizen Project</b>	Playground to develop and evaluate new services and apps for the city of Trento using a bottom-up and user-center approach
	Interactive Maps	<b>Smart Campus</b>	A "ServiceDK" to develop user-centric open data apps
		<b>Smart CitySDK</b>	Web mapping service: satellite imagery, route planning, street maps and views
		<b>Google Maps</b>	Wireless pedal assist system: it helps you pedal, when you need it plus an App to monitor your ride and socially connect
Mobility & transport	Sustainable Transport	<b>Copenhagen Wheel</b>	Dynamic and flexible bus-service system by Philips
	Public transport	<b>Flexible bus stop</b>	Accessible and flexible car rental system
	Car sharing	<b>Car2Go</b>	Interactive second-skin for building that records, presents and forecasts weather conditions (**)
Intelligent Building	Intelligent Building	<b>Xeromax Envelope</b>	Outdoor structure that thrives on information from its urban environment (**)
		<b>Datagroove</b>	Interactive canopy for public thermal bath & event pavilion (**)
		<b>Thermaespheres</b>	Robotic and sensorized urban waterfront structure (**)
	Interactive Display	<b>Hydramax</b>	Piano staircase to incentivize stair use (*)
		<b>Piano staircase</b>	Interactive advanced directional signs
		<b>Pointssign</b>	Adaptive outdoor piece of furniture that serves as a display interface between the city and the citizen
Culture & Tourism	Interactive Exhibitions	<b>Birloki System</b>	Modular and controllable illuminated outdoor furniture (**)
		<b>Light Lines</b>	User-generated content and interactive exhibit on the castle ruins of Vordingborg, Denmark
		<b>Danmarks Borgcenter</b>	To mediate industrial history at authentic and interesting locations along Oslo's Akerselva river in Norway, integrating social media and digital technologies
		<b>Akerselva digitalt</b>	A museum exhibition hold in Aarhus in 2010 where digital technology is an integral part of the exhibition to encourage dialogue between visitors and installations
Platform for public participation	Smart Governance	<b>The Digital Natives exhibition</b>	An App for citizens to involve them in designing public spaces
		<b>Hackity App</b>	An App for reporting issues to the local government
	Smart Economy	<b>FixMyStreet</b>	Representation and promotion of urban data in 3D real-time environment accessible via "cloud"
		<b>Smart City+</b>	Mobile network of vendors using real-time communication developed by MIT

(\*) TheFunTheory; (\*\*) Future Cities Lab

According to our respondents the greatest challenges to the adoption of best practices based on Urban Interaction Design in the Industry are related to budget, deadline constraints and lack of involvement of the final user in the early stages of the design process.

### 3.1.2 Benefits from Implementation

From our survey, the implementation of Interaction Design fundamentals seems to be more popular among private companies, while public ones appear in most cases to adopt a top-down approach for decision making, with occasional public consultations. According to our respondents, this last point is, in fact, the most important issue to tackle for an effective Smart City design.

Urban Interaction Design is recognized for its human-centered approach and methodology more than for its clear boundaries, which are still in definition.

The use of Interaction Design in the development process of products and services brings some positive impacts, such as driving and facilitating innovation acceptance, improving usability and accessibility and generating an “inclusive” product (see Figure 2).

One of the most relevant aspects of Urban Interaction Design is that it can support bottom-up innovative solutions for the Smart City. It is clear for our survey respondents that all application areas could benefit from the use of Interaction Design, the more popular ones being “mobility and transport”, “education, culture and art”, “governance”, and “urban planning and intelligent buildings”. Respondents agree that even when the inclusion of Interaction Design will bring changes in the project cost structure it will also have a positive impact on the final result, such as, client satisfaction and higher sales. Specifically, the most popular belief is that the adoption of Interaction Design brings higher upfront investment, but potential cost-savings in the long-run.

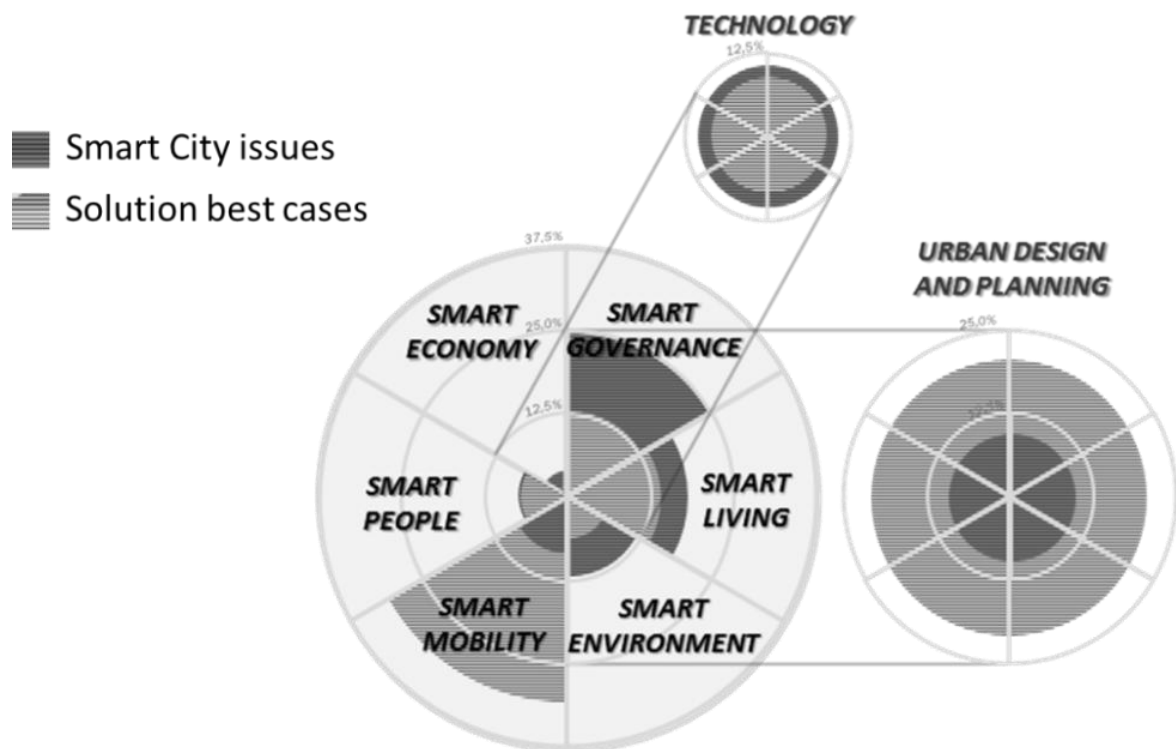


Figure 3. Percentage mapping of the survey suggested solutions (light grey) vs issues (dark grey) in the Smart Cities

### 3.1.3 Best cases of Applied Urban Interaction Design

The survey was also aimed at identifying the most relevant solutions where the respondents acknowledge an approach drawing from Urban Interaction Design. The survey counted more than a hundred cases, but not all of them were strictly compliant to the general scheme shown in Figure 1, thus insisting on the three pillars of the Urban Interaction Design – technology and data, society, design and arts – and showing a user-centered approach. Therefore we pruned the list down to 29 best cases, clustering them according to the following areas: civic gamification, ICT development, mobility & transport, intelligent building, culture & tourism, public participation.

The most representative examples of the application of Urban Interaction Design in the Smart City context were found on intelligent buildings, including public interactive displays and smart furniture, the use of gamification to nudge people toward better behaviors, platform for public participation, both governance and economy oriented, interactive exhibitions for culture & tourism, sustainable solutions for mobility and transport. The complete list of the selected best cases is listed in Table 1.

### 3.1.4 Market Opportunities

By confronting issue occurrences for innovation in the Smart City to the existing solutions for the same category, we identified some area of opportunities, which we plan to further analyze in future work. The assumption made here is that those areas where few solutions were suggested require more attention and effort in terms of future developments. These areas fall in the categories of smart governance, living, environment, where the percentage difference in issues and solutions identified in the survey is 25% to 13%, 18% to 14%, 12% to 6%, respectively.

## 4. CONCLUSIONS

In this work we presented the current approaches to design Smart Cities and create services for e-Citizens, leveraging on the assumption of the pervasive presence of urban data-rich environments and technologies that leverage on these. A new field, Urban Interaction Design, which is based on the creative contamination of the Art, Society and Technology domains, keeping a user-centric approach, can powerfully innovate the way we create the said services, offering an effective tool to understand and tackle the challenges holistically.

In order to better comprehend this field and assess its potential and maturity level we conducted an online survey, whose results have been presented with a specific attention to the Industry and market analysis. We observed that as tool Urban Interaction Design is yet considered a “must to have” instead of “nice to have”, also because of its relatively lack of familiarity.

In terms of opportunities, our preliminary analysis highlights that areas such as smart governance, smart living and smart environment can be considered as particularly interesting as few examples of solutions, valuable in terms of design, are known to exist.

## ACKNOWLEDGEMENT

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# EGOVERNMENT IN THE CZECH REPUBLIC – DO DATA RUN OR CITIZENS?

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## ABSTRACT

One of the mottos of Czech eGovernment is „To make data run, not citizens“. Proclamations of some Czech politics sound like everything have been already finished except for several minor issues. However, everybody who gets in contact with Czech public services (both in electronic and in paper form) encounters the fact that the excellence of electronization is still far ahead. There are varieties of technologies and fragmented data sources in the Czech public administration despite a high number of available electronic applications and services. The official supervisor of Czech eGovernment is the Ministry of Interior Affairs, but the development of certain agendas is under supervision of the Ministry of Finance and the Ministry of Labour and Social Affairs without any coordination with the supervisor. Similar situation can be observed at regional and local level. We focused on analysis of benefits of Czech eGovernment project Czech POINT that is currently the most publicly known project. According Czech media, the Czech POINT is a showcase of Czech eGovernment. There are millions of printouts from registers provided to Czech citizens at Czech POINT one-stop-shop places. The process of obtaining a printout is much easier than in the beginnings of the project in 2007. But the question is for whom and how is the printout used then? According to the results of our survey, more than 40 % of printouts were generated from the system then handed to a citizen who forwarded it to another clerk who entered the data to another system. Do data run, or citizens? The answer is obvious – the citizens.

## KEYWORDS

Czech Republic, eGovernment, Czech POINT, public administration, Ministry of Interior Affairs, information society.

## 1. INTRODUCTION

eGovernment brings changes together with massive deployment of information and communication technologies (ICT) into rigid public administration processes. It has impacts on the way, how the public administration operates, activities of businesses, citizens and political life (Heger, 2012). The beginning of eGovernment in the Czech Republic is dated in the end of past century when the Act no. 106/1999 Coll. on free access to information was enacted and firstly put an obligation for public authorities to publish certain information in an electronic way.

In the Czech Republic, we have been experiencing electronization of public administration for fifteen years, which is a period of time long enough to make an evaluation of it. There is a similar situation abroad (Snead, 2014) where various eGovernment approaches and development stages provide wide array of opportunities for evaluation of effectiveness, forms, successes and fails (Lohmeier, 2014). Some authors have started to understand eGovernment as a new multidisciplinary scientific branch (Cumbie, 2014; O' Brien, 2014) with focus on efficiency of realized changes and implemented processes. Open access to public administration data is related to another phenomenon (Graves, 2014).

Further steps for eGovernment development in the Czech Republic were made in the year 2000 when the Act on Information Systems in Public Administration was approved (Špaček, 2012). The same year, the Office for Public Information Systems was established and it should be responsible for strategic planning and connection of public information systems. Next, the Office of Personal Data Protection was set up that operates as a supervisor of personal data processing in the Czech Republic. Czech legal environment was enhanced with the institute of the electronic signature that enables communication of Czech citizens and businesses with public authorities. During 2001, the Czech Republic joined eEurope+ Action Plan that

supported the development of information society in participating countries. Consequently, the Action Plan for State Information Policy for the year 2003 was accepted in 2002.

In the beginning of 2003, the Office for Public Information Systems was revoked and its duties were transferred to newly established Ministry of Informatics that was supposed to take charge for future development of electronic public administration, telecommunications, postal services and general support of information society. In October the same year, a pilot testing of the Portal of Public Administration was launched (at the address <http://portal.gov.cz>) and was designed to help citizens and businesses with communication towards public authorities. Its official start was announced a year after.

In March 2004, the Czech government accepted the strategy for development of the information society between 2004 and 2006. Next year, the state Strategy for Information Protection and Privacy was released. In 2005, the public institutions started to run e-registry that is a secured e-mail system for sending and receiving data with digital signatures between public and authorities.

In spring 2007, new members were accepted to the Government Council for Information Society that is an expert advisory body of the Czech government in the field of the information society. The key function of this body is to provide the government with knowledge base support for its decisions in eGovernment and ICT (GOVCZ, 2014). The Ministry of Informatics was dissolved that year, and Czech Arbitration Court changed rules of electronic juridical process that year. All arbitration documents have to be signed with digital signature and sent electronically since then. The Ministry of Interior was delegated with coordination of eGovernment projects and has become responsible for development of the information society in the Czech Republic (MICZ, 2007).

Popularization and further direction of eGovernment was supported by a new project eGon that demonstrates relevancy and interlinks of particular steps of electronization. The eGon represents a living creature that symbolizes Czech eGovernment. All living functions are mutually dependent in a living organism, which applies to eGon as well. The body parts represent the most important elements of eGovernment – “fingers” are places of contact with the public administration managed by Czech POINT; “blood system” is the communication infrastructure of the public administration; “heart” is the Act on eGovernment, and “brain” is made of basic registries of the public administration.

The most visible component of the eGon is the system Czech POINT (which stands for the Czech Filling and Verification Information National Terminal). The aim of the project is to create guaranteed service that can be used particularly by citizens and businesses in order to communicate with the state via single contact place (Špaček, 2009; Špaček and Malý, 2010). The aim speaks about interactions with the state, but the project attempts to improve not only interactions in the field of state administration, but also in self-government and especially in municipal self-government. Czech municipalities represent front-line institutions of self-government as well as state administration. The same joined model is characteristic for Czech regional administration. In the Czech administrative system more than 6200 municipalities represent a basic level, which may be problematic for e-government rationality, because majority of them (almost 60 %) has less than 500 inhabitants, and almost 80 % of them have less than 1000 inhabitants. In the area of self-government, municipalities and regions are not in subordination relationships as it is the case of hierarchical state administration. State administration is required by the Czech legislation as the duty, not the right. This causes tensions in various areas, including ICTs management and coordination of public administration information systems (Špaček, 2009).

Czech POINT provides a guaranteed service for the communication with government bodies through the network of access places where clients can obtain various facts with official statements from different registers, lists and databases kept by the state. Printed documents can be converted in an authorized way between electronic and paper form, and administrative processes can be started here. Czech POINT has brought significant level of flexibility in communication with public authorities in the Czech Republic. In its final stage, fillings and applications will be available fully online (Czech POINT, 2014)

The network of Czech POINT is currently made of more than 7000 points of contact, out of which 79 % are placed at municipality offices and 14 % at Czech Post offices. Among the most used documents that could be obtained from Czech POINT belong verified copies from: the Cadastre of Real Estate, the Companies Register, the Trade Licensing Register, the Criminal Record Register, some other types of extracts and submissions from and to various other public registries. The current overview of the most wanted types of extracts is depicted in Table 1.



Table 1. Structure and rate of extracts issued at Czech POINT (Czech POINT, 2014)

Type of extract	Rate
Criminal Records	42.46 %
Land Registry	22.06 %
Trade Registry	16.78 %
Conversion to paper	7.50 %
Drivers' score	4.40 %
Small Business Register	3.19 %
Conversion to electronic	2.10 %
Data boxes	0.90 %
Qualified Suppliers	0.38 %
Basic Registers	0.12 %
Other	0.11 %

Further details about Czech POINT background and technical solution are provided in Špaček (2009).

The goal of our paper is to verify the level of achievement of the main goal of Czech POINT project: “To make data run, not citizens”, in other words, to which capacity the documents are really exchanged electronically between government bodies.

## 2. MATERIALS AND METHODS

Our working hypothesis is that most of extracts that citizens obtain at Czech POINT places are then submitted in paper form to other public authority for its request despite the fact that the data should be exchanged automatically between public information systems.

We conducted a questionnaire survey at four different Czech POINT places (Prague 1, Prague 6, and towns Stříbro and Šumperk). With the assistance of Czech POINT operators, clients filled anonymously information about the purpose of their request and further use of the extract. Offered choices to answer were such as: to submit to public administration office; to submit to private organisation; to apply in public tender; to submit to the bank; for personal use.

Questionnaire forms were distributed and collected at Czech POINT places by several students from the Faculty of Economics and Management at Czech University of Life Sciences Prague within their bachelor and master theses research in the first quarter of 2014.

There were 456 administered forms and 421 were returned filled back. The largest interest was in extracts from the Land Register (35 %), Criminal Record Register (31 %) and Trade Registry (19 %). In total, those three registries made up 85 % of extracts. The national average of these registries is 81.3 % for all the existence of Czech POINT (Czech POINT, 2014).

## 3. RESULTS AND DISCUSSION

Based on the survey, we can observe that 38 % of clients passed their extracts to other public administration bodies, and 30 % asked for extract due to the application for a job position in private sector (see Table 2). Above stated working hypothesis was accepted because public authorities request citizens for information in form of printed documents despite the fact that they are obliged to exchange them automatically without the involvement of the applicant. In addition, verified original printed document belong to the most often required type of document when a citizen makes an application at the public authority. Here we can see a failure of the legislation that does not fully enable to retrieve the data from information systems. Without further legislative changes, no improvement can be expected in this area.

Table 2. The structure of extracts according the purpose of use

Purpose of use	Rate
Public administration	38.00 %
Private sector	30.00 %
Public tender	7.00 %
Banks	18.00 %
Personal use	7.00 %

Source: own survey, 2014.

Regarding the fact that the use for a public tender is also an act towards public administration, it adds to the total rate 45 % of Czech POINT extracts that are submitted back to other public bodies. The total number of outputs at Czech POINT was around one million extracts in 2014, which represents one million physical visits at Czech POINT places in one year to pick up a paper copy and hand it to other public administration office.

Nowadays, it is not clear, what is the rate of original printed extracts from public registries and what is the rate of electronic extracts. Public administration officials present that the rate is being changed in favour of the electronic form, but there is a lack of evidence.

#### 4. CONCLUSION

There is a legal requirement for public administration bodies to obtain information from public information systems remotely through networks or electronic services in concordance with the Act no. 365/2000 Coll. on Public Administration Information Systems. Our survey revealed that it is not done in many cases. Public administration officers require printed documents with information from public information systems. The negative effect is partly caused by the fact that there are certain legal issues that nourish the problem.

It must be added that in number of cases clerks are able to get required data without asking the citizen. Key services that enable Czech eGovernment are the information system of basic registers and the remote access to Czech POINT for bodies of public administration (the service is called CzechPOINT@office). The rate between the number of printouts produced for the personal use of citizens or businesses and the number of printouts for the use of other public authorities is not known yet. It could be assumed that the purpose of this state is the lack of coordination of activities between various resorts of the public administration and the legislation that is not proper. We found that clerks that operate Czech POINT services are aware of defective and non-logical issues, but if the legislation does not force them to do it in different way they still can use their clients as messengers.

In spite of above stated, there have been significant advancements in development of eGovernment services in the Czech Republic. To fulfil the mission “to make data run, not citizens” a piece of the effort still must be taken to reach the goal in the Czech Republic. We can see the coordination and the cooperation of all governmental departments as main factors.

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# VACCINATION REMINDER SYSTEM - SOLUTION FOR YOUNG MOTHERS

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## ABSTRACT

Lately we are witnessing wonderful solutions that help ease the problems already exist. However, this emerging trend also means that experience in setting up viable environments is rare. Some see it as a challenge, but we think of it as a great opportunity. Web applications are the new swift in this decade and most of the developers are engaging their time to develop on web. This particular web application is made for immunization of the children in the dispersion of time from 0-18. The purpose of the application is to simplify and enhance the time scheduling of the immunization process where the families members such as parents will get the possibility to keep in touch with the schedule and be reminded of the immunization for their children.

## KEYWORDS

Vaccination; web application; young mothers; child vaccination; vaccine reminder; immunization.

## 1. INTRODUCTION

Health care systems are focusing their attention on three key functions: reducing costs, improving health outcomes and enhancing patient satisfaction. Furthermore they will more and more value and reward clinicians who focus on these functions. Because attention to health promotion and disease prevention can contribute greatly to all three functions, it will be essential helping patients maximize their health and prevent illness. It is a general saying that “prevention is always better than cure”. Vaccines protect people from catching specific diseases. Vaccines also help preventing the spread of infectious diseases in a country. Such diseases include polio, whooping cough, diphtheria, measles, rubella, mumps, haemophilus influenzae type b and tetanus (Malone & Hinman, 2003).

Parents are constantly concerned about the health and safety of their children. Therefore, they take many steps in order to prevent their children from catching a disease. In this direction one of the most common options is vaccination. Vaccine works to protect infants, children and even adults from illnesses and death caused by many infectious diseases. Vaccination has its own time, period and schedule. By Rodewald, the dosage of vaccination remains the same among babies but may be different for adults (Rodewald, 2005).

Nowadays, the computer systems have been developed to serve the needs of various situations. Systems supporting the purposes of education, entertainment, commercialization, business transaction, manufacturing, and healthcare can be easily found. The progress of ICT in healthcare is being progressively present in the most recent literature (Daniela and David, 2014).

Currently, in healthcare there have been developed various IT solutions. Liddell bring into being that there are more than 50 cancer related web sites developed in the USA (Liddell, 2005). As an example, Yu-Chu and Huei-Lih designed and developed a system for use among cancer communities (Yu-Chu and Huei-Lih, 2005). Besides, a system that follows up with patients has been proposed by Garcia (Garcia, 2007). Another situation that makes people visit the healthcare practitioners is after the first child is born. However, literature shows that very few works have been done after the pregnancy period. In current practice, information about vaccination is disseminated through posters in clinics and other healthcare services outlets. Also, websites have been developed to disseminate important information, such as Liao (Liao, 2010).

However, the research conducted in our region showed that the awareness of the parents about children vaccination is at very low level (InPress, 2014). Generally, small number of parents knows about the vaccination order for their child. Additionally, the young mothers do not know what good and bad effects correspond to taking or not-taking the particular vaccine. This situation is present particularly among the first time being mothers. In Macedonia, young mothers go to vaccination centre on certain date assigned by the centre to take the corresponding vaccine. During the vaccination time, doctor assigns the next visit. For every vaccination visit young mothers receive by post an invitation letter from the vaccination centre two or three weeks previous to the vaccination time. Very often this information is forgotten if mothers are not reminded before the vaccine date. This study presents an alternative way to help young mothers be aware of their children vaccination process, where the short message services (SMS) and email technology could help (Karehka, 2014).

The paper consists of four sections. It starts with this section that discusses the issues of the vaccination system platform. The coming section elaborates on the design and development of the system. It is followed with the evaluation part which includes testing and initial feedbacks from potential users. Finally, a concluding remark section presents the advantages and drawbacks of the system as well as suggestions for future research.

## **2. THE PROTOTYPE IDEA**

Literature Review of the use of ICT in various sectors among other shows that SMS and email technology has been utilized for many purposes in our country Macedonia (Zels, 2010). For example E-Reminder (E-Потсетник) is a project undergo by the Ministry of IT in Macedonia that reminds the Macedonian citizens for the services offered by the Ministry of Economy Public Enterprise for state roads, Authority for the conduct of the registration books, Employment Agency of the Republic of Macedonia and Agency for Financial Support in Agriculture and Rural Development (<https://e-potsetnik.mk/Institutions>). The main idea of the study presented in this paper is to give young mothers the possibility to have on time information and a reminder concerning their child vaccination through the use of a web based application that sends information to mobile phone in the form of SMS. The system will be used to notify young mothers with issues concerning the vaccination through SMS and email generated from a web based system called [www.emama.mk](http://www.emama.mk).

## **3. VACCINATION SYSTEM PLATFORM**

The web application was build using different platforms. Starting with the simple HTML/CSS, PHP and MySQL for generating the dates and saving them to database, jQuery, JavaScript for displaying the dates and enable/disable input fields. Also, for the design the whole web application, bootstrap was used. Further on, open source Notepad++ editor and XAMPP platform were applied for testing the web application.

For developing the web application on Windows Azure, Microsoft Matrix was used which gives FTP access and also ability to modify the code directly on Azure. Also FileZilla was used for better FTP access, followed by Matrix for better ability to send more files and folders on cloud. The actual application can be accessed by the following link: [www.emama.mk](http://www.emama.mk). The site represents a social network available to mothers, where this vaccination reminder features is available only for the registered users in [www.emama.mk](http://www.emama.mk). At this point the social network is available only in Macedonian language.

## **4. SYSTEM DESIGN AND USAGE**

The design process of such systems is becoming increasingly important. The access to this application is done by logging-in in the social network through the login form.

Once the user will sign in to the application, he/she will be redirected to the main page of the application where an empty schedule is like in Fig. 1. From that page users can check the immunization schedule without choosing the child from the dropdown menu, only they need to choose the date from the calendar. Also, if they don't have added or selected a child, users can't save the schedule to database.

Возраст на деца кои подлежат на имунизација	Болест против која се врши имунизацијата	Датум за вакцинарање (г-мм-дд)	Вакцинација/Ревакцинација	Примено/Непримено	Календар	Потврда
до 24 часа од раѓање, 2 и 6 месеци	* Хепатит Б (3 дози)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
до 24 часа од раѓање	* Хепатит Б (1 доза) * Туберкулоза(без тестирање)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
до 2 месеци од раѓање	* Хепатит Б (2 дози)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
6 месеци од раѓање	* Хепатит Б (3 дози)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>

Figure 1. Main page

To add a child, users need to go to “Додади” (“Add”) page where they need to choose the date of birth of the child and to add a name. It is a simple page where after filling the fields when the users click the “Додади” button, users will be redirect again to the main page, but with the date and the name of the child that they previously added to the “Додади” page. Now, main page have that credentials from the “Додади” page, but schedule with dates is still empty. Also when the users click the “Додади” button credentials from the fields will be added to the database. When the user clicks the generate schedule button which is under the calendar, application will generate schedule with dates for immunization which is shown in Fig. 2 and after that they are able to save all the dates.

Возраст на деца кои подлежат на имунизација	Болест против која се врши имунизацијата	Датум за вакцинарање (г-мм-дд)	Вакцинација/Ревакцинација	Примено/Непримено	Календар	Потврда
до 24 часа од раѓање, 2 и 6 месеци	* Хепатит Б (3 дози)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
до 24 часа од раѓање	* Хепатит Б (1 доза) * Туберкулоза(без тестирање)	2014-06-14	Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено	0000-00-00	<input checked="" type="checkbox"/>
до 2 месеци од раѓање	* Хепатит Б (2 дози)	2014-08-12	Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено	0000-00-00	<input checked="" type="checkbox"/>
6 месеци од раѓање	* Хепатит Б (3 дози)	2014-10-11	Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено	0000-00-00	<input checked="" type="checkbox"/>
4.5 1/2 и 7 месеци	* Дифтерија, * тетанус, * голема кашлица (3 дози)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>

Figure 2. Main page with generated dates

On the main page users need to choose does the vaccine is received or not. If the vaccine is received, on the next row users will need to add the received date of the vaccine via a pop up calendar. At this point is generated the date for the next vaccine which depends on the date of the previously received vaccine. This is shown in Fig. 3.

Возраст на деца кои подлежат на имунизација	Болест против која се врши имунизацијата	Датум за вакцинарање (г-мм-дд)	Вакцинација/Ревакцинација	Примено/Непримено	Календар	Потврда
до 24 часа од раѓање, 2 и 6 месеци	* Хепатит Б (3 дози)		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
до 24 часа од раѓање	* Хепатит Б (1 доза) * Туберкулоза(без тестирање)	2014-06-14	Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено	2014-06-16	<input checked="" type="checkbox"/>
до 2 месеци од раѓање	* Хепатит Б (2 дози)	2014-08-15	Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
6 месеци од раѓање	* Хепатит Б (3 дози)	2014-10-11	Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>
4.5 1/2 и 7 месеци	* Дифтерија, * тетанус, * голема кашлица (3 дози) * Делта паразит (3 дози) (3 дози третична орална вакцина) * Дифтерија.		Вакцинарање	<input type="radio"/> Примено <input type="radio"/> Непримено		<input type="checkbox"/>

Figure 3. Main page with received vaccine date via pop up calendar

All changes that the users will make should be saved on the database. They can do that by clicking the icon with the “save” image above the schedule table. After saving the results, every time when the user will access the main page, he/she will see in dropdown menu a list of child/children that he/she has added into the database and also the saved schedule. The notification via email was realized with [www.setcronjob.com](http://www.setcronjob.com), where the server will take the mail.php file, will execute the query and if there are some children from immunization that the date of immunization is one day ahead from the actual vaccination date. Users will receive an email that they have scheduled a vaccine for a given child on the next day. In parallel, besides the email, the SMS notification would be performed through the code that sends reminding SMS to the user whose child should be vaccinated a day prior to vaccination (Fig. 4).

```
$subject = "Vakcinacija";
$time = $row['lme_date'];
$da = $cDate;
$date1 = str_replace('-', '/', $da);
$tomorrow = date("Y-m-d", strtotime($date1 . "+1 days"));
$message = "Na $tomorrow treba da se vakcinira. $time ";
$to = $row['user_email'];
$mob = $row['user_mob'];
$sql = "INSERT INTO `12c_outbox` ('to', 'body') VALUES ('$mob', '$message)";
$vnes = mysql_query($sql);
mail($to, $subject, $message);
```

Figure 4. The code that sends reminding email and SMS to the user

## 5. SYSTEM EVALUATION

Once the application was developed and implemented, the evaluation was conducted to determine and enhance its functionality. Positive feedback from several users with the design was received. The initial test period was one month (February 2014). During this period group of users who agreed to test the system were adding data into the system and checking the notification accurateness. The system was consequently modified and improved based on the feedback received by the user. Bellow are presented some of the remarks received by the users and resolved right after that.

1) The 1st User: Macedonian, 24 years old Female

The first user mainly liked the “feel and look” of the actual application. The delays after activating some of the available features, somehow to be solved.

2) The 2nd User: Macedonian, Female, 27 years old

Apart from her being captivated by our application, her idea of having the notification for vaccines in taskbar sound interesting. She furthermore thought there should be a cancellation feature for the alerts and save button for the schedule.

3) The 3rd User: Macedonian, 30 years old Female

This user felt the application is easy to use and she liked the idea of having a message feature in Macedonian, but she also gave us the idea of having a search or more button to find and read vaccines information.

4) The 4th User: Albanian, 29 years old Female

This user thought the application is user friendly, but it would be good if it would be available in Albanian language too.

5) The 5th User: Albanian, 23 years old Female

This user thought that the application is easy to use, but it could have been more beautiful and faster.

6) The 6th User: Macedonian, 28 years old Male

This user thought the application is easy to use and very promising. He thought that it would help young parents to be remaindered for very crucial things.

Overall, users were satisfied with the application and we receive green light for its further development.

## 6. CONCLUSION AND FUTURE WORK

This paper presented the idea and the implementation of the scheduling system for the immunization in Macedonia. The further work would include adding several functionalities to existing features as well as adding completely new features. The aim of these new elements of the system will be to bring the system as

friendly as possible to the user. Some of these novelties in the system will be: another saving button, so that the tables will be saved as .pdf format and will be printable, language chooser option, so that the user will be able to choose the languages they prefer, including: Albanian, English, and Serbian. Moreover, most wanted users' requests will be considered in our next version of this application. Also we will optimize the web application for the mobile. So far, the web application is optimized for seven inch screen and greater.

This vaccination system is designed to help pregnant mothers to track their child vaccination wherever they are. The system was built in based on existing web sites that contain information on similar topics.

When tested with potential users, the level of satisfaction with the system was very high. Among others this experience confirms that IT solution such as this contribute towards making a better organization in the providing health care services and at the same time for preventing diseases and better health of the patients. Further on, permanent enhancement and user tests should be carried out.

In conclusion we look positive on this web application, because is the first in Macedonia translated in Macedonian and its usage will span in a fastest way.

Finally, we find that the work presented in this paper will motivate researchers to put more emphasis on assisting mothers with similar technologies.

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# THE ENIGMA OF IMPACT: CAUSES AND COSTS OF BENEFIT IN A GHANAIAN E-HEALTH PROJECT

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## ABSTRACT

In a reflection on ICT4D, Unwin (2009) argues that a maximization of project benefit requires a critical understanding of both theoretical and practical dimensions of ICT. This short paper connects theory and practice in order to work towards such a critical understanding. It encompasses some analysis-in-progress based on data gathered in the context of an ongoing e-Health impact assessment in northern Ghana. Most importantly, our findings suggest a discrepancy between the scope of project objectives and the complex impact of interventions. Such discrepancy highlights the relevance of explorative research on the actual impact of ICT on 'development' and confirms the urgency of a holistic investigation into the complexity and multifaceted character of transformation processes. We discuss how complexities emerging from our impact study reveal these challenges. Most notably are the issues of causality and power. A Foucaultian approach is taken to explore the latter and explain the intricacies of innovation and the socio-cultural embeddedness of interventions.

## KEYWORDS

e-Health, critical ICT4D, Ghana, qualitative research, Foucault

## 1. INTRODUCTION

This short paper involves an ongoing study on e-health in rural Ghana. The study's objective is to assess the impact of the 'ICT in Community Health Project' (ICHP); an ICT4D project concerning interventions in ten districts in Ghana's Upper East and Northern Region. Although the impact assessment investigates innovations aimed at improvements in sexual and reproductive health, maternal care and patient administration, we will not focus on these interventions here. Rather, this paper focuses on the introduction of mobile phones in order to critically contemplate the complex process of unravelling effectiveness and determining the costs and benefits of interventions. In particular, we will explore the issues of causality and power and assess (a) the interactions of interventions in a context of project plurality, and (b) the way in which apparently power-neutral project objectives may facilitate hegemonic forces, producing unintended effects. As this paper concerns work-in-progress rather than crystalized contemplations, we use this text to share our insights and look for theoretical clues for explorations during the rest of our research project.

Data upon which this report is based was gathered during a two week period of fieldwork in the third quarter of 2014. The researchers have visited clinics subject to the interventions at two sites in the Northern Region and two sites in the Upper East Region. At each of these sites, semi-structured interviews were conducted and focus-groups were organized with clinic staff, Traditional Birth Attendants (TBAs), Traditional Medicine Practitioners (TMPs), and members of adolescent health clubs. Informal visits to homes of TMPs and TBAs were scheduled to gain ethnographic understanding of the context of use. Additional insights derive from a survey on SRH as well as from clinic statistics.

First analysis of our data underscores the call for a critical explorations of the impact of ICT on 'development' and confirms the need for thorough dissection of the complexity and multifaceted character of transformation processes (e.g. Thomson 2004; Burrell and Toyama 2009). We will assess the manifestation of this complexity in Northern Ghana through a contemplation of the question of causality and a Foucaultian assessment of mobile phones as devices that help to incorporate traditional health workers into the mainstream (biomedical) health system. Foucault's interpretations of *biopower*, *dispositif* and *normalization* are introduced as conceptual beacons that, combined with detailed empirical insights, guide us to a more intricate understanding of power dynamics in the ICHP. First however, we will sketch the objectives of the ICHP and analyze them as exemplary of a persistent belief in progressive transformation that reflects previous notions of modernization.

## 2. MODERNIZATION AND CAUSES OF BENEFIT

As Schech (2002) observed more than a decade ago, ICTD enthusiasts often embrace a modernization discourse (see Lerner and Schramm 1967). These ‘techno-optimists’ seem to suggest ‘underdevelopment’ can be partly explained as the outcome of knowledge shortage and the absence of a Western-style communication infrastructure. Development as such is considered to require the diffusion or transfer of ideas, ways and systems from an advanced setting to a setting that is yet to advance. The objective of the ICHP suggests such a perspective. It indicates the implicit assumption that straightforward improvements in information and communication – including supporting technologies – will lead to desired change. According to the consortium’s project proposal: *[The] main objective, as far as ICT use in healthcare delivery service is concerned, is to integrate appropriate and sustainable use of information, communication and supporting technologies into ten [...] health institutions to improve healthcare delivery services to rural populations in Northern Ghana by the end of 2014.* This improvement, the proposal explicates, consists of (1) improved communication between clinics and ‘traditional’ health workers, and between clinics and adolescent reproductive health clubs, (2) the introduction of ‘efficient’ electronic record keeping practices, (3) the expansion of learning and knowledge sharing activities, and (4) ICT capacity building of clinic staff and community representatives. These intentions inspired the design clusters of interventions that were implemented over the past two years. Examples are the introduction of an electronic patient record system (Health Management Information System); the establishment of Community Health Information Centers with free internet access; and the distribution of mobile phones among TBAs, TMPs and representatives of adolescent health clubs. As indicated in project documentation, a crucial motivation for these innovations is the belief that improvements in the processes of information and communication will produce changes that seem factual progress and should be interpreted as evidence of development. For instance, according to the impact study’s ToR, success should be measured in terms of shifts in capacity of health workers – defined as, increases in ‘knowledge’ – improved communication, and changes in people’s knowledge, attitude and practice. However, our data indicates that such notion of success is inadequate because of (a) unclarity concerning the causality of change and (b) complications concerning the manifestation of change in context.

The first, the issue of causality, relates to the question whether occurrences that are considered indications of impact can indeed be attributed to the interventions. This is undoubtedly a challenge in assessments of the impact of interventions of all kind. In the case of the ICHP impact study, the valuation of effectiveness was further complicated because of (a) the absence of data from a solid base-line investigation and (b) project plurality and the subsequent overlap in agendas of different actors. More specifically, the presence of different NGOs and various co-existing (often unconnected) programs focused on similar change in the realm of health, means that the impact of distinct interventions cannot be easily isolated. The distribution of mobile phones among TBAs to improve interaction and transfer knowledge, and thus reduce the number of ‘unsupervised deliveries’ and increase referral rates, is illustrative. Parallel to this innovation, another NGO sought to increase referral rates through rewarding birth attendants with one Ghana cedi<sup>1</sup> per referral. Although referral statistics were initially considered an indication of success, this simultaneity severely complicates the attribution of the dramatically increased numbers of referrals<sup>2</sup> to a particular intervention.

In order to deal with such challenges of causality and still work towards a valid assessment of the project’s effectiveness we have opted for a qualitative causal-comparative (ex-post-facto) design in which we compare similar groups exposed to different conditions as a result of local variations in intervention trajectories. This strategy – mainly participatory assessments in the form of workshops, focus groups and semi-structured interviews – allows us to unravel the complex configuration of a health care system as realm of external intervention. Besides, this in-depth approach provides us with important information concerning the manifestation of change in context. In fact, it offers crucial detail and insight that forces one to abandon simple perspectives on progress and contemplate socio-cultural dynamics that shape the local appearance of interventions. In the case of the Ghanaian m-health project, the assessment of change in context as the second complication of the impact study necessitates the analysis of power.

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<sup>1</sup> 0,31 USD

<sup>2</sup> The number of ‘TBA referrals’ in this community rose from 19 in the first six months of 2012 to 147 in the first six months of 2014.

### 3. POWER AND THE COSTS OF BENEFIT

Crucial to such recognition of the complexity of ‘development’ is a focus on power. Our initial findings show how seemingly power-neutral interventions concerning the improvement of communication, the transfer of information and implementation of electronic registration, inevitably imply the exercise and distribution of power. In a way, this reflects poststructuralist perspectives on development that critiqued the manner in which the invention of notions like ‘underdevelopment’ and ‘Third World’ work to create and sustain asymmetrical and/or exploitative relations of power (e.g. Ferguson 1990; Escobar 1995). In fact, preliminary analysis of our data guides us to the work of Foucault for the sake of conceptualizing and framing change as practice of power.<sup>3</sup> The relevance of such a Foucaultian perspective can best be explained by looking at those ICHP interventions that target TMPs and TBAs.

Since 2013, approximately four hundred TBAs and TMPs were given a mobile phone. These phones were meant for both communication and information. More specifically, they were distributed to encourage referrals and to transfer knowledge and instructions concerning health and hygiene. TBAs and TMPs receive voice messages, and they are able to call the clinic and health workers free of charge. According to the (power-neutral) project summary: *[This] project is being implemented to address the poor communication and information flow among health workers and key departments within the health facilities. [It] will facilitate two-way feedback from both community health workers and community members, which is essential to provide useful information for future decisions and community health planning.*

Along with the distribution of phones, training and capacity building events were organized to train recipients in their use and to educate TBAs and TMPs on those issues of which, according to the project initiators, knowledge was lacking or erroneous and even dangerous. In Northern Ghana’s context of project plurality, this educational effort – like the payment of one Cedi per referral – connected to a cluster of interventions aimed at improving health care through a realization of the unused potential of traditional medicine (See Krah 2014). To be precisely, the m-health project was one of several co-existing initiatives aimed to tackle limited access to health care/facilities in remote areas by means of incorporating of the easy-access traditional medical system into the mainstream health infrastructure.<sup>4</sup> Phones thus became part of a tendency to utilize the dense networks of TMPs and TBAs in order to connect the rural population to clinics and ‘externalize’ the most rudimentary care from overburdened clinics into communities at minimum costs.

This effort reveals a Foucaultian exercise of productive force as it entails (a) the intentional transformation of autonomous medical practitioners (TBAs and TMPs) into low ranked assistive health workers, and (b) the subsequent erosion or marginalization of existing care practices and knowledge as well as the forceful marketing of an allegedly superior alternative. It reminds of Foucault’s explanation of the exercise of *biopower*. At least, the distribution of phones and clinic referral cards, the registration of TMPs, the training of TBAs, and the instruction of both by means of voice messages, can be considered part of a body of techniques and practices meant to increase the utility of human subjects or discipline individuals in ways which make them more productive (Foucault 1979). Brigg (2002) uses Foucault’s interpretation of *dispositif* – an ‘ensemble of discursive and material elements [...] and the] system of relations established [...] between these elements’ (Foucault 1980:194) – to explain a similar operation of power in the field of development. Though we lack the space to dissect this notion, it might be employed to look at non-traditional health care as a collection of institutions and structures characterized by a discourse that reflects a specific epistemology which is related to rules and techniques that regulate conduct and practice. Such system of health care or *dispositif* entails the formation of a structure of power and control that translates into the dominance of some actors (e.g. NGO and clinic staff) over some others (e.g. traditional health workers).

Brigg (2002) mentions Foucault’s notion of normalization to capture the manner in which governing effects occur through a *dispositif*. Likewise, Escobar uses the notion to explain the exercise of power in the context of development. According to him, development concerns forms of power that ‘act not so much by repression but by normalization’ (Escobar 1995:53). The distribution of phones among traditional health

<sup>3</sup> Post-development authors, sometimes criticized for limited (albeit frequent) use of Foucault (e.g. Lehman 1997), focus on his ideas about discursive practices and formations to explain development. In our case the more comprehensive notion of *dispositif* is more appropriate.

<sup>4</sup> Reports indicate that the physician-to-population ratio in Ghana is 1:20,000. In northern rural regions this figure lies at 1:100,000. By contrast: the equivalent ratio for traditional healers is 1:200. Consequently, traditional healers remain responsible for much of the health care burden and many, as much as 80% of the population, rely upon traditional medicine for their primary health needs (see Krah 2014).

workers is illustrative. Change is not imposed; the practice of traditional care is not sanctioned or eliminated by force. Rather, change is realized through a gentle system of discouragement that allows shifts in practices, perceptions and truths to remain largely unquestioned and accepted as natural and logical. As an elder TBA observed: *[knowledge] is lost. And they will not know it again. They now believe the hospital. What they have is lost. And [TBAs] know it is going to continue that way, so they don't teach their children.*

In the remainder of our research project, we aim to further explore this process of change and analyze the role ICTs play as possible instruments or catalysts of normalization and thus function as accidental power tools that help stir transformations of a totally different order than those forecasted in the project proposal.

## 4. CONCLUSION

Our data show that the assumptions underlying the ICHP m-Health interventions entail a perspective on development that is not sufficiently sensitive to the socio-cultural dynamics of ICT4D. Building on this observation, we discussed some of the complexities inherent to ICT4D impact assessments. In our case study, this is most notably manifest in challenges concerning the causality of change, and complications concerning the context of change including change as a practice of power. We have suggested a Foucaultian approach to power to address the latter in the context of m-health in Ghana. We believe Foucault's conceptual instrumentarium can serve to sensitize ICT4D optimists, and to inspire the scrutiny of the socio-cultural context of ICT4D implementation and to anticipate unwanted or even adverse outcomes of interventions.

The use of Foucault indicates the relevance of theory for a critical exploration of the actual impact of ICT on 'development'. As Unwin (2009) observed, critical ICT4D however requires such theoretical explorations to be accompanied by detailed understanding of practices and the complexity and multifaceted character of processes of change. Extensive investigations are indispensable. In fact, these investigations should connect to a radical embrace of flexibility. In other words, for ICT4D to work, it should be insightful and interactional; designed as a progressive transformative process rather than a predetermined project, grounded in comprehensive understanding of places and people, alert to obscured challenges and opportunities, and willing to be shaped by as much as shaping local conditions.

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# EFFECTIVENESS OF MOBILE PERSONAL DIETARY LOGGING

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## ABSTRACT

Learning a proper lifestyle is crucial for the prevention and the management of chronic diseases. Nutrition is arguably one of the most important controllable factors of lifestyle, and since it is very hard to change, support from mobile information technology can be effective. There are several dietary logging and analysis applications available, but a systematic assessment of their accuracy is usually missing. The paper investigated the practical applicability and attainable accuracy of the Lavinia android based lifestyle support application in a small scale clinical study involving 17 diabetic patients in a rehabilitation hospital. The results showed that after some practice, the average time needed for logging decreases to ca. 5.5 minutes a day even for elderly and technology naïve users. The most important types of logging errors were omissions and magnitude errors of weight estimations. In our next trial we provide the patients with kitchen scales and also use body-worn heart rate sensors to track physical activity combined with manual logging.

## KEYWORDS

Telemedicine, lifestyle, nutrition-log, mobile computing

## 1. INTRODUCTION

Ageing modern societies place an increased burden on the health care system, which calls for the application of telemedicine and a higher level of patient self-management. Mobile information technologies can be efficiently exploited to support this structural change. The daily application of a telemedical solution is especially beneficial for the management of chronic diseases like diabetes, and for prevention. The role of information technology in these cases is not limited to the traditional task of storing and transferring medical data for the disposal of a supervising doctor

Learning, understanding and practically implementing a proper lifestyle is crucial for the prevention and management of a chronic disease (Carrera-Bastos, 2011). For example, it is estimated that 95% of the diabetes management is self-management (Wagner, 2011). Lifestyle is important because it incorporates the controllable health risk factors. One of the most important such factors is nutrition. However, it is very hard to successfully implement a change in life style without knowing in detail the characteristics of the present life style (Boutelle, 1998). Previous studies have shown that it is very cumbersome to track an outpatient's diet by traditional paper based dietary logs to support for patients who want to lose weight (Baker, 1993). According to a recent study, mobile technology is the preferred choice for dietary logging and analysis in modern telemedical solutions (Rusin, 2013), due to omissions and underestimations by the subjects (Krall, 1987). There are also very encouraging results for the specific case of diabetes, where the role of nutrition is paramount due to the nature of the disease (Sevicka, 2008).

There are several web-based or mobile applications that provide an interface for the logging of the user's meal and various services related to the analysis of the log like daily/weekly overview charts, support for losing or gaining weight etc. The Calorie Counter android application boasts with the biggest recipe database of more than half a million<sup>1</sup>, a large part of which was contributed by the users. Similar applications, with a smaller database, are the My Diet Diary<sup>2</sup> and Tracker 2 Go<sup>3</sup>. Though such services do provide a nutritional

<sup>1</sup> Calorie Counter PRO <https://play.google.com/store/apps/details?id=com.fourtechnologies.mynetdiary.ad>

<sup>2</sup> My Diet Diary <https://play.google.com/store/apps/details?id=org.medhelp.mydiet>

analysis, the accuracy attainable by this approach was seldom evaluated systematically. We take a more systematic approach. A serious drawback of the user-contributed recipe databases is the lack of professional dietetic validation. There are several other sources of possible errors as well, like the shortcomings of the dietary database or the user interface, the food and dish (recipe) variants, amounts over- or underestimated by the user, the cooking transformations of nutrients and the personal variability of absorption.

The focus of this paper is the assessment of a mobile personal dietary logging application developed by the authors. We already performed a study previously about the completeness of the database (Vassanyi, 2013), now we focus on user errors and acceptance.

## 2. METHODS

Our dietary logging application, called Lavinia Lifestyle Mirror<sup>4</sup>, is based on the Menugene expert system that supports dietary logging on web and mobile interfaces, dietary log analysis, and also personalized menu generation using a dietary database specialized for the Hungarian culture. Its data base currently stores 9500 food items along with their nutrient contents and 1373 dishes composed from the foods, but on the mobile user interface we show only the most important 299 dishes and 360 foods, organized in a hierarchical structure of 195 manually designed sets. The reason for limiting the search space is that we want to simplify the search and thus preserve user motivation. We are convinced that user motivation is the key for a long-term effect on lifestyle (Svetkey, 2008), therefore, when we plan a logging user interface that is expected to be used several times a day, it is imperative to keep the time expenditure needed for that at an absolute minimum. The balanced set structure has three levels, so it is possible to find any food or dish item in just three strokes. We even allow the logging of a general set name instead of a concrete dish or food, in case the user cannot find a specific item e.g. ‘fish soup’ set instead of ‘whale soup’. In such cases we log the average nutrient content of the member items of the set selected. Nevertheless, we do provide the traditional keyword based search facility as well. If no acceptable food/dish item or set has been found, the user can send a request to the dietitian to extend the database. The extended database will be available for the application at the next database synchronization. Alternatively, the user can also enter her/his own recipe by food ingredients and have it stored as her/his custom dish.

When the user identified the item to be logged (s)he can select the quantity on the next dialog panel. Several natural units are offered for each item with the most common one (usually ‘portion’) as default. The application learns user preferences of the units. In most cases, the recording of the quantity takes just one or two strokes. The best accuracy can be achieved when the user takes a kitchen scale and selects the g or dkg as unit. Without a scale, the accuracy depends on the user’s ability of weight estimation, or, in the case of the ‘portion’ unit, the food vendor’s conformance to standard portion weights.

The mobile logging application puts an emphasis on giving the user an instant personalized feedback on any item recorded in the log, and also several forms of overview assessment for longer periods. Figure 1 shows two examples of such assessments on the user interface.

In a previous small scale study about the accuracy achievable with the Lavinia application we found that the relatively simple database with a carefully designed user interface can deliver nutrient estimation errors around 15% (Vassanyi, 2013). The study involved 5 young persons, familiar with android, but new to the Lavinia logging application. We also found that the average time needed to enter a whole day’s menu is ca. 6 minutes for the new user, which decreases to ca 3 minutes by the end of the third week.

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<sup>3</sup> Tracker 2 Go. <https://play.google.com/store/apps/details?id=com.byoni.tracker2go>

<sup>4</sup> Lavinia Lifestyle Mirror. <http://www.lavinia.hu>

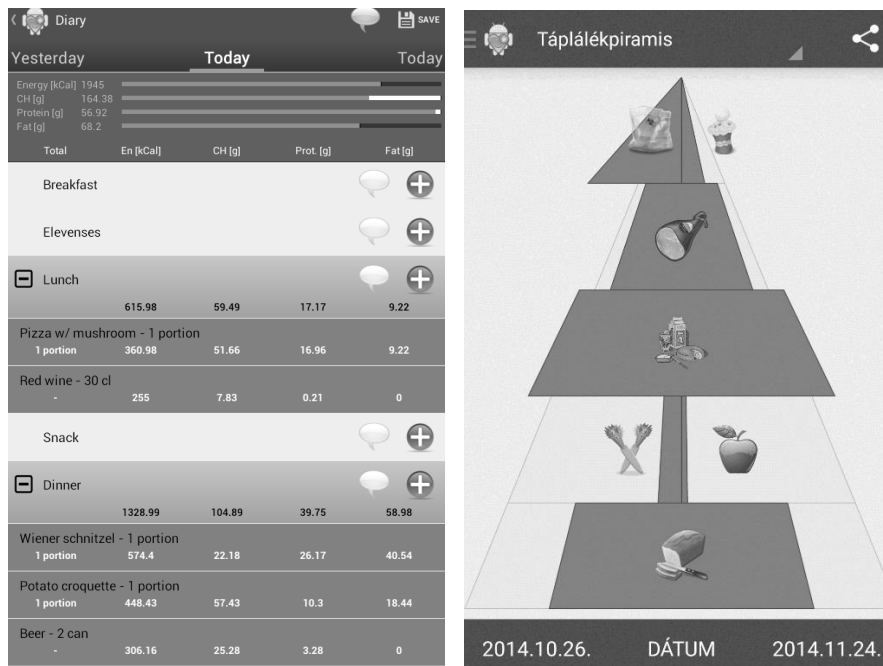


Figure 1. A daily dietary log summary (left) and the measured food pyramid for a one-month period (right) in the user interface of the Lavinia android application. The log summary shows an instant feedback on the energy nutrient contents of the logged item in the form of a green bar that spreads the entire width of the page when the logged amount of the nutrient reaches the RDA, and turns partially red if the amount exceeds it (such as fat and total energy in the figure).

Based on these encouraging results, we designed the new study to better simulate the real circumstances of the planned lifestyle counselling application. We involved 17 diabetic patients taking part in a 21-day cardiac rehabilitation care in a local hospital (10 men and 7 women). The average age of the patients was  $61.5 \pm 10.2$  years. Most of them had very limited prior experience with mobile technology or smart phones. This, combined with the higher age, was a much more realistic scenario and a considerable difference compared to the previous study. This approach follows the recommendations of (Burke, 2011) for the design of telemedical studies. 10 patients used a Nexus 4 smart phone, 7 used a Nexus 7 tablet, with the Lavinia application pre-installed. After a standard verbal introduction of 3..5 minutes, we asked the patients to log the meals served for them at the hospital and any other private meals as well for the next three weeks. The application automatically recorded the time spent searching the set hierarchy, the time of the keyword based search and the total user time as well.

After the end of the study period, we manually separated entries that belonged to the hospital menu from private items and identified items that were served but were not logged. For the hospital menu entries, we also calculated the ratio of those that were incorrectly identified by the user e.g. sausage instead of bacon. Finally, we manually analyzed the correctness of the quantity estimated by the patient for each correctly identified entry. At the end of the three-week period, we asked all participants to fill in a questionnaire about their prior information technology skills and the perceived effectiveness of using the Lavinia tool.

### 3. RESULTS AND DISCUSSION

#### 3.1 Accuracy of the Log

The 17 patients have logged a total of 3416 entries, from which 2109 (61.7%) belonged to the 'official' hospital menu. In 518 cases, a dish that was served to a patient, was not logged in the diary. 1900 entries of the 'official' menu were correctly identified by the patients (90.1%), 203 entries (9.6%) incorrectly, and in 6 cases (0.3%) the patient logged a set name instead of the dish. Set entries mean inaccurate nutrient estimations, since in such cases Lavinia uses the average nutrient content values of the set members.

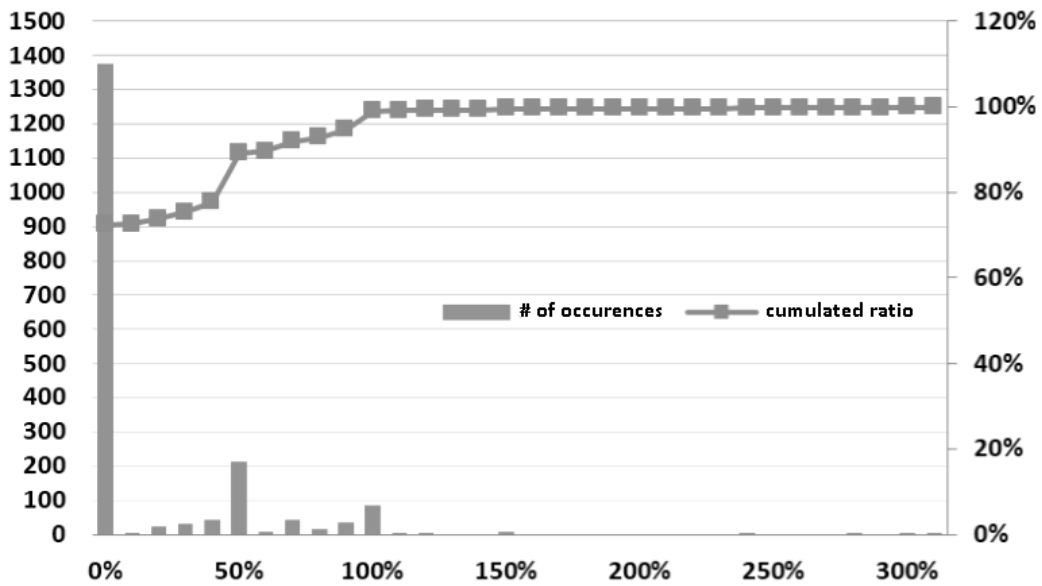


Figure 2. The distribution of quantity errors. The horizontal axis shows the error in %. Left scale (bars): number of cases, right scale (dotted line): cumulated percentage of cases

In 1365 cases (64.7%) of the 1900 correctly identified entries, the quantity (weight of the item) was correctly estimated, while in 535 cases there were slight or significant errors in the estimation. Figure 2 shows the distribution of the errors. As the trajectory of the graph shows, a rather common source of errors is mixing up magnitudes e.g. logging 2 g instead of 2 dkg. Such cases can be identified by an exact 50%, 90% or 100% error in the graph. This experience calls for an alert function in the application when the user attempts to log exceedingly high or low values as a quantity. The rest of the errors stem from the limited experience of the user, which could be improved by using a kitchen scales at least in the learning phase i.e. first couple of days of the experiment.

### 3.2 User Acceptance and Involvement

The average time needed to log a single entry was 35.05 s for the whole period, starting from ca. 50 s on the first days and gradually decreasing to less than 30 s by the end. This is in line with the usual logarithmic learning curve phenomenon for such computerized tools. For a whole day, the total logging time was ca. 10 minutes in the first days decreasing to ca. 5.5 minutes by the end. Though this time is considerably more than that measured for young and smartphone-literate subjects in the previous study, it is still acceptable. An important result of the study was that the patients used keyword search in only 9.8% of the cases, which may be due to the efficiency of the hierarchical set based search. A typical search started in the set hierarchy, and only when the patient did not find the item, switched (s)he to keyword search. The average time to record the quantity was 10 s, decreasing only very slowly with more practice. Those users who had a previous experience with mobile devices had only slightly better results than the average.

The questionnaires showed that though only 40% of the patients used a smart phone before the study, 73% of them found it easy to use the application and 23% actually enjoyed it. The logging time estimated by the subjects was generally higher than the actual (measured) time. All patients would recommend the use of the system to others.



## 4. CONCLUSIONS AND FUTURE WORK

The paper presented the results of a study to assess the practical applicability of a mobile dietary logging application. The results show that the time expenditure is highly acceptable and the user interface is easy to handle even for elderly and mobile-naïve users. We think that the quantity estimation errors could be reduced by careful warnings and the application of a kitchen scale, at least in the learning phase. In our current, ongoing trial we provide the patients with kitchen scales and also use body-worn heart rate sensors to track physical activity combined with manual logging.

## ACKNOWLEDGEMENT

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# USING NARBS FOR POLITICAL PREDICTION

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## ABSTRACT

There is an increasing availability of unstructured textual data in the depositories of big databases that are constantly produced and updated. Such unstructured data, such as tweets from journalists and their followers play the role of narrative bits – narbs – in creating specific stories about an individual, group or institution. A selection of narbs emanating from a set of followers of the tweets of prominent journalists in India are analyzed using the theoretical foundation of the narrative paradigm to demonstrate how analytic protocols adapted from Latent Semantic Analysis and Natural Language Programming can be used to political outcomes.

## KEYWORDS

narb; big data; discourse; narrative; analysis; politics, vote, prediction.

## 1. NARRATIVE ANALYSIS

The construct of looking at culture, communication and human behavior and beliefs through the lens of a narrative was suggested by the work of Walter Fisher who in turn based his work on earlier scholars who identified the importance of story-telling and narratives in the process of making meaning of everyday life as people operate within the cultural and social spaces that they occupy (see, e.g., Andrews, 1982; Gadamer, 1982; MacIntyre, 1981; Ricouer, 1977, 1983, 1984; White, 1984). In setting forth the notion that human beings operate not only as a rational and rhetorical being, Fisher suggested, people can also operate as a narrative being where the act of creating and articulating a coherent and rational narrative becomes a part of being human. In doing this, the narrative paradigm offers a different way of analyzing and understanding communication, and the way in which people act.

There are many aspects of the narrative paradigm that merit examination in the early Twenty-first Century of Big Data, particularly when the analysis of large data sets seeks to provide an account of how persons come to believe and behave (see, e.g., Kosinski, et. al. 2013). The narrative paradigm suggests that it is possible to examine a story to seek internal coherence and fidelity of a story. Coherence refers to the internal logic of the story to see if indeed all the elements connect in a coherent fashion and fidelity refers to the believability of the story in terms of its truth value. Stories that demonstrate high coherence and fidelity could become the components that supplement the structural part of any big dataset by providing insights into the story and its author.

Consequently, using the paradigm, it is possible to understand how people believe and behave by systematically analyzing the stories that are being told. In the case of social media systems these stories appear as collection of narbs that are made up of the different ways people express themselves – from simple status updates to the elaborate process of offering visual information that makes up the elements of the narrative.

## 2. NARBS AND BIG DATA

As discussed elsewhere, a narb is a narrative bit of information that an individual produces every time an individual places information in a digital space (Mitra, 2014a, 2014b, 2013, 2012a, 2012b, 2011, 2010). The

term can refer to an update on social media systems, a micro-blog, and segments of blogs or other personal digital discourse that is available in the virtual space. It is these narbs that make up much of the narrative component of Big Data, and are amenable to narrative analysis. The term has commonly been utilized in discussions of the analysis of large data sets within the realm of computer science as in the case of the work of Weiss and Indurkha (1998) in the discussion of mining large data sets, just as the term was discussed within the context of macroeconomic measurement and forecasting (Diebold, 2000, 2003, 2012; Lohr, 2013). The key to the idea of Big Data is the fact that this is personalized data that is coming from people who are actively and voluntarily contributing to the compilation of these data sets (see, e.g., Mayor-Schoeberger and Cukier, 2013). Much of the attention on Big Data has focused on the two key components – 1) gathering the large amounts of data and 2) quantitatively analyzing the data to obtain both personal-individualized information as well as information about different groups of people. Generally, the structured data refers to quantifiable elements of the data, which for an individual are things like, gender, age, education, income and other stable and easily measured and quantified attributes. Such data is amenable to numeric analysis, which is the forte of computers, to produce specific statistics about an individual or cluster of people. It is the “unstructured” data that becomes more challenging to analyze and interpret. There are only exploratory and proprietary numerical tools that can extract meaningful statistics from thousands of messages sent, for instance, via Tweeter, or the millions of lines of status updates that are produced by the nearly one billion users of Facebook. All these messages become narrative bits (narbs) of information, and as demonstrated earlier, it is possible to categorize narbs to begin a more careful analysis of Big Data. Narbs serve as the repository of personal and communal narratives that need to be extracted from the data to offer a better understanding of the person and group represented by Big Data. The premise here is not necessarily new; indeed it has been argued that analysis of the material available on the Internet is indeed a process of discursive analysis (see, e.g., Mitra, 1999; Mitra and Cohen, 1998). The combination of the theory of narbs and the availability of narbs in Big Data offers the opportunity of developing the analytic protocol discussed in this essay.

### 3. THE ANALYSIS

The availability of Big Data has posed a significant challenge to the traditional mode of text analysis since that analytical process required the use of human coders who needed to be trained to code the texts while maintaining a high level of inter-coder reliability. The volume of texts available by mining the depository of Big Data is simply too large for effective human coding of the texts to discover the narratives contained in the text. This challenge has been answered by automated processing of texts. This processing has gone through many different developmental stages which began with simple enumeration of the words in a body of texts. This process resulted in large sets of tables which reported the frequency of occurrence of a specific string. Such listings, however, did little to uncover the overall meaning of a series of texts or to point towards the stories that were narrated by the texts. The next development in the realm of automated text analysis led to stages such as Latent Semantic Analysis (LSA) which used complex mathematical processes based in linear algebra and matrix manipulations to begin to discover the relationship between words in a text to not only show the words contained in the text but also how they came together to create specific meanings that could tell specific stories. The LSA process has also been developed into the Latent Dirichlet Allocation/Analysis (LDA) which too applies computational processes to the text to discover specific topics contained in the text. Such tools allow for a quicker and more reliable analysis of large volumes of data that become available from the domain of Big Data. However, the automated analysis systems draw upon such dictionaries, and the process of LSA/LDA, to produce results that show what specific opinions are expressed in a text. The opinion analysis thus produces a more detailed analysis of the stories contained in the narbs of Big Data. In most such cases the analyst has little control on contextualizing the analysis and relies on the dictionaries for the automation. However, texts do not operate in a vacuum. As has been pointed out in years of research on text analysis, it is known that texts are often connected with other texts – thus the notions of inter-textuality. Similarly texts have multiple meanings – thus the notion of polysemy. Texts are also sensitive to the culture within which it is produced. Yet, much of the automated analysis miss these nuances of texts that are fundamental to the way in which texts are able to tell stories and illuminate specific attributes of the author as suggested in the narrative paradigm. In the analysis offered here, the automation is coupled

with contextualizing of the dictionary and offering an intermediary step that mimics the traditional coding process of earlier textual analysis allowing for the recognition and incorporation of the context under which the unstructured big data has been produced. This is the process that was used on the narbs extracted for this case study.

#### 4. POLITICAL CONTEXT

The specific instance used in this essay uses narbs of a set of people in India who follow the tweets of several prominent journalists in India. As is the case of journalists across the World, Indian journalists also tweet their opinions and the tweeting became particularly frequent prior to the national elections in India in 2014. This election was particularly contentious since the incumbent Congress Party was under significant threat from the opposing Bharatiya Janata Party (BJP) which had proposed to name a controversial politician as the new Prime Minister of India, if the BJP would win the elections. Within this scenario in the most populous democracy in the World, journalists and their followers were tweeting their opinions. In this study, the tweets were analyzed as narbs to understand the political climate and predict the outcome of the election. Nearly a year’s worth of tweets were collected and analyzed.

#### 5. FINDINGS AND PREDICTIONS

The analysis results in the production of narrative maps that offer visualization of the narratives by showing the connection between the key categories in the narrative. In these maps, the size of the circle, or node, representing the narrative category indicates the frequency with which that category appears in the narbs, and the thickness of the line between the nodes indicates the strength of the relationship. In this essay only some such preliminary connections are reported.

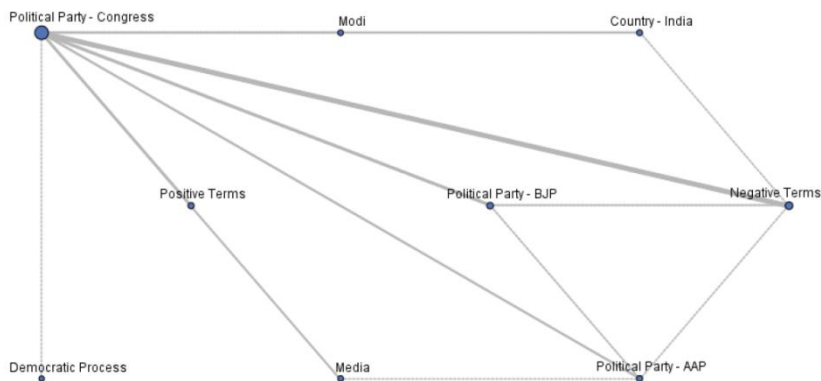


Figure 1. Narrative map of political parties

In the first of the maps, Fig. 1, there was evidence to support that the narrative emerging from the tweets is strongly negatively tilted with respect to the Congress Party with a strong connection between the use of “negative terms” and the “Congress Party.” Indeed, nearly 3.2% of all the narbs that used negative terms also mentioned the Congress Party. On the other hand, as the map shows, there are far fewer narbs that use negative terms when discussing the BJP. Indeed only 0.5% of the narbs that use negative terms also mentioned congress. In other words, it is six times more likely that narbs with negative terms will include a mention of the Congress Party as compared to the mention of the BJP Party. This leads to the sense that in the elections, the Congress Party might not fare too well and the BJP has a greater chance of winning.

This analysis was supplemented with the analysis of the connection between a set of other terms that showed that the people who were tweeting were using more negative terms than positive terms when talking about different issues. As seen in the table below there is ambivalence about issues, which is expected, but there are some interesting trends in the story as well. This ambivalence created an uncertain political climate

with people being more positive towards the Congress Party but at the same time being positive towards Modi as a politician with little to say about Rahul who was the erstwhile leader of the Congress Party. Based on such data, it was possible to predict that Modi would be the Prime Minister of India if his BJP party were to gain a majority of seats in the Parliament of India. Indeed, this is precisely what happened in India.

Table 2. Connection between concepts and opinions

Topic	Percent Using Negative terms	Percent Using Positive Terms
Country - India	10.35%	7.98%
Media	5.58%	4.55%
Democratic Process	4.53%	3.22%
Modi	3.48%	2.22%
Political Party - Congress	3.64%	2.11%
Political Party - AAP	2.51%	2.00%
Political Party - BJP	3.07%	1.33%
Rahul	0.81%	0.78%

## 6. DISCUSSION

There is little doubt that Big Data would increasingly play an important role in many different kinds of decision making processes ranging from political campaigns to identifying points of threats to national securities. This analysis demonstrates that information from narbs can have predictive value when considering specific questions such as election outcomes. When this analytic process can be scaled up to large data sets, it is likely that the predictive value will improve as well. Furthermore, the analysis can be done repeatedly at different moments in time to understand how specific trends shift with time. Here, the data was collected over a period of time and continuing analysis demonstrates that opinions changed over time, eventually leading to the overwhelming victory of BJP at the polls.

## 7. CONCLUSION

Even with the best of automated content and semantic analysis tools, the human researcher plays an important role in providing the context of the analysis. Here the researcher must be the one who is asking the questions and the machine is doing the analysis to help answer the questions using the narrative maps. Sometimes, even in the days of complete automation, a human being must ask the relevant questions to seek the answers from the Big Data that surrounds us.

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# KNOWLEDGE MANAGEMENT IN AIRLINE INDUSTRY: CASE STUDY FROM THE BRITISH AIRWAYS

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## ABSTRACT

With the global expansion and increasing complexity of business processes, knowledge management has become an essential topic for managers. Managing knowledge in organisations influences multiple aspects of the business, starting with the design of organisational strategy and ending with the improvement of customers` experience. In the airline industry knowledge management plays even more important role, taking into the account the scale of the industry and the complexity of its operations. British Airways have been effectively managing knowledge inside the organisation through a variety of tools and represent an interesting case within its industry. The article will explore how knowledge is managed in the British Airways and the impact it has on the business.

## KEYWORDS

Knowledge management, information processes, business strategy, British Airways.

## 1. INTRODUCTION

“Don`t fly @BritishAirways” – said a tweet posted by Hasan Syed, an annoyed customer whose father has lost his luggage on the flight from Chicago to Paris (Wakefield, 2013). Accusing the UK`s leading airline company of delaying in dealing with the lost luggage issue, Mr. Syed has paid to promote his post on Twitter (Popken, 2013). While it took eight hours for British Airways (BA) to respond to the angry tweet with “Sorry for the delay in responding, our twitter feed is open 09.00-17.00 GMT”, thousands of Twitter users and several news portals have seen and spread the information around the globe (Wakefield, 2013). Dealing with concerns of every single customer is not an easy task for a company serving 38 million passengers annually which by no means allows BA to neglect the customers` needs. Mismanagement of data, information and knowledge is an important issue in any organisation, yet for the airline industry it is crucial. This article will examine knowledge management (KM) systems in BA, focusing on practices in internal communication, strategic planning, improvement of customers` experience and facilitation of operational research. An overview of other airline companies will be given as a comparison of KM initiatives in the airline industry.

## 2. DEFINITIONS

When talking about KM it is important to be clear about what knowledge is. Prusak (1997:4) defines knowledge as “what we know, or what we can accept we think we know and has not yet been proved invalid”. Knowledge can be used in organisations in order to support systems and can be gained from personal experience or the experience of the others (Ackoff, 1996). Building on the information gathered in past and present knowledge allows predicting future events (Kock, McQueen and Corner, 1997). The most influential definition of knowledge was developed by Nonaka, Toyama and Konno (2000:7) who described knowledge as “justified true belief” with an emphasis on the truthfulness of knowledge. Nonaka argues that knowledge is dynamic, relational and is derived from information “interpreted by individuals and given a context and anchored in the beliefs and commitments of individuals” (Nonaka, Toyama and Konno, 2000:7).

KM is a process of managing different types of knowledge to solve current problems and identify opportunities (Quintas, Lefrere and Jones, 1997). Establishing competitive advantage by applying and sharing expertise, the process of KM involves several consequent steps (Liebowitz, 1999). Marquardt (1996) identifies four stages: acquire, create, transfer (and use) and store. DiBella and Nevis (1998) define the steps of KM as acquisition, dissemination and utilisation. Alavi and Leidner (2001) distinguish the KM processes as creation, storage and retrieval, transfer and application. All the three approaches share similar structure.

### **3. KNOWLEDGE MANAGEMENT IN THE BRITISH AIRWAYS**

#### **3.1 British Airways: Company Background**

British Airways is a British airline company operating domestic and international flights. It has launched its first international flight from London to Paris in August 1919 under the name of Aircraft Transport and Travel Limited. In 1924 it expanded to other European destinations and in 1935 it merged with United Airways, Hillman's Airways and Spartan Airlines to be established as British Airways Limited (British Airways, 2014). Today BA has 270 aircrafts, 57,000 passenger seats and more than 40,000 employees and 170 destinations served (Butt, 2014). The departments of BA include: operations, flight operations, commercial planning, marketing communications, global contact centers, e-commerce, mileage partnerships and distribution (British Airways, 2007). Although BA is a leading UK airline, during a ten year period starting from 2001 BA has faced several global problems such as world financial crisis and disruption of air travel due to the ash cloud. The low cost competitors like Easy Jet and Ryanair and full-service ones like Virgin Atlantic together with a falling customer satisfaction have caused a major threat for BA (Marketing Society, 2013). To overcome these challenges and improve the service, BA has paid close attention to KM.

#### **3.2 Internal Communication and Knowledge Sharing**

Throughout the years BA has developed a variety of tools that allowed employees communicating with each other. Emails are used to deliver urgent news concerning daily operations and to deliver Weekly Brief documents that contain important information about the industry. The other tools include intranet, which is used as a forum for discussing day-to-day issues and weekly newspaper BA News contains information for each of the departments and provides a helpful source of knowledge for the employees. E-learning modules are available for all the employees through intranet and internal communication is strongly supported by the executives (British Airways, 2007). In order to bring together 41,000 employees BA has introduced a social networking application Yammer Enterprise, supported by the Microsoft 365 (Microsoft, 2013). Yammer is a social network available on mobile devices, its features include individual profiles, creation of groups and collaboration on documents and other features. Yammer has an increased amount of inbox space in comparison with email. Using communication systems similar to social networks was preferred by BA after the company has analysed non-work communication habits of their employees and revealed that employees were more active on social networks. Yammer united eleven thousands BA staff members including cabin crew and front-line employees enabling them to communicate with engineers, pilots and managers to share their expertise and come up with optimal solutions. When a new A380 airplane performed the first flight, the employees have shared their impressions and experience in order to facilitate the work with the new airliner through Yammer (Microsoft, 2013). Communication processes are facilitated by a number of tools. The briefings headed by the chief executive are aimed at discussions with the department managers and delivering discussion outcomes to the employees through these managers (British Airways, 2007). BA annually holds a business fair for 5500 participants, the fair includes presentation stalls dedicated to various business issues and has experienced TV presenters to deliver the presentations (Jones, 1996). After the presentations another session is organised to allow the participants ask the chief executive and several directors any questions (Jones, 1996). Another innovative approach that allows sharing knowledge is the company's private television – BATV which broadcasts to all the destinations of BA (Jones, 1996). The programmes include the business fair sessions to increase the awareness of those staff members that could not attend the fair (Jones, 1996). Television allows reporting even negative issues in a more neutral way (Jones, 1996).



### 3.3 Knowledge Management for Strategic Planning

After 2001, the company had to address long-term issues and formulate solutions for the future. The chief economist of BA proposed to use scenario planning with the application of rich picture technique, selecting eight experts among employees from the whole company to form a 'Halo Group'. After interviewing forty managers, the experts identified and grouped three sets of the most essential issues: main uncertainties, predetermined elements and driving forces. This procedure gave birth to the 'Official Future' plan that reflected BA perspectives for the next decade (Ringland, 1998). Afterwards, the experts focused on predicting events and outcomes; this step was implemented with the use of two techniques: story writing and rich pictures. Story writing is a technique used to transmit values and norms across the organisation, strengthen the sense of trust, spread tacit knowledge and develop emotional connection (Sole and Wilson, 2002). Sharing stories allows transmit tacit knowledge and facilitate innovation, using a more 'humane' transmission of knowledge and emotions. Group storytelling requires one individual create a story and other members of the group that participated in the activity, add their own stories simultaneously or at different times. Two stories were produced by BA's experts, approved by the Chief Economist. While the stories were focused on the company development and governance, supportive numerical data was produced by the analysis of the past data on passenger numbers, economic growth and aircraft related data; basing on this data, future models were produced and gathered into a stories booklet (Ringland, 1998). Technical staff create reports using story telling technique, based on real technical problems. Sharing their individual experience in simple stories makes it easier for pilots to manage complicated situations basing on the analysis published in Flywise.

The rich picture technique was used to build descriptive models of those stories. The rich picture technique is a way of depicting the interrelations between various subjects through pictures and is used to communicate, record or explain information. BA has built several models: the Driving Forces scenario depicted the changes that would occur in future and influence the airline industry (presented in Figure 1); the Governance and Growth scenario (presented in Figure 2) described the situation where "a new generation of leaders" (Ringland, 1988:265) appear and are in between two scenarios: 'wild gardens' and 'new structures'. It was in the last model where the rich picture technique was used. The picture depicted a snake with two heads, where one stood for 'wild gardens' – a scenario where international integration has impeded the construction of new governance structures and the other one 'new structures' – a situation where common values allow the growth in a predictive and manageable way (Ringland, 1998). After the scenarios were discussed in a workshop and valuable ideas were developed, new strategies were defined and compared in a matrix form (Ringland, 1998). The outcome of all these procedures was the generation of strategies for different levels and departments; workshops were used for communicating the detected external issues to the interested parties. The workshops were accessible to all the workers of BA and the participants were instructed to focus on the needs of the customers when discussing the strategies. The results of discussion in each other workshops were grouped together and the common trends and ideas were summarised into a report which was presented to the Managing Director's group (Ringland, 1998). The scenarios helped to align the strategies across different levels of management and communicate them effectively to external stakeholders, such as Trade Unions (Ringland, 1998).

### 3.4 Knowledge Management for Improving Customers` Experience

While rich picture and storytelling enabled BA develop and communicate business strategies within the company, the main goal of these strategies remains customer satisfaction. To build the knowledge of its customers, BA started from managing the customer database that reflected the interactions of BA's passengers. Previously data was stored in separate databases maintained by Oracle, Teradata and IBM (My Customer, 2001) and was processed in four separate outsourced centers with different computer platforms (PR Newswire, 1999). Because the amount of customer data increased by 50%, BA has implemented the 'Ocean Wave' scheme that joined all the data in a single database, implementing a data warehouse powered by Teradata. With this new scheme BA was able to gather data from across the organisation and use it to manage global marketing and customer communications (My Customer, 2004). This solution contributed into the goal of BA to save one billion pounds in the year 2000 (PR Newswire, 1999). BA created the 'Know me' loyalty scheme to build information about online behaviour and purchasing habits. The programme was

implemented with the help of software created by Opera Solutions that enabled the development of offers for loyal clients in case of service failures such as missed flights or lost luggage. Before the ‘Know Me’ programme was introduced it took around nine months to analyse the data whereas due to the Opera Solutions software this time was decreased to three weeks. As a further development of this initiative, BA has provided the flight assistants with iPads that contained information about all customers: their complaints, seat preferences, status of frequent flyers and other available information (CIO2CIO, 2014). However, the company was accused of disruption of privacy as individual information was stored and used by the company to which its representatives responded that the information was being used only for the benefit of the clients. The elimination of such accusations would be possible if BA followed the practice of KLM, that enabled their clients to choose whether they want to share their information by introducing an online consent form (CIO2CIO, 2014). Other type of software installed on the tablets allows improving the speed of technical maintenance of the airplanes. Information and KM significantly improves the safety of the air vehicles through a variety of tools. The Panasonic Toughpad is a tablet that can be used to register technical characteristics of the flight, which is transmitted in real time to engineers and allows them to quickly identify and fix the technical failures of the aircraft. It also has an option of printing out the technical data pages with accurate and up-to-date information; moreover the software records the fuel levels, measures the carbon emissions and creates reports on de-icing the airplanes in low temperatures (Panasonic, 2013).

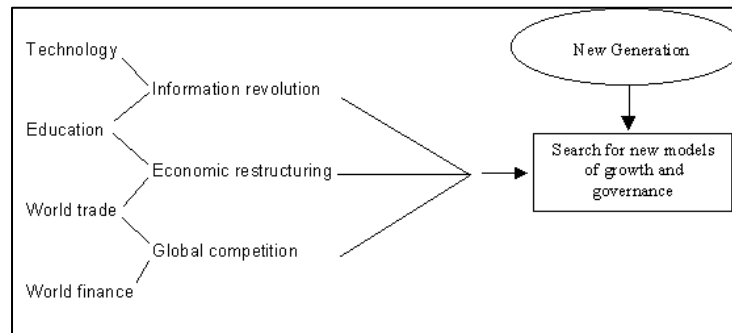


Figure 1. Driving forces scenario

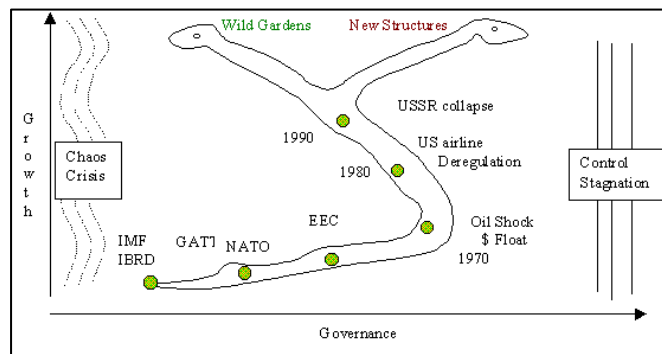


Figure 2. Governance and Growth: two-headed snake scenario

### 3.5 Knowledge Management to Facilitate Operational Research

The last but not the least aspect of KM in British Airways is operational research. Operational research is application of “advanced analytical techniques in order to solve complex problems” (Curtin, 2005:925). These problems include inefficient use of scarce resources or negative outcomes of certain operations. The analytical tools are mathematical models represented by objective function linked to the organisational aims (Curtin, 2005). Because BA practices soft operational research techniques, it is essential to understand what it means. Soft operational research is focused on structuring the problem, allowing the researchers to “identify what particular information and knowledge might be structured in order to manage complex problems” (Yeoman, Sparrow and McGunnigle, 2000: 122). The soft operational research techniques include strategic

choice, soft systems method, cognitive mapping and systems thinking. BA uses soft operational research techniques to increase the passenger revenue yield. In order to do this, operational researchers maintain capacity and information management, support operations, marketing and customers service. The first challenge that these experts confronted was to understand what kind of knowledge is being used in the company and how it is accessed. By assessing the soft operational research procedures, experts have revealed that the method of communicating knowledge was informal negotiation as well as art of persuasion and language. The research held in BA has shown that the company uses soft operational research to create structural models of the problem, simplify communication in the projects and facilitate the discussion of the problem between the consultant and the customer (Yeoman, Sparrow and McGunnigle, 2000). The technique of soft operational research that is mostly used in BA is cognitive mapping. Cognitive mapping is a method of understanding the cognitive process; it describes how individuals percept the space and how these perceptions are reflected and utilised in their spatial behaviour (Kitchin and Freundschuh, 2000).

#### 4. CONCLUSION

BA has developed an effective set of KM initiatives to improve customer service, strategic planning, operational research and internal communication. After analysing how KM is applied in BA, it is possible to make several conclusions regarding KM. First, more emphasis is put on internal communication, which means that the company motivates employees to share their knowledge through such methods as business fair or corporate television and newspaper. Modern technologies are widely used in BA to speed up the technological control and build customer knowledge with the use of software. The strong side of KM in BA is the versatile nature of its initiatives. Although BA has an efficient KM system, a further improvement could be implemented in the area of customer knowledge taking into the account KM practices in other airlines. Though BA sends out customers surveys, they are quite long and have more than twenty questions (Nunwood, 2014) which may demotivate the customers to give any feedback. This could be improved by creating shorter surveys or motivating the customers to complete the survey by various bonuses. This would increase the amount of knowledge about the customers. BA could introduce a system of rewards for those employees who are most active in the communication applications used by the company. BA could also benefit from adopting Singapore Airline's initiative of sharing ideas of non-managerial workers through the 'bottom-up knowledge processes' (Goh, 2007:348). The company has developed a scheme called Staff Ideas Action, which allows frontline employees express their opinion and ideas on how to improve customers' service. Because the company believes that the best ideas cannot be generated under a set of rules or strict control, BA managers motivate its employees to share their knowledge (Goh, 2007). Taking after the Malaysian Airlines, BA could cooperate with other airlines, for instance with Virgin Atlantic, in order to share knowledge and improve customers experience through collective knowledge database. Malaysian Airlines cooperates with other airlines by code-sharing and establishing bilateral relations of knowledge exchange for mutual benefit.

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# BROADBAND USE AND CREATIVE COMMUNITIES IN THE UK

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## ABSTRACT

In the UK, the creative sector is becoming increasingly important for the economy of rural areas, despite the urban bias found in the literature on the creative industries. Digital technologies enabled by broadband access are becoming crucial for creative practice, yet many rural communities in the UK cannot access broadband Internet of at least 2 megabits per second. UK Government is working to resolve this urban-rural digital divide by rolling out improved broadband access across all of the UK. This short paper reports research in Cornwall – a region of the UK which up until recently has suffered from poor or no Internet connectivity. Cornwall is currently undergoing a large-scale rollout of superfast broadband across the entire region. The paper reports on research that sought to understand the role of broadband technologies for rural creative practitioners across the region. We report on findings from in-depth interviews with creative practitioners that reveal a number of interesting insights into broadband use, particularly in relation to social media. The paper concludes with recommendations relating to improving digital support for small-scale creative enterprises in rural regions.

## KEYWORDS

Creative practice; rural; broadband; social media.

## 1. INTRODUCTION

The creative industries are an increasingly important business sector in rural areas of the UK and are seen as a major area of economic growth. Despite this, much of the academic literature on creative practice is biased towards urban geographies (Harvey, Hawkins and Thomas, 2012). This creates an overly urban impression of the creative industries. Yet creative and artistic individuals are often attracted to the beauty and tranquility of rural areas, and many subsequently become part of the economy of such areas (White, 2010). These industries are an important sector in terms of tourism, because their outputs and activities add to the attraction of rural regions as a place to visit. Many rural regions in the UK rely heavily on revenue from tourism as their main economic sector. Creative practices are important to the quality of life of those living in rural areas because they afford expression of identity and social cohesion (Kazana and Kazaklis, 2009; EU Commission, 2009). Digital technologies, particularly applications enabled by broadband are playing an increasingly important role in creative practices (Bell and Jayne, 2010). For the creative industries, the use of websites and social media are favoured channels for self-promotion and networking with potential clients, suppliers and collaborators. The distribution of creative content online is becoming the preferred approach amongst creative practitioners. Unfortunately many rural areas have poor (or no) broadband connectivity – a problem with a number of negative implications for rural communities and the rural economy (Ofcom, 2011; Skerratt and Warren, 2004). This problem is being addressed by the EU Commission who aim to realise broadband for all by 2015, and UK Government who have allocated funds of £530m within the lifetime of the current parliament to roll out broadband to virtually all parts of the UK and provide the best superfast broadband network in Europe (BDUK, 2011). Even where broadband is adequate, rural areas are typified by poor adoption of digital technologies (La Rose et al., 2007). Our research finds that this is true of some rural creative practitioners who as a result miss out on opportunities available to those engaging in online spaces.

In this paper we introduce ‘Cornwall’s Connected Communities and Broadband’ (CornCCoB) and highlight research findings from in-depth qualitative interviews with creative practitioners in a rural region of the UK. The paper adds to a growing body of literature concerning the rural creative industries, in particular contributing new insights into the importance of digital engagement for small-scale creative industries in such areas.

## 2. THE RESEARCH

The CornCCoB project is investigating the role of broadband use for creative practitioners across Cornwall. Cornwall is a largely rural region forming a peninsula in the southwest tip of England, and is historically well known for its artistic landscape. Cornwall remains a hub of creativity (Morel Research, 2008) and is one of the most touristic areas of the UK, a place which both attracts a great number of in-migrants due to its rural idyll whilst at the same time being one of the UK's poorest regions (Bosworth and Willet, 2011). Creative industries are an important part of the region's identity, adding to the vibrancy of Cornwall as a place to visit, boosting revenue from tourism and improving quality of life for those who live there. Creative practice has regenerated some of the poorer areas within Cornwall such as Redruth; a post-industrial town that suffered deprivation following the closure of its mines yet has subsequently experienced redevelopment through creative practice (Harvey et al., 2012). The theoretical framework for the project derives from a body of literature on the concept of social capital (Bourdieu, 1992; Coleman, 1988; Putnam, 1995), particularly in relation to bonding and bridging capital. More recently research has considered the importance of creativity or "making" (Gauntlett, 2011) and its contribution to social capital and sense of community. CornCCoB aims to extend this field of research by addressing the research question: "how does creative practice contribute to the social capital of rural communities, and how might broadband impact on this process?"

### 2.1 Methodology

During the first stage of the project, in-depth qualitative interviews were carried out with 15 rural businesses positioned in the creative industries, representing industries ranging from fine arts, crafts and furniture making to photography and film making, in order to fully explore the potential of broadband to enhance various approaches to creativity. Practitioners derived from a range of backgrounds – some native to the area, although most had in-migrated from other (often more urban) places. For those that had in-migrated, they were mostly seeking a particular quality of life (rural, scenic, relaxed) as is typical throughout Cornwall. Most were professionally trained arts practitioners although some were coming to this as a later-in-life interest with an entrepreneurial element. Many were not able to support themselves economically through their creative practice alone and were performing other work, e.g. teaching art classes. We also spoke with two arts-based community groups in order to investigate the ways in which such creative activities contribute to sense of community and place, and the role that broadband can play in this process. Interviews explored communities of place and interest; use of the Internet in their creative and networking activities; support and training requirements and expectations of superfast broadband.

"Superfast Cornwall" is an initiative to bring superfast broadband to Cornwall and the Isles of Scilly. The programme is funded by the EU, BT and Cornwall Council and is managed by the Cornwall Development Company. 80-90% of communities are being provided with fibre-optic superfast broadband (24Mbps and above). Those premises located beyond the fibre-optic footprint will be provided with broadband of speeds of at least 2Mbps, utilising a range of alternative technologies including satellite. The original goal of CornCCoB was to explore perceptions before and after the use of superfast broadband. However, some of the respondents had already been upgraded to superfast broadband, and some were not sure if they had been upgraded or not. For those with faster broadband, they were largely unable to realise the benefits of the extra capacity (with the exception of the film maker who was able to upload large files much more quickly). Therefore this paper focuses on broadband use generally rather than the benefits of superfast broadband. This observation is important, because it suggests that Cornwall's creative practitioners (and perhaps rural entrepreneurs more generally) do not always know how to exploit the additional bandwidth, and therefore require support and guidance if they are to realise the benefits of enhanced broadband speeds.

### 2.2 Findings and Discussion

In this section we highlight some of the findings from the interviews. Overall we found that all creative practitioners were using the web to some extent for their work. At the most basic this was communication via email, with one or two respondents expressing a lack of skill or confidence in using online tools beyond this. Those with less digital skill or confidence were generally older. Not all respondents had a website – some had tried to design their own, reporting varying levels of success. Others had invested in their web presence

by commissioning a web designer in the role. Other important uses of the web included meetings with collaborators and clients via Skype, blogging and social media. Given the project interest in community and networking, much of the discussion focused on online social networking, again with varying degrees of engagement.

Cornwall has a thriving and vibrant arts scene and community, which most of the respondents enjoy for the most part, having friends with shared interests and gaining a great deal of local support in their professional activities. Yet some feel this is over-saturated and it is therefore hard to make a living as an artist: *“shake a tree and a bunch of artists will fall out!”*. This suggests that being immersed in a region that is rich with artistic activity and creative industries, whilst on one level increasing social capital through shared points of interest across and within communities, can also be detrimental to the economic viability of those trying to make a living in this sector.

Despite a strong sense of community (both of place and interest) for most, many find being an artist in Cornwall isolating. The extent to which this is characteristic of on the one hand being an artist, or on the other running a business in a rural area is not yet clear (Dinis, 2006). This gives added meaning to online communication – those already using it confidently felt it was helpful in reducing this feeling of isolation: *“living down here, it’s a little bit away from things anyway, and I suppose that’s where the technology comes in isn’t it, it’s made it all a little bit smaller”*. The web connects them to a wider professional network and provides them with peer review/critique and support, up to date information and access to opportunities (such as exhibiting in local exhibitions that they may not have otherwise heard about) or potential collaborations. It is also useful in accessing a wider audience, some of which are potential clients: *“It’s a way of getting work in front of somebody”*. Two respondents have developed a theatrical company (interviewed together) in which they engage with their audience during performances via Twitter: *“[we are] sending out Twitter feeds through social media throughout the experience from our characters, to other characters, to the audience. And then the audience themselves send messages to each other.... They have specific tasks that they have to impart.”*

Social media, particularly Twitter and Facebook is useful for raising one’s profile, selling work and raising levels of confidence in one’s work: *“A piece which went up on the Facebook page. And people were liking it! And I was sort of – whoa! People who I didn’t know, who I’d never heard of”*. Given that some rural communities may focus on strong ties and resultantly become insulated from outside opportunities (Grannoveter, 1973; Gilbert, Karahalios and Sandvig, 2008), the role of social media may be particularly relevant to such communities in building bridging social capital: *“it [social media] has the potential to be the bridge for us down here”*.

Feelings towards social media tools vary greatly. Some find it an essential part of their working practice: *“if you don’t do it, you’re invisible”*. Others find it hard to extract meaningful information from the chaos (such as one respondent with dyslexia who struggles with a *“sea of text”*), or find it a meaningless form of social interaction. Others feel pressured to be on social media sites such as Facebook by peers. It’s not for them, yet they feel they are excluding themselves from something big. For most the web is a learning curve that they feel they need support with, particularly in terms of social media strategies, web design, or online engagement with (and beyond) Facebook and Twitter. Facebook and Twitter emerged as the most central social media tools that respondents feel they “should” be engaging with, yet some are held back because they feel there is etiquette associated with professional use of these tools, raising questions along the lines of “how often should I post an update?” and “how personal should I make my tone of voice?” Regardless of skill level, almost all participants stated a desire for more information and even support and training in social media use, as well as suggesting that it may be useful to speak with peers in the creative industries to understand how others approach it.

### 3. CONCLUSION

The findings reported in this paper show a range of approaches to the use of broadband amongst creative practitioners in Cornwall. Perhaps because the research is concerned with how broadband can enhance social capital amongst creative communities, the majority of findings from the interviews are focused on social media use. Some are skilled and confident with such tools and use them to their benefit; others either lack skill and confidence, or do not consider them relevant or appropriate to their work. Respondents invariably

gravitated towards discussion in this area. This acts as both an advantage of our work (uncovering and focusing on a particularly important area within the creative industries) and as a limitation (other relevant areas were not similarly interrogated). Future work might focus attention on other important areas of broadband use such as web design and collaborative online production (e.g. in terms of music and film making). Given that findings from the interviews overwhelmingly point to the need for training and support with social media, the next stage of the research comprises workshops which will both provide training and support in social media tailored to the arts, and encourage brainstorming sessions in small groups, mixing academics with creative practitioners to further understand the nuances of social media use in the creative industries.

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# UNDERSTANDING HOW MOBILE HEALTH INFORMATION SYSTEM COULD BE USED TO IMPROVE HIV AND WELLNESS TESTING

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## ABSTRACT

Mobile health (mHealth) platforms offer a promising solution to some of the more important problems facing the current healthcare system. This paper examines some of the key challenges facing mHealth with a focus on how mobile Health Information System could be used to improve HIV and wellness testing. We considered the potential and current uses of mobile phones and tablets for HIV and Wellness testing. Mobile Health can bring health prevention and promotion to the general population. One of a South African healthcare organisation that deals with HIV/AIDS and other chronic diseases was used. Data was collected and analysed using the Innovation-Decision Process conceptual model.

## KEYWORDS

Mobile Health (mHealth), Information Systems, Healthcare, HIV, Wellness

## 1. INTRODUCTION

Since the discovery of the epidemic Human immunodeficiency virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS) collaborative forces, while valiantly attempting to find a cure, have focused their attention upon preventing transmission of HIV (CDC, 2003). Currently most of the healthcare organisations use paper-based systems to carry out HIV and wellness testing. This causes delays, as the data have to be manually captured on the forms at the different testing centres. The captured paper forms, then need to be send to the headquarters where it needs to be manually captured once more in the healthcare decision support system.

This tedious process can cause the paper forms to get lost or misplaced during transport to the headquarters. The process of manually capturing and the delaying of the paper based forms, causes data not to be available in real-time. This further causes statistical data to be skewed, and most importantly patients are not getting timely follow up from a specialist. . Some patient deaths could be as a result of this delay, as they do not get timely assistance. The objective of the study is to examine how the use of mobile devices improves the process of providing HIV and wellness testing feedback to patients. In achieving this objective, human interactions were examined.

## 2. LITERATURE REVIEW

For the purpose of this study literature around mHealth and information systems were reviewed. According to Carey at el, (2004) HIV and wellness Human interaction is a fundamental aspect and an integral part of every organisation. The purpose of human interaction is to ensure functionality and usability of an organisational system, as it relates to user friendliness. Organisations can have both technical and non-technical interactions. Non-technical interaction could refer to interaction that does not involve any form equipment, hardware or software, whereas interaction with a technical system, such as with computers, can be referred to as human-computer-interaction (HCI) (Stupak, 2009). Thus, enhancing computer usability and receptiveness of the user's needs is indicated to improve interactions between users and computers (Jacko, 2012).The legacy paper based data capturing system currently being employed to manage and deliver patient care has become a hindrance in delivering timely care to patients. Qin and Liu (2011) confirmed that with the

advancement in IT, more and more medical devices or equipment are controlled, operated or managed by computers. Therefore medical data becomes easier to be collected, processed and transported. Healthcare organisations are the central sources of where information is gathered from patients and entered into a data capturing system for processing and analysing of this data. Sepulveda and Young (2013) emphasized that this organisations are the purveyors of information, in the form of laboratory results, which may be numbers, text, graphs, or images, together with interpretive data, to assist health care providers in delivering optimal patient care. This data is captured and highly desirable since it can be used to assist the decision makers to make informed decisions and provide adequate data to the respective team members to assist in saving patient lives.

In order to improve on the current data capturing system it has become important to note and understand the current environment we are finding ourselves in. According to Musa, Yusuf and Meckel (2012), in order to address this issues the necessary technology platform that would allow hospital assets, personnel and patients to be tracked in real-time for the purpose of optimising operations in all aspects of the daily activities of the hospitals. This is paramount as technology has become integral in the daily lives of patients and this needs to be harnessed in order to provide optimised patient care.

Successful implementation of mHealth makes the right information available at the place, at the right time, and in the correct form. According to United Healthcare (Company, 2011) Wellness testing is a screening tool to help you and your health care provider determines your health status. The results along with your health history and physical examination are needed to make an accurate health assessment.

### **3. RESEARCH METHODOLOGY**

Based on the study' objective a qualitative method and the case study approach were adopted for this article. The analysis of data was done using a conceptual model. A qualitative study is defined by Hill (2006) as "methods that allow us to gain an insider's point of view of behaviors, experiences, attitudes, opinions, values, motives, feelings, and knowledge.

The semi structured interviews were conducted with groups of doctors. There were nine groups, and there were four doctors in each of the groups. The workshop consisted of nurses from different areas of specialisation. The workshop lasted for five working days. The data which were collected from both doctors and nurses were combined for the purposes of this study. The data collection focused on how mobile application could be used to provide services to the communities.

A conceptual model "Innovation-decision process" from the perspective of the DoI theory was employed in the data analysis. In DoI theory, technological Innovation is communicated through particular channels, over time, among the members of a social system (Nemutanzhela and Iyamu, 2011). The theory is concerned with the manner in which a new technological idea, artifact or technique, or a new use of an old one, migrates from creation to use. The diffusion of innovations is important because it is relatively hard to invent (or develop) many kinds of useful knowledge. Complex techniques are combinations of many skills, and develop over a long period of time. It is usually difficult to invent all the requisite parts in the right order, foresee the advantage of nascent new technology, (Rogers, 2003).

### **4. DATA ANALYSIS**

The data was analyzed to get a better understanding on how mHealth information systems could be used to improve the process of HIV and wellness testing in the communities of South Africa. Even though the data was combined, they are labeled according to the sources, DocGroup and NurGroup, for doctors and nurses, respectively. Using the Innovation-Decision Process conceptual model (Rogers, 2003), the analysis of the data is presented as follows:

Communication Channels

#### **Knowledge**

Knowledge on the privacy and use of mHealth is required. However due to the fact that many healthcare organisations are already using different types of mHealth information systems it becomes easy to communicate this knowledge. With the growth of technology usage around the world, the knowledge and

training required for the devices used becomes less costing as most people are familiar with the use of cellphones and tablets.

The use of this technology in the field of health and wellness is known as pervasive healthcare. Mobile computing describes a new class of mobile computing devices which are becoming omnipresent in everyday life. Handhelds, phones and manifold embedded systems make information access easily available for everyone from anywhere at any time. The goal of mHealth care is to provide health care services to anyone at any time, overcoming the constraints of place, time and character. According to DocGroup in South Africa “the nurses are more knowledgeable on the use of mobile devices (Tablets and Phones) which made it easier for them to translate the knowledge of using these technologies.

#### **Persuasion**

According to DocGroup “*Without comprehensive security safeguards to protect patient privacy, the transition to electronic medical records systems may well fail. Patients must believe that use of health information technology is in their best interest and buy into the mammoth effort to transform the practice of medicine through digitization*”. Any well-publicised privacy leaks could erode patient trust in computerised systems and create political backlash against them, especially if the breaches cause discernable harm, such as embarrassment, loss of employment opportunities, or damage to reputation. Fear of such consequences may cause individuals to forego needed medical care or not to be fully candid with Clinicians who treat them.

In general a very positive perception of mobile technology devices by doctors was evident even though half of them had never come into contact with one before. They perceived the device as a reference tool, patient information tool and even contemplated its use as a decision support tool that could help in diagnosis and medication prescription. However, NuGroup said that “*It also usually improves the medical outcome that can be achieved. As with other industries, a better product sometimes carries a higher, but justifiable, cost*”.

#### **Decision**

When dealing with sensitive data that has an HIV status of patients certain measures should be taken to help prevent loss or theft in the first place. Devices should be stored securely if not in use for example. GPS activation can be utilized to monitor device location. Consequences should be established for the hospital employee if the device is lost. An education program with reminders should be put in place to educate employees about keeping their devices safe. In the event of loss or theft, there should be a feature on the device that allows the hospital tech department too remotely (selectively) wipe the data off of the device. According Nugroup, “*study conducted showed that it will cost a lot to actually make sure that the electronic medical record system is functioning properly without any use of paper*”. However, if this process can be fully functional lot of benefits will be achieved, and risk of data being accessed by wrong people will be reduced.

#### **Implementation**

Lack of resources to support their use of these devices by the hospitals did not negatively influence their intention to adopt. This could be attributed to the social circumstances South African doctors find themselves in, where they have learnt to cope with limited resources on a daily basis. Despite their extremely pressurised work environments, and poor hospital management and administration, patient care is uppermost in their minds. According to DocGroup “*we are willing to use our personal mobile phones and tablets to initiate this project*”. These groups were persuaded and were willing to give this innovation a go.

While the patient’s adoption of mHealth technology has been rapidly trending upward, physicians and healthcare systems are often not yet equipped to use and/or disseminate the mHealth data obtained by their patients and vice versa. Over time through additional innovation, adoption of required skills, and acceptance, mobile healthcare technology as a medium for receiving one’s health data will become as much a part of everyday patient healthcare as picking up the phone and/or driving to their healthcare provider for treatment. According to NuGroup, “*Our Patients will appreciate the use of this new technology more especially those who use to wonder where we take those papers that have their details, some will resist at first because of fear to change.*”

#### **Confirmation**

The development of mobile medical applications has opened new and innovative ways for technology to improve health and healthcare for all consumers. The large adoption rate from consumers of smartphone mobile medical apps is one example of their willingness to embrace this newer method of receiving and delivery of medical care.

## 5. FINDINGS

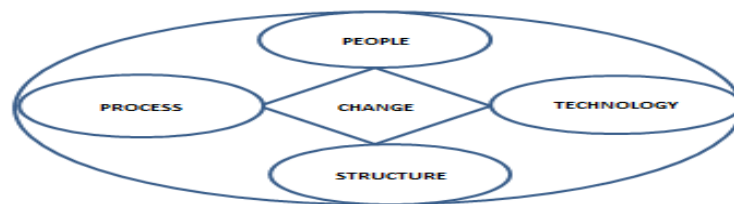


Figure 1. Change method of receiving and delivery medical care

### Change

Change is inevitable. Hence, regardless of user's perspective on the mHealth system, influenced by privacy or whatsoever, change will always happen and does result into new challenges. The mHealth system is a new age eradication option and it needs to be effectively communicated to end users and embraced by all stakeholders. Change champions have always existed in organizations and have been responsible for most of the significant changes that succeed. While there may not have been a formal name to describe this important role or training to prepare people for this role, the fact is that change is rarely accomplished without someone championing it.

When initiating change it is important to involve key stakeholders and build commitment to changes. Key stakeholders are people who are in the best position to influence or contribute to the success of the desired change. Their involvement is critical to designing and implementing successful changes and the need to build and rebuild or buy in and commitment to change is something for which change champions must be constantly aware.

### Technology

Technology has largely influenced every aspect of living. It has made life easy but as well with concerns that can cause change in how people live, work and in organization productivity. The use of technology does impact the productivity of a system. Mobile technologies offer the ability to connect patients with their doctors, care-givers and loved ones and enable timely health monitoring which suggests improved patient engagement and better health outcomes. Mobile technology can aid in providing access to information, helping to lower costs, facilitating remote care and increasing efficiencies by connecting patients to their providers virtually anywhere. Though there's a cost concern on system acquiring, the Nurses are well pleased with the main objectives of the system.

For this study advantages of technology include better accessibility of data. Due to increased number of people infected with HIV in South Africa and need for wellness testing each and every time; a technology plays an important role in achieving this. HIV and wellness testing using technology (mobile phone or tablets) is faster as well as more accurate in business results and solutions through technology. Technology has also enabled the automation of manual work thus saving time and money. Patients are now getting scripts authorization via sms that they use to go to the nearest pharmacy to collect drugs.

### People

People played an important role in this study. Nurses, Doctors and Patients were identified as key participants for the study because they were the ones utilising the innovation. Nurses are the ones using the devices (Tablet or Phone) for testing. Doctors relies on the information from the devices to be able to do follow ups and give prescriptions. Patients are at the receiving end of patient service delivery. The patients are the ones that are tested; hence they provide their demographics and blood samples to the healthcare practitioners (Nurses and Doctors) for processing and feedback on the results.

### Structure and Process

The use of mHealth information system is indicated to be used at the organisations understudy. Nurses and doctors use the specified system to carry out their duties. Benefits are realised as a result and some of these benefits are reduced training costs and enhanced healthcare services. Lower training costs because the Nurses and doctors at the organisations are already familiar or knowledgeable about the use of mobile devices (Tablets and Phones). Hence no lengthy workshops or training was found to be necessary. Enhanced service delivery because information about patients tests are immediately captured on the system using the mobile device, this information is than immediately available to the testing centre. Once the results are

available the patient is contacted for an appointment depending on the outcome of the test. The patient is scheduled or booked to see the nearest clinic or HIV/AIDS consulting centre within the region or based on the patients' geographical location. Follow up reminders are consequently send via the mobile device prior to the appointment of the patient.

With the paper based system, when test are done for patients, it is manually recorded on a file. This file is transferred via transport to a specified healthcare or clinic. Some files as a result get lost and never make it to the testing centre. The file or files that do reach the testing centre are re-captured on the computerised system which is indicated to be time consuming.

## 6. CONCLUSION

HIV/AIDS is a big public health challenge in South Africa. The delivery of Antiretroviral Treatment (ART) is a key component of the government's strategy to reduce HIV/AIDS-related morbidity and mortality, which can be compromised due to ineffective records management. But through 3G wireless technology, reductions in the administrative burden on healthcare workers and improvements in patient care could be achieved by strengthening pharmaceutical management systems for ART.

The objective of the study was to provide a mechanism that can be used to improve the process of providing feedback to patients. In achieving this aim human interactions were examined. Key stakeholders were found to play a role in the interactions of people with the mHealth information system, namely technology, people, structure and processes all of these entities go through a form of change. Mobile devices such as Tablets and Phones are indicated to improve the patient feedback process in HIV and wellness testing. Faster feedback to patients is realised as a benefit because the testing is done and immediately captured on the mobile device which is immediately available or send through to the testing centre for test processing and feedback.

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# CENTRALISATION OF HEALTHCARE SYSTEMS IN NAMIBIA USING INFORMATION TECHNOLOGY

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## ABSTRACT

Healthcare systems in Namibia are characterised as slow and incompetent by their users. Acquisitions of data have gone from difficult to impossible as hospitals struggle with none centralised systems. Centralisation is required as a strategy for coordination of data in healthcare systems. Centralisation efforts in organisations are facilitated through information technology (IT). IT supports and enables automation of business activities and processes. Also it enable organisations to deliver their products and services efficiently on time, thus IT has become a necessity in every organisational endeavour. The lack of a centralised healthcare system can have negative impacts on the health of individuals and the society at large. This will result in cases such as the delay of treatments, mismanagement of patient's data and duplication of efforts in hospitals. The lives of people are at stake thus this study aims to discuss the need of having a centralised healthcare system in Namibia using IT.

## KEYWORDS

Information Technology, Centralisation, Patient Data.

## 1. INTRODUCTION

Every organisation depends on data to make informed decisions. However, most organisations often fail to manage their data, including healthcare organisations. Data is often found in an unorganised and dispersed manner making accessibility and retrieval difficult. Namibia faces a number of challenges in healthcare which could be attributed to lack of a centralised healthcare information system (Williams et al., 2012). Some of these challenges are a reliance on paper based patient hospital passports and files that are prone to getting lost or to wear and tear. Considerable overlaps of activities are additional challenges. However with the use of Information Technology (IT), patient data can be managed from a centralised healthcare system (Hatami & Mosleh, 2010). IT is indicated to support and enable information flow and patient data access within healthcare (Hersh, 2009). By implementing a centralised healthcare system all patient data that is in one environment are aggregated making it efficient for retrieval (Hatami & Mosleh, 2010). Thus centralisation of data allows for uniformity and reduction in duplication of medical data. The purpose of this paper is to investigate the impact of a centralised healthcare system using IT in the Namibian healthcare environment. The following research questions were employed for the study, 1) What are the challenges of having patient data dispersed? 2) How will a centralised healthcare system be beneficial? 3) How will patients use Information Technology to interact with a centralised healthcare system?

## 2. BODY OF PAPER

### 2.1 Literature Review

#### Information Technology

The composition of different devices such as peripherals, hardware and software amongst others makes up information technology, used for business related practices (Farquharson, 2009). Experiential studies indicate enhanced outcomes, that relates to production and value output that information technology (IT) brings to an

organisation (Wimble, 2012). However Wimble (2012) argues that the use of IT in healthcare is deemed to be unclear as it relates to the impact thereof. Nonetheless, healthcare systems can be centralised in order to provide centrally stored patient data to both health professionals and patients for improved healthcare services. To achieve interoperability between two or more disparate systems has been both a strong desire and difficult challenge to information professionals ever since viable technological innovations according to (Kumar, Rao, & Govardhan, 2010). Huskey (2009) indicates that the use of IT in healthcare for optimised information security and reduced administrative costs is an essential need. The enormous volume of patient data being conveyed to hospitals and the complexity of information to be managed, make IT essential for healthcare system centralisation.

### **Centralisation**

Centralisation can be defined as “the process by which the activities of an organization, particularly those regarding planning and decision making become concentrated within a particular location and/or group” (Hatami & Mosleh, 2010). Borriello et al. (2007) states that centralisation has a goal of managing resources from a single point. It refers to the allocation of all IT resources to one particular business unit that provides IT services to the whole organisation (Beck, 2010). A centralised healthcare system is adopted to integrate the patient data. A well-planned centralised system holds data used across the organisation in one place, allowing all staff to access it. This makes it both faster and easier to undertake organisation-wide activities. The centralised healthcare system will have the aggregated information of all regional hospitals and acts as a single representative or point of access to patient data (Yang & Pardo, 2011).

### **Patient data**

Patient data include information about diagnoses and operations, age group, gender, ethnicity, date of admission and discharge, the patient’s treatment and where they live (Lillrant et al., 2009). According to Lenz and Reichert (2007) patient data is collected during a patient’s time at hospital and is submitted to allow hospitals to be paid for the care they deliver. Additionally patient data security is a vital factor within the healthcare system. Behnam and Badreddin (2013) emphasized that if patient information is not encrypted, it is not protected, meaning patient data is not secure and cannot be easily transferred among doctors, insurance providers and other health entities. Behnam and Badreddin (2013) further stressed that patient data records are not securely protected because healthcare organisations rely on the security of the third party systems which can be easily susceptible to both negligent and malicious attacks. The current system in Namibia is still mainly a paper-based healthcare system, which can be time consuming and expensive. According to Constantinescu et al. (2009) having an established hospital information system can help to democratise health data management and widening its availability, he further stated that it is essential that data is delivered in a timely-context manner.

## **2.2 Methodology**

Based on the research questions of the study, a qualitative research methodology was adopted. The primary rationale for selecting this method is that it allowed the researcher to examine and study a case in its natural setting. According to Bernard and Ryan (2010) a qualitative method of research allows the interaction between the researcher and the participants, which help to gain deeper understanding of the phenomena.

A case study was used as the research design. A case study approach allows a specific entity to be examined. According to Yin (2008), “a case study research method is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used”. Windhoek Central hospital in Namibia was used as a case. The hospital is known to be a referral hospital and it was primarily selected because at the time of the study it was the only hospital in Namibia that had implemented and was using a health information system.

Data was collected by means of a documentation technique. Silverman (2011) adduces that documents are social facts in that they are produced, shared and used in a socially organised way. The author further argues that the researcher has to approach documents for what they are and what they are used to accomplish. The documents reviewed were published between 2009 and 2013. The year range was motivated by the use of recent and relevant documents.

## 2.3 Data Analysis and Discussions

The interpretive technique was used in the analysis of the data. Myers and Avison (2007) reasoned that interpretive research in information systems are aimed at understanding the phenomena through the meanings that people assign to them. The technique helped to have a better and deeper understanding of the qualitative data collected. The analysis was carried out using the research questions as follow.

### 1. What are the challenges of having patient data dispersed?

Patient data is a crucial asset of healthcare delivery. Its overall management shapes the delivery of medical care. There are various factors that could affect patient data when it is dispersed. Data duplication, data inconsistency and out dated information are but a few of those factors. The following three areas were looked at to describe the challenges of having dispersed data in the Namibian healthcare system.

**Storage:** There are two different modes of storage within the Namibian healthcare system, the electronic and the traditional paper based or non-electronic storage mode. However the dominant mode of storage is the non-electronic mode, in which patient data is recorded on files and these files are physically stored in filing cabinets. This produces a major obstacle in providing centralised and country wide access to patient data. There is however developments of an electronic system that can store patient data, a case of a public hospital in Windhoek. However this system poses an integration challenge that would allow for national access by the appropriate stakeholders.

**Retrieval:** Due to the non-electronic and dispersed mode of operation, patient data retrieval could be a tedious process, in that the healthcares heavily rely on patient passports for patient information. At times when archived patient data is required, the responsible medical personnel have to trace the required file literally record by record, file by file and cabinet by cabinet. This practice could prove to be time consuming and strenuous.

**Accessibility:** Data is manually accessible from different healthcare locations physically. In other words when a medical professional wants to access patient data contained at a different location, he/she have to physically go to the location or telephonically request for the information. Additionally, patients that lose their health passport have no other means of accessing their medical history.

### 2. How will a centralised healthcare system be beneficial?

Johnson (2011) explains that it is hard to underestimate the importance of healthcare information technologies once they become embedded within the everyday working practices of clinical staff. Centralisation helps to ensure that patient data is available wherever they are required at different points of care. Therefore various benefits are indicated when adopting a centralised system. The below explores these benefits.

**Rapid information sharing:** Users don't have to keep waiting for information to be found and collected from different locations. With a centralised healthcare system information is accessible from the point it is made available at any point of consultation or portal.

**Reduced paperwork:** A centralised system reduces paper work as patient data will be stored on electronic records. Thus this reduces time spend by healthcare professionals filling in lengthy paper forms which in most cases are always left incomplete.

**Reduced duplicated tests:** Doctors sometimes order tests that you've had before simply because they do not have easy access to prior test results. If all your test results are recorded in a centralised healthcare system by electronic records then a health care provider can see your prior test results that are available and order only truly necessary tests and procedures, saving time, money, and discomfort while reducing risk.

**Secure access to information:** All users access the healthcare system according to their profiles and user passwords; these enable users to see only information linked to their roles. Data is most regularly backed up; in the event of natural disaster or other tragedy the hospitals will rely on the backed up data. Furthermore with proper investment in security technology and procedures, this central healthcare system can be adequately protected against compromises to confidentiality, integrity and privacy.

### 3. How will patients use Information Technology to interact with a centralised healthcare system?

With the centralised system, patients could also be more actively involved with the healthcare system. They will have much more information and control and will interact with the healthcare system outside of visits. All this will be facilitated by IT. Patients will access the system through websites that allow them to interact with the healthcare system. This accessibility is made possible by integrated networks within healthcare



organisations. The use of patient portals enables patients to schedule appointments, ask questions regarding their health, view test results and order prescription refills. Patient portals may also be used to discuss health issues that do not necessarily require office visits.

## 2.4 Findings

Centralisation of the Namibian healthcare system is not realised, thus hindering the flow of patient information between different healthcare organisations. Patient data is found to be relevant for use only to a specific healthcare that a patient visit and this information cannot be shared with other healthcares, as there is no central database or portal that patient information can be send to for access by health professionals and patients across the nation. Furthermore patient data is primarily stored in physical files, disadvantaging the need for centralisation. Due to the non-electronic nature of storage, the ability to retrieve patient information is shown to be a time consuming task, as the retrieval process consist of seeking the files manually. There are however benefits indicated with centralising the healthcare system, such as faster information sharing, reduced paper work and secure access to information. The findings obtained from our analysis and discussions are further depicted in Figure 1. The diagram depicts three main areas namely a, 1) non centralised system, 2) centralised system using IT and 3) benefits of a centralised system, and is discussed below.

### 2.4.1 Figure 1

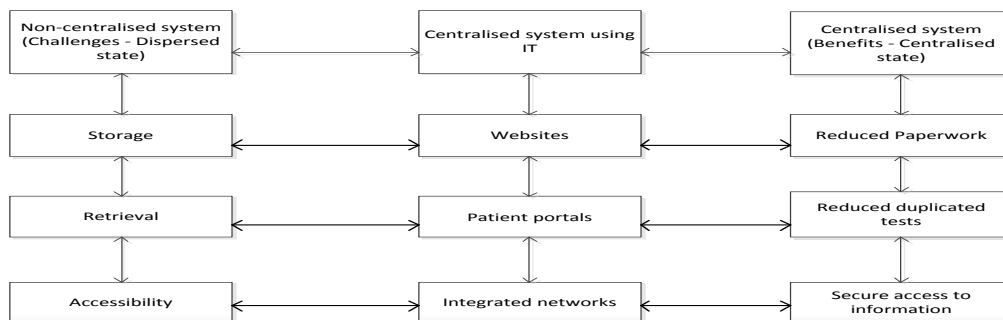


Figure 1. Non-centralised vs centralised healthcare system

**Non-centralised system:** The non-centralised system is faced with several challenges as discovered in the data analysis and findings. These challenges are outlined as storage, retrieval and accessibility of patient data. The predominant use of the traditional paper based storage poses an obstruction in the need for centralisation and centralised access, retrieval and storage of patient data. The dispersed state of patient data is confined to the boundaries of a healthcare making data retrieval and accessibility from another location challenging or impossible. Thus the need for centralisation by using information technology is identified and discussed below.

**Centralised system using IT:** A Centralised system using IT enables and support organisational processes and activities. Centralised systems provide patients with access to their confidential records anywhere, anytime through the use of IT technologies such as websites patient portals and integrated networks. Websites and patient portals can be accessed by any patient from anywhere through authentication of the patients. Patient portals enable patients to have personalised access to their individual medical records. For example to confirm if a set of x-ray scan results are available, a patient can access his or her patient portal. Integrated networks enable patients and medical staff to access data stored on different systems in different locations. Having a centralised healthcare system thus provide benefits to both patients and medical personnel and these benefits are herewith discussed as follow.

**Benefits of a centralised healthcare system:** Benefits such as reduced paperwork and duplicated test as well as secure information are recognised. With the automation of processes and activities, a centralised healthcare system will reduce paper work across the hospitals. The system can improve the facilitation of information to patients, in empowering patients and medical practitioners with the necessary data to make informed decisions and improve treatment of patients. Such efforts reduce the duplications of patient's tests conducted by medical officials as a result of missing data concerning the tests.

### 3. CONCLUSION

The Namibian healthcare system experiences challenges with regards to centralisation of patient data. The challenges impact significantly the flow of information between different healthcares which could affect the healthcare service delivery. This paper studied how the centralisation of the healthcare system using IT can be a solution to challenges experienced both by medical professionals and patients as it relates to patient data.

IT offers capabilities that support and manage data from a centralised environment enabling centralised decision making during patient encounters and universal access to information in real time. Thus a centralised healthcare system can provide an opportunity for integration of patient information, improved efficiency and quality of care across a wide range of patient populations.

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# INVESTIGATING THE IMPACT OF INTEGRATION MOOCS INTO SAUDI WOMEN'S HIGHER EDUCATION

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## ABSTRACT

Massive Open Online Courses are online courses most often taught by leading universities with the promise of providing free, high quality education to an unlimited number of learners. MOOCs also offer a new opportunity for blended course design, so instructors can integrate campus course components and activities with a MOOC. This kind of blended learning will help 'face-to-face' instructors to utilize lecture time for meaningful discussion, identifying and clarifying misconceptions or mentoring students on a group project. The paper presents an initial study of the context of Saudi Arabian education, the emerging MOOC landscape and proposals for a future study. The proposed study will examine the impact of integrating MOOC elements into taught courses within Saudi women's higher education. There are a number of strong reasons for studying Saudi Arabian context. The Saudi higher education system is gender-segregated, so men and women are taught separately. Information communication technology has long been utilized in Saudi women's universities to offer a remote interaction between female students and male lecturers. However, while video conferencing, CCTV or use of an online learning platform can provide remote access to lectures, they fail to provide the richer learning experiences Saudi women desire. Participation in MOOCs may be able to enhance the interaction and achieve a high level of participation to secure an overall learning experience. Evaluation of these outcomes may be generalizable to other similar contexts especially in less developed countries.

## KEYWORDS

MOOC, blended learning, blended MOOC, Higher Education, Saudi Arabia.

## 1. INTRODUCTION

Technology is becoming increasingly important to improve education in traditional and online settings especially in developing countries, like Saudi Arabia, where the challenges are difficult. The current study will use Saudi Arabian female higher education system as a laboratory context. The Kingdom of Saudi Arabia is one of the largest countries in the Middle East with more than 25 government universities. Saudi educational institutions of women are facing many problems:

- The increasing number of female students. For example, there were 283,000 students in the women's universities and colleges in 2005 compared to 444,000 in 2013.
- Schools and universities are gender-segregated; women are taught in separate domains where men cannot see them. There is no direct interaction between female and male students; women are taught by female staff, although in some cases women may view lecture by men through CCTV.
- Saudi women's higher education has insufficient well-qualified instructors (Al-Rasheed, 2014).

The aim of this study is to make a contribution towards improving the performance and competence of the female institutions of higher education in the Kingdom of Saudi Arabia. It is concerned with the impact of contextualized Massive Open Online Courses into Higher Education in Saudi Arabia, and the effects of this approach on the student's outcome and engagement.

Massive Open Online Courses (MOOCs) are online courses typically taught by elite universities with the promise of providing free, high-quality education to an unlimited number of learners (Johnson, Becker, & Cummins, 2013; UK, 2013). A major proposition is that MOOCs can provide educational access as they allow learners to enrol on a huge scale on courses offered by leading faculty and well-qualified instructors (Educause, 2012).

A recent development in MOOCs has been allowing the integration of online courses and college courses in the form of blended learning, which will help to make the most of classroom time for hands-on activities and group discussions (Chen, 2013). MOOCs have also made use of social networking tools that stimulate interaction between learners. The collaborative and learning spaces of MOOCs can extend across multiple social networks and online resources. For instance, MOOC learners may use their own blog space and/or microblogging service to reflect on what they have learned on a MOOC course and to express themselves (Liyaganawardena, Adams, & Ann Williams, 2013).

It may be that MOOCs may be able to help to fill the gap caused by the inadequate number of qualified instructors in Saudi Arabia. They may be able to enrich Saudi higher education and enhance the quality of student-teacher and student-student interaction, regardless of gender. The author will examine the possibility of Saudi women's higher education being enriched by MOOCs and the potential impact of integrating MOOCs into Saudi women's higher education, as well as teachers' and students' attitudes towards this type of course design. Findings may be generalizable to other developing countries.

## 2. BACKGROUND OF MOOCS

A MOOC, a 'Massive Open Online Course', is a term coined in 2008 by Dave Cormier and Bryan Alexander when they tried to describe an online course (CCK08) taught by George Siemens and Stephen Downes following a number of earlier successful Open Online Courses (OOCs) (Fini et al., 2009). This particular course was freely available to everyone, worldwide while at the same time it was aimed at a group of 24 fee-paying students on-campus. At the end of the course there were around 2,200 registered participants with varying levels of participation and involvement (Downes, 2009; Fini, 2009).

In 2011 Sebastian Thrun and his colleague Peter Norvig offered 'Introduction to Artificial Intelligence' as a free online course through Stanford University, and attracted 160,000 people from 190 countries (Firth, 2011; Rodriguez, 2012). The success of this course led Sebastian to found UDACITY, a commercial start-up that motivates other educational institutions to do the same (Pappano, 2012). Since then a wide range of both studies and platforms has been developed and the phenomenon has been described as 'the educational buzzword of 2012' by Daniel, (2012), reflecting a deep and widespread interest in the MOOC initiative. The New York Times called 2012 'the Year of the MOOC' (Pappano, 2012).

'*Massive*' refers to the number of participants. MOOCs can easily accept hundreds to thousands of learners simultaneously on a course. '*Open*' refers to 'the fact that anyone is free to register... [and that] [t]here are no prerequisites, other than Internet access, and no fees are required' (Bond, 2013). It may also refer to further concepts: open source, open registration, open curricula, open syllabi, open assessment and the open learning environment (Rodriguez, 2012). '*Online*' refers to the use of the Internet and the World Wide Web to deliver course components. '*Course*' refers to a series of lectures, readings or other course materials with schedules and facilitators, all structured and organized around a particular topic (Billington & Fronmueller, 2013; Bond, 2013).

Rodriguez, (2012), in his famous article in European Journal of Open, Distance and E-learning, categorizes MOOCs into two types: connectivist MOOCs (cMOOCs) and cognitive-behaviourist MOOCs (xMOOCs) (with small contributions of social constructivist). They are quite different in terms of their pedagogy. The pedagogical style of cMOOCs is based on networking and connectivism learning theory, such as a CCK08 course, while xMOOCs, (such as AI course) developed by elite US universities, follow a more cognitive-behaviourist approach. Perhaps the delayed reaction from educational institutions to the first experiment is to some extent because of the very recent emergence of xMOOCs (Daniel, 2012).

### 2.1 Blended MOOC

A recent development of MOOCs has been the integration of MOOCs into campus courses in the form of blended learning. Blended MOOCs have some face-to-face class sessions, but part of the course content and activities is offered via a MOOC platform. Recent studies of blended MOOCs, (Billington & Fronmueller, 2013; Bruff, Fisher, Mcewen, & Smith, 2013; Joseph & Nath, 2012; Kelly, 2014), have identified some potential gains (see Table 1)

Table 1. The potential benefits of MOOCs in higher education context

Potential gains (Criteria)	Students/ learners	Hosting institution	MOOC providers
1. Access to relatively high quality educational resources.	√	√	
2. More opportunities to interact with other learners.	√		
3. More flexibility, customization and accessibility.	√		
4. Access to expertise of leading universities.	√	√	
5. Have two instructors with contrasting roles: 'one served as an informative lecturer and the other as an effective facilitator'	√	√	
6. More opportunities for assessments, feedback.	√		
7. Open up space for collaborative and productive class discussion and generating new ideas.	√	√	
8. An opportunity to broaden the cultural understanding of learners.	√		
9. Improve critical literacy through evaluating and analysing large quantities of information.	√		
10. Design and refine local courses.		√	
11. Gain an international reputation and to create new opportunities for more collaboration.			√
12. Enhance retention rate in a MOOC as students may be more commitment to the course.			√

### 2.1.1 Experiences in Blended MOOCs

The following describes some experiments in using blended MOOCs in teaching:

1. Fisher (2013), a lecturer at Vanderbilt University, integrated a Stanford Machine Learning MOOC into his on-campus course in Machine Learning during the autumn of 2012. The course was delivered through Coursera platform and taught by Professor Andrew Ng, Director of the Stanford Artificial Intelligence Lab and co-founder of Coursera. Students' response to this kind of blended course was generally enthusiastic.
2. Martin, (2012), and his 16 students (from the Computer Science Department at the University of Massachusetts, Lowell) used the massive open artificial intelligence (AI) course offered by Stanford University by Sebastian Thrun and Peter Norvig. The course attracted wide publicity and there have been about 160,000 participants since its launch in October 2011. Martin and his students were of the 23,000 students who completed the 10-week course. They met once a week for a 75-minute session, when he used classroom time for hands-on activities and conversations about what they had learned and what they had found confusing or had disagreed with. They found the MOOC's format relaxing and engaging and rated Thrun and Norvig as strong teachers.
3. In late 2013, San Jose State University experimented with hybrid or blended MOOCs. They used an introductory edX MOOC on Circuits and Electronics on campus to enhance student performance. Preliminary findings of the study reveal an improvement in performance improvement. Professor David Parent, a lecturer in an electrical engineering department at SJSU, says the average score on the first mid-term was higher than usual.
4. Tony Hyun Kim integrated MIT's 6.002x on 'Circuits and Electronics' with an on-campus course for a group of 20 students in Ulan Bator, Mongolia. Kim found remarkable results: 12 students received completion certificates and a 15-year-old did very well on the course as one of 320 students worldwide. Kim's hybrid style is known as the 'flipped classroom', where students watch the MOOC content at home and Mr Kim spends lecture time reviewing materials, practising them through labs, discussing and solving any problem.

The proposed study will draw on these examples of good practices and evaluate the impact overall.

## 3. METHODS

The main contribution of the study is to examine the impact of blended MOOCs on the students' outcomes and engagements. The study will use mixed method approach; survey will be conducted as a quantitative approach to evaluate the criteria mentioned above and their impact on students' attitudes and engagements.

As a qualitative approach, an interview with teachers will be held to obtain a deeper understanding of learning environment and students' behaviours. In order to triangulate the data, an experiment will be carried out with first-year undergraduate female students in computer science introductory course in winter 2015 at Imam Mohammed University in Saudi Arabia. Specifically, we will examine the *retention rate* in the course (number of students who will take the final exam with respect to the number of students who register in the course) and the *pass rate* in the course. Student retention is a major objective in Saudi higher education.

In the study, two types of measures will be obtained: 1) an objective measure which will be the final exam mark awarded; and 2) a subjective measure, which will be the student's engagement, obtained from survey. So, our second goal is to study whether there is a relation between the students' attitudes and engagements (the subjective measure) and the final mark awarded (the objective measure). There will be an initial period observing experiences within a local UK MOOC used in a blended format at the University of Southampton. This will inform the study design further.

### 3.1 The Proposed Blended Course Design

The proposed course will have three main phases (see Figure 1).

1. The first phase is '*learning via MOOC*', which has two models of learning: *synchronous learning* (live sessions, webinar) and *self-paced learning* where students watch/read MOOC materials at their own pace, then evaluate their understanding by taking online quizzes on the MOOC platform.
2. '*Face-to-face learning*': students come to class and obtain further materials relating to the MOOC resources. Students have the opportunity to engage in a group discussion or hands-on activity, and to ask questions about the course. Teachers have the time to identify and clarify any misconceptions.
3. '*Online collaborative learning*': students can reflect and share what they learned and discuss it with others through social media. Students would be encouraged to be producers of knowledge.

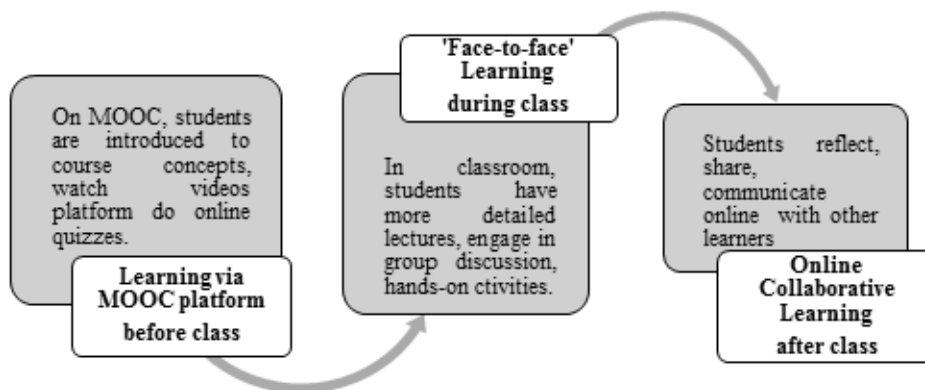


Figure 1. Blended MOOC framework

## 4. DISCUSSION

MOOCs are 'the budding revolution in global online higher education' and have the potential to offer high quality education to the public free of charge (Friedman, 2013). They also offer a new opportunity for blended course design and may be used to build a successful hybrid course (Bruff et al., 2013; Martin, 2012). Instructors can wrap local course components and activities around a MOOC. For example, on-campus students may be asked to participate in a MOOC offered by lecturers at another institution. This kind of blended learning will help 'face-to-face' instructors to utilize lecture time for meaningful discussions, identifying and clarifying any misconceptions or mentoring a group project. Indeed, a 2010 US Department of Education meta-analysis indicates that, in recent experimental and quasi-experimental studies, the blended learning approach has proved more effective than either pure e-learning or traditional face-to-face learning. Online materials must be relevant to work in the classroom and also the converse: face-to-face discussions and activities must draw on online materials (Bruff et al., 2013). Moreover, using MOOCs in a hybrid or

blended format may solve some of the authenticity, certification and assessment issues facing stand-alone MOOCs and may enhance the completion rate of MOOC-takers (Joseph & Nath, 2012).

Saudi Arabia is one of the developing countries in the Middle East. The Saudi education system is gender-segregated, and the majority of women's degrees are in education and teaching, science and the humanities. Recent data shows a lack of female enrolment in scientific and technological fields (AlMunajjed, 2009; Islam, 2014). Not only are there low levels of enrolment of female students in these fields; some, such as engineering and agriculture, remain predominantly male because they have only recently opened a women's section. For example, the first female engineering faculty in government universities opened as recently as late 2012 and has only two disciplines: Electrical Engineering and Industrial Engineering. The other fields of study are restricted, dependent on the university. Women's universities suffer generally from a lack of well-qualified female instructors (Al-Rasheed, 2014) and female students may not receive the same quality of education as their male counterparts because their educators are better trained. For example, more than 18,000 of men teaching at government universities hold doctorates, compared to only 7,000 of women teacher. In response to this disparity, the Ministry of Higher Education has recognized the need to formulate new programmes for teaching in the women's section, and women's universities now tend to hire male instructors to lecture on various courses by means of a television monitor or closed-circuit television (CCTV) (AlMunajjed, 2009). However, lecturing in this way may be distracting instead of useful as it has many drawbacks: 1. Technical problems: This kind of communication technology is not always reliable. There may be an inability to connect with students or the clarity and quality of the audio-visual content may be below par. 2. Connection stability: In the middle of an important part of discussion or instruction, students may be disconnected and may have to wait to be reconnected. 3. There is a certain time delay in audio-visual presentations that leads to difficulty in interacting promptly and efficiently with the lecturer. 4. A video camera cannot capture all parts of the room at the same time, so students may not be able to see the board and the lecturer simultaneously. For these reasons robust teaching and scientific research is inevitably needed in the arena of Saudi women's higher education. Opportunities for cross-disciplinary study and research with other global leading educational institutions, as well as the use of foreign expertise, are not broadly available (AlMunajjed, 2009)..

The early results from blended MOOCs look promising. By introducing experiences above the educational faculty in Saudi Arabia would have the chance to emulate the gains achieved by Martin, (2012) and Fisher (2013). Saudi universities can benefit from the combination of the pedagogical strength of blended learning with the scalability of MOOCs. This kind of blended learning will provide a valuable opportunity to hear a global voice and move beyond the classroom, country and even continent, out into universe of borderless education. Using MOOCs in Saudi women's higher education could be a cost-effective instrument to maintain gender separation and segregation yet exploit high quality learning resources, which in turn, enhance learning outcomes. Alone, CCTV, a TV monitor or an online learning platform may provide remote access to the lectures yet fail to provide the richer learning female students desire, but MOOCs may be able both to do this and to provide the level of participation necessary to achieve the overall learning experience.

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# EFFECTS OF USERS' DIVERSITIES ON THEIR ONLINE INFORMATION SEEKING BEHAVIORS

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## ABSTRACT

**Purpose** – This study aims to investigate the effects of Chinese users' diversities including gender, educational level, knowledge background (measured by major), cognitive style, online searching experience and online searching skills on users' online information seeking behaviors, which are defined as the methods of searching online information resources and the types of satisfactory online information resources.

**Design/methodology/approach** – An experiment was conducted in a usability laboratory. Data from 36 participants were collected on a set of measures of online information seeking behaviors and analyzed by SPSS. There were three stages to conduct the experiment: 1) pre-experiment test, in which participants needed to answer a questionnaire and complete a cognitive style test; 2) experiment test, where two online information seeking tasks were constructed – one is familiar and the other was unfamiliar; 3) post-experiment, in which the participants were respectively involved in a structured interview.

**Findings** – Gender, knowledge background (measured by major), cognitive style and online searching skills have influenced users' online information seeking behaviors in various ways, whilst the effects of educational level and online searching experience have not yet been seen.

**Research limitations/implications** – The study was limited mainly in the variety of participants chosen and the number of tasks used.

**Originality/value** – The study provided empirical evidence to the effects of Chinese users' diversities on their online information seeking behaviors. The results may help the owners of commercial databases and developers of open source platforms to tailor the services to their users' needs.

## KEYWORDS

Internet users, User studies, Information retrieval, Information behavior

## 1. INTRODUCTION

In the age of big data, users are the core of the Internet services. It is crucially important for the Internet service developers to tailor their services to users' characteristics and needs if they are looking for a long-term development. Hence, discovering the effects of users' diversities on the online searching behaviors is of great importance. According to the literature review, previous studies on users' online information seeking behaviors are mainly focused on single factor independent variables rather than multiple factors<sup>[1]-[3]</sup>. Although it is commonly assumed that information behaviors are dependent variables<sup>[4]-[6]</sup>, researchers rarely define the online information seeking behaviors as the methods of searching online information resources and the types of satisfactory information resources. Therefore, an investigation of the influence factors is meaningful.

This study undertakes a survey on the effects of users' diversities including gender, educational level, knowledge background (measured by major), cognitive style<sup>[7]</sup>, online searching experience and online searching skills on users' online information seeking behaviors.

## 2. METHODOLOGY

### 2.1 Participants

In total, 36 participants were recruited from Nankai University, including 12 undergraduate Engineering or Computer Science (UE) students, 12 graduate Engineering or Computer Science (GE) students, and 12 master of Library and Information Science (MLIS) graduate students<sup>[8]</sup>. The participants as a whole were a very computer literate group, with over 75 percent considered themselves very experienced with searching on the Internet (rated above 4 on a seven-point scale) of online searching experience, and over 70 percent considered themselves as skillful in searching information online.

The other observed factors included gender proportion and cognitive style: 44 percent of the participants were male, while 56 percent were female; 56 percent had a cognitive style of field independence<sup>[7]</sup>, while 44 percent of them were field dependence<sup>[7]</sup>. All of the participants in the study signed the project consent form.

### 2.2 User Tasks

Two online information seeking tasks were designed: one search task with a familiar knowledge background to the participants and the other task with unfamiliar knowledge background to them.

There were two tasks in the experiment: 1) to conduct a search online to find out the trends in the field of building energy saving; 2) to conduct an online search to find out the trends in the society of reading. UE & GE and MLIS participants were required to complete both of the tasks in a randomized order. The participants could use any search method(s) as they wanted. They were asked to save the top ten ranked digital resources from their most satisfactory search result list among all they obtained with different, if more than one, query tries. They were then asked to illustrate the method(s) by which they obtained the most satisfactory results, and make relevance judgment on these saved search results.

Both tasks were designed to explore the whole process of the online information seeking. The process started from an information need (the task) and ended up with making a relevance judgment for located information resource(s)<sup>[8]</sup>. Each participant was assigned either a familiar or unfamiliar search task, because a pilot study showed that remarkable test results could be obtained when applying familiarity comparison among tasks. No time limit was set for each specific task, but the participants were asked to complete the experimental session in about two to three hours.

### 2.3 Experimental Design

A within-subject experiment was designed for the study. The experiment involved two information seeking tasks. To avoid any possible bias caused by learning effects, a Latin Square design was employed to randomize the presentations of the tasks, so that the results could hardly be attributed to the learning effects. For 36 participants, there were two orders of familiar and unfamiliar search tasks. The orders of familiarity were assigned to the participants that every two of them would follow the same familiarity order.

It was noted that the task itself would become easier and easier as the participant advanced in the experiment process. However, by rotating and balancing the familiarity order of the tasks, each task could get the equal chance to be the first, or the second searching that the participants would complete. Therefore, the Latin Square design employed in the study could systematically reduce the learning effect<sup>[8]</sup>.

### 2.4 Measures

Measures for users' online information seeking behaviors are the methods of searching online information resources and the types of satisfactory information resources. The methods of searching online information resources refer to: 1) commercial databases, which normally require a payment when downloading information resources; 2) open source platforms, which do not require any payment for the resources. The search method of the most satisfactory search result of each task would be chosen by the participant.

The types of satisfactory online information resources refer to the types of top ten ranked online information resources, including but not limited to journal articles, conference papers, open source documents and newspaper & reports.

## 2.5 Data Analysis

The results from the tasks and the data collected by questionnaires were manually entered into SPSS. The interaction details of completing the tasks were captured in the experiment process and in the post-experiment interviews. The sample scale was 36 (>30), which was a large sample statistically, could be regarded as normal distribution<sup>[9]</sup>. As a result, One-way ANOVA and Independent-sample t Test were the major statistical procedures for data analysis<sup>[9]</sup>. In One-way ANOVA and Independent-sample t Test, if the significant difference of the assumption was found at  $p < 0.05$ , the assumption would hold, i.e. the dependent variable would be remarkably affected by the independent variable. Otherwise, the assumption would not be accepted<sup>[9]</sup>. To measure the effect of a third factor, ANOVA test was used with Partial Correlation Analysis.

## 3. RESULTS

Table 1 demonstrates the general results of data analysis. It shows that gender, knowledge background, cognitive style and online searching skills have remarkably affected users' online information seeking behaviors in various ways, whilst the effects of educational level and online searching experience have not yet been noted.

### 3.1 Gender

It is noted that among the six studied users' diversities, gender has one of the most extensive effects on online information seeking behaviors (Table 1).

Table 1. Effects of users' diversities on their online information seeking behaviors

Users' Diversities	Online Information Seeking Behaviors (dependent variable)			
	Methods of searching		Types of satisfactory resources	
	Familiar	Unfamiliar	Familiar	Unfamiliar
Gender	Task <b>.019<sup>1</sup></b>	Task .061	Task <b>.036</b>	Task <b>.000</b>
Educational level	1.000	<b>.007</b>	.647	.141
Knowledge background	<b>.005</b>	<b>.000</b>	.357	<b>.002</b>
Cognitive style	.345	<b>.002</b>	.562	<b>.017</b>
Searching experience	.143	.205	.242	.357
Searching skills	.222	.236	.064	.501

(<sup>1</sup> Every number in the table is a value of significant difference of the causality relationship between dependent and independent variables. If it is found at  $p < 0.05$ , the assumption hold, i.e. the independent variable has a remarkable impact on the dependent variable.)

When searching for the information with familiar knowledge background, 75 percent of male chose to use commercial databases only (Table 2) and a majority of them were most satisfied with journal articles under this circumstance (Table 3), whilst 55 percent of female decided to search via both methods (Table 2) and a majority of them chose open sources as the most satisfactory result (Table 3).

Table 2. Gender distribution on different methods of searching for online information resources

<b>Knowledge background</b>	<b>Methods of searching for online information resources</b>			
	Familiar task		Unfamiliar task	
	Commercial databases	Open source platforms	Commercial databases	Open source platforms
Male	75%	25%	75%	75% <sup>1</sup>
Female	55%	55% <sup>2</sup>	65%	35% <sup>2</sup>

<sup>1</sup> 75% of male participants chose both commercial databases and open source platforms when searching for information relating to the unfamiliar topic.

<sup>2</sup> 55% of female participants chose both methods when searching for information relating to the familiar topic.)

When it comes to unfamiliar topics, 75 percent of male participants searched via both methods (Table 2) and over 60 percent of male preferred open-source information (Table 3), whilst 65 percent of female participants decided to use commercial databases only (Table 2) and a vast majority of them preferred journal articles (Table 3).

Table 3. Gender distribution on the type of most satisfactory online information resources

<b>Gender</b>	<b>Types of most satisfactory online information resources</b>	
	Familiar task	Unfamiliar task
Male	Journal articles (75% of male)	Open source (>60% of male)
Female	Open source (60% of female)	Journal articles (90% of female)

### 3.2 Knowledge Background

Knowledge background was measured by majors of the participants. It also has extensive effects on information seeking behaviors. However, there is no notable evidence to show the relationship between knowledge background and the types of satisfactory online information resources when it comes to a familiar searching tasks (Table 1).

Regardless of their familiarity with the task, a vast majority of participants with MLIS knowledge background tended to believe in commercial databases (Table 4), and they scored high for journal articles. While more UE & GE participants would like to try both methods (Table 4) and most of them believed journal articles and open source documents were both acceptable.

Table 4. Effects of knowledge background on methods of searching for online information resources

Knowledge background	Methods of searching for online information resources			
	Familiar task		Unfamiliar task	
	Commercial databases	Open source platforms	Commercial databases	Open source platforms
MLIS <sup>3</sup>	70%	30%	92%	8%
UE & GE <sup>3</sup>	55%	55% <sup>1</sup>	52%	52% <sup>2</sup>

<sup>1</sup> 55% of UE & GE participants chose both commercial databases and open source platforms when searching for information relating to the familiar topic.

<sup>2</sup> 52% of UE & GE participants chose both methods when searching for information relating to the unfamiliar topic.

<sup>3</sup> MLIS stands for Master of Library and Information Science. And UE & GE stands for undergraduate and graduate of Engineering or Computer Science.)

### 3.3 Cognitive Style

Cognitive style works only when searching unfamiliar topics (Table 1). Based on the experiment data, when searching for information from an unfamiliar background, 55 percent of field independent users tried both methods to find satisfactory results, whilst 75 percent of field dependent users chose commercial databases as their only way of searching. Meanwhile, over 60 percent of field independent users regarded open- source documents as their favorite type of information resource, while 88 percent of field dependent users preferred journal articles.

### 3.4 Online Searching Skills

Online searching skills work only on familiar topics (Table 1). In this circumstance, users who considered themselves fairly skilled in online searching tended to choose commercial database to be the only search method and they preferred journal articles, whilst users who considered themselves less skilled tended to rely on both commercial databases and open source platforms and they preferred documents from open sources.

## 4. DISCUSSION

Our results demonstrate that gender difference is an overall influence factor. Male and female users differ from each other in various ways when seeking for information resources online. According to the post-experiment interviews, most males thought that it was a waste of time on making comparisons between the results and they would like to directly obtain online information resources via authorized channels, e.g. commercial databases, when searching for information that they might be familiar with. The possible explanation is that male tended to have more faith in their own judgment when they were in their comfort zone<sup>[10]</sup>. In contrast, female users were more hesitant and prudent even if they were familiar with the topic. A majority of females chose to compare all the results from different searching methods and then make relevance judgment on them. However, when facing a brand new online information need, males tended to make relevance judgment based on a massive collection of data, while females preferred the answers from authorized channels.

In addition, the results show that knowledge background has an extensive impact on the Internet users' information seeking behaviors. Owing to their professional trainings, users from a knowledge background of

LIS had more faith in authorized online information, while users with Engineering or Computer Science background had more flexible choices and most of them gave a high score for open-source documents.

Cognitive style also shows a remarkable impact on users' behaviors in unfamiliar searching tasks, but not in familiar searching tasks (it is hypothesized that training and education may offset the impact of the cognitive style [7]). Most field independent users are dominated by inner motivations [7], thus, when facing unfamiliar searching topics, their strategy was to collect information resources via multiple methods and make comparison and judgment later on. Meanwhile, field dependent users, psychologically, are more suggestible [7]. As a result, they preferred authorized information resources when dealing with an unfamiliar searching task.

Contrary to the operational mechanism of cognitive style, the results indicate that the impact of online searching skills became noticeable only when the users were facing familiar searching tasks. Users who considered themselves less skillful in online searching were more willing to experience multiple searching methods before making any decisions than the more skillful group.

However, there is no clear evidence that educational level and online searching experience correlate with the Internet information seeking behaviors. Nevertheless, we cannot deny the possibility of their impact.

## 5. CONCLUSION

We found out through the investigation that except for educational level and online searching experience, gender, knowledge background, cognitive style and online searching skills of users have influenced their online information seeking behaviors in various ways,

We realize that this research has its limitations. First, the sample population was limited to computer literate participants. Therefore, the results may not be applicable to all the users. Second, limited by the experiment time, there was only one familiar search task and one unfamiliar task. This rarely happens in real life situations where people often face a variety of tasks. Such a design may have affected the generalization of the findings. Third, due to the small sample size and limited knowledge background variety, the comparison of the users' Internet information seeking behaviors was incomplete because of the lack of sufficient data. This should be enhanced using a larger and diverse sample size in the future.

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# ADOPTION OF AN E-REVENUE COLLECTION SYSTEM: A CASE OF GATUNDU NORTH AND SOUTH SUB COUNTIES

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## ABSTRACT

The use of ICT to automate government processes is taking shape in Kenya and across the globe. The benefits are enormous hence its proliferation and successful adoptions by governments around the world. It is based on these success stories that the County of Kiambu, a region in the Central province in Kenya, offered to the public and private sector firms to develop a system that would automate its revenue collections.

A consortium formed by the Strathmore Research and Consultancy Centre, Namu Health and iPay applied for a tender and won the offer to carry out a pilot project in two sub-counties: Gatundu South and Gatundu North. The pilot project sought to automate revenue streams such as parking fees, market fees and cess, single business permits, land and property rates. For the purpose of this paper, we focus on how the implementation of single business permit applications has contributed to numerous benefits due to its accessibility.

Desktop research, interviews, focus groups and the study of the financial gazette of the county were conducted to gather enough requirements for the development of the automated system for single business permits. The new system, CountyPro was developed, tested and found to meet the requirements. Post implementation interviews were administered to the various stakeholders and findings revealed that 80% of the users preferred the new system to the old one in terms of ease of use, flexibility, transparency, accessibility, modes of payment, reporting and workflow management.

## KEYWORDS

Single Business Permit, e-Government, Automation, Revenue Collection.

## 1. INTRODUCTION

The increasing adoption of Information Communication Technologies is taking the center stage in almost all areas of the economy, from its use in education, to integration into businesses and in marketing. This phenomenon has been contributed to by the ubiquity of the internet. Consequently, this has increased pressure on the government to adopt similar services with high levels of efficiency and effectiveness.

According to a report by IBM (2008), government agencies are constantly looking for ways to better serve the needs of citizens more effectively and responsively. Citizens and business users are now used to getting their information and completing transactions online. They expect this level of service from government, and they want it on demand, 24 hours a day, 7 days a week.

Through an integrated web-portal, it will be possible for citizens and businesses to complete a transaction with government agencies without having to visit several separate ministries/departments in separate physical locations. In addition, e-government strategy is enabling public sector organizations to interact directly and work better with businesses, irrespective of their locations within the physical world. This includes digitizing procurement services from and to businesses in order to improve their service quality, convenience, and cost effectiveness (Heeks, 2001; McClure, 2000).

With the ushering of the new constitution in Kenya in the year 2010, county governments replaced the old centralized and municipal council form of government in the country. Since they are supposed to generate their own share of income, these county governments are constantly looking for ways in which to increase their revenue share. A baseline survey released by the Institute of Certified Public Accountants in Kenya (ICPAK, 2014) shows that thirty seven percent (37%) of 17 counties sampled rely on business permits as their core sources of revenue, thirty two percent (32%) relied on user fees and charges while thirty one percent (31%) relying on property rates. Single business permits contribute to very high sources of revenue in most counties.

A study by Devas and Kelly (2001) shows that the government in Kenya has been constantly improving the process of obtaining Single Business Permits. Local Authorities Integrated Financial Operations and Management System (LAIFOMS) was introduced in the year 1998 with the purpose of strengthening public expenditure management systems, among them improving the processing of Single Business Permits. However, this system's major flaw is that it lacks accessibility to the citizen. Only county officials can access this system.

The time required to obtain business permits has been substantially reduced due to the introduction of one-stop-kiosks (Fjestad and Heggstad, 2012). Another study done in Entebbe Municipality, Uganda by Sander (2003) shows that simplifying the process of payment of Single Business Permits has many benefits, among them increased revenue to governments.

A pilot project conducted in two sub counties in Kiambu County (Gatundu North and South) sort to identify the problems faced by citizens while using existing systems to get access to business permit services.

This paper demonstrates how an e-revenue collection system can enhance revenue mobilization through, facilitating the ease of access of services for citizens while accessing single business permit information. It also demonstrates how its functionalities are designed to enable county managers and finance officers make well informed decisions.

## **1.1 Objectives**

The objectives of carrying out the pilot were as follows:

- i. To develop an automated system that would enhance single business permits revenue collection for Kiambu County.
- ii. To develop an online portal that would enable citizens to easily apply for single business permits and pay online for their application.
- iii. To provide a reporting tool that graphically and intuitively displays a summary of revenue collected.
- iv. To provide alternative channels of payment to citizens such as mobile money, credit/debit card payment and mobile banking.

## **2. BODY OF PAPER**

### **2.1 Problems with Accessibility**

Some of the challenges faced while using LAIFOMS were such as; in this old manual system, it was not possible to apply for your Single Business Permit online. An applicant had to take the time out of his or her working day to visit the sub county only to find long queues resulting to a lot of time wastage.

Secondly, the only payment mode accepted in the old system was through a specific sub county bank. This therefore resulted in long queues in banking halls especially when the deadline was nigh. It was impossible for an applicant to track his or her application. One had to constantly visit the sub county office to find out whether their business permit was ready. This resulted into inconveniences and a lot of time wastage. One could take up weeks to months to get their permit ready. Failure to have a business permit may lead to closure of business premises. With the new system, the process of applying for a business permit takes less than five minutes.



County officers could not access the finer details of revenue collection. For example, it was not really clear how many businesses were in operation and those that were registered in a particular ward. Among those registered, they would not clearly point out defaulters of payment of the Single Business Permit fee. A solution would later be developed to address the challenges faced.

## **2.2 Similar Experiences and Systems**

An Integrated Revenue Collection System (IRCS) was deployed in the United Arab Emirates. The CUECENT ePay Integrated Revenue Collection System is being used for cash and receipt management (Bahwan CyberTek, 2012). This system is efficient in terms of e-payments, has role based access controls for operations users, management or finance users, service provider users and entity users. The County Pro system has been able to incorporate all these entities. However, the IRCS system does not show daily projections or reduction in revenues in specific business areas. The County Pro system points out the smaller subdivisions of counties, which are Sub County and wards, and their status in terms of daily revenue collection. This feature is important in order to observe the flow and point out low revenue areas in the sub counties and wards.

An e-municipality system solution deployed in Namibia and South Africa is very similar to County Pro where areas from Custom Software Development, Systems Integration and Enterprise Architecture, IT infrastructure and support and project management are covered. Project management is the center of the whole process of change from the old system to the new system.

## **2.3 Methodology**

The pilot project started off with data collection; it involved interviews, focus groups, reviews of the county financial gazette, study of the existing system and documentations to identify weaknesses and formulate suggestions for improvement.

The data collected was processed and grouped into meaningful chunks for easy understanding of the requirements and development of the system. The developed system was deployed in the two sub-counties, Gatundu North and Gatundu South and desired functionalities tested for effectiveness of the system.

After successful implementation, the team embarked on training the sub-counties' officers to equip them with relevant skills that would allow the officers to better operate the deployed system.

During and after the pilot, the project team were ready to assist the sub-counties' officers whenever they needed help. The team also conducted interviews to get feedback from the various stakeholders.

## **2.4 Results**

### **2.4.1 System Description**

The County Pro system also displays the percentage of revenue brought in specific business areas. A revenue officer is able to easily identify the areas that bring the most amount of revenue every month. He or she can therefore identify the factors that lead to increase or decrease in revenue in a particular month as illustrated in Figure 1 below:

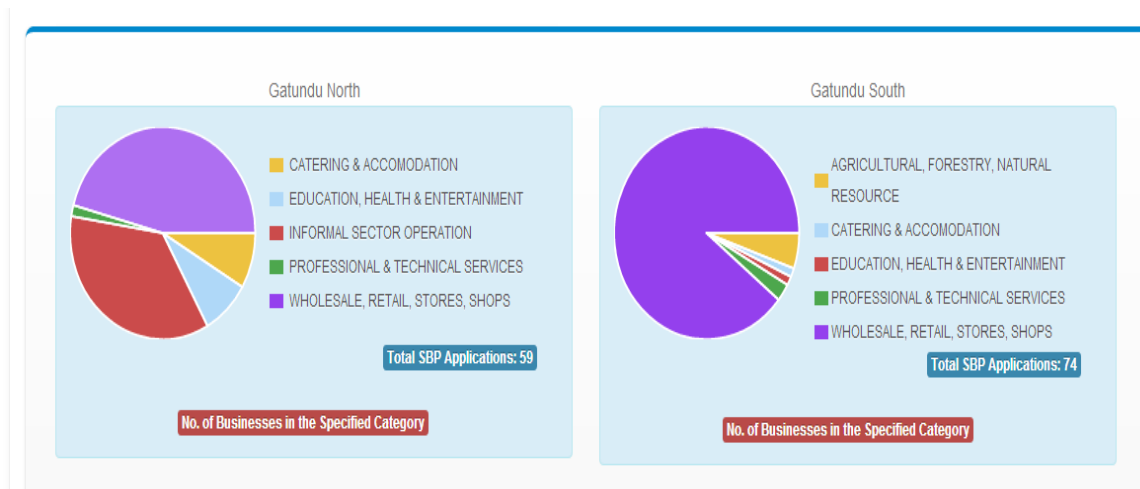


Figure 1. Category wise business areas segmentation

The County Pro revenue collection system gives graphically represented views of the revenue collected in a particular ward- subdivision of a sub county, for a particular module. It allows for various modes of payment and the ability of a citizen to track the status of a Single Business Permit application.

It handles different kinds of payments including cash, mobile money or credit/debit payments. The system allows for online tracking of a SBP (Single Business Permit) application either via Email or Short Message Service (SMS). It is integrated with Short Message Service (SMS) and Email Server to ensure that SMS and Email alerts are sent to citizens upon making applications for SBP, confirming payment receipts and upon receipt of digitally signed QR (Quick Response) coded permit.

Digital documents produced by the system are QR Code enabled to allow for verification of validity. The system also has a Business Intelligence Portal to enable revenue officers to view summary of revenues collected and to analyze the same.

### 2.4.2 Discussion of Results

The new CountyPro system has been well accepted by the county officers; 80% of the officers were comfortable using the system and preferred it to the old system while 20% experienced some challenges as they were so used to the manual processing of SBPs.

The CountyPro system has made it easier for customers to apply for SBPs online; 85% of the citizens were content with the fact that they no longer have to make trips to the county office to apply or check on the application progress, while 15% were concerned about the extra coins they have to spend for Internet access at the cyber café, furthermore, the fear of making mistakes in SBP application.

The supervisors were able to view instant reports of SBP collection and send them to the chief financial officers without delay. The enforcement officers were able to download the QR reader to their phones and easily verified the validity of processed SBPs and receipts. 75% of the officers were happy with the exposure to technology and the ability of smart phones while 15% were fearful of new gadgets and resistant to the new system.

The new system will help identify defaulters of payment of business permits in the county. It will also help identify individuals who have accumulated arrears over the years and could not be identified using the old system. This will lead to a significant increase of revenue in order for the county to sustain itself.

## 3. CONCLUSION

The county will benefit from the system in various ways such as minimizing queues at the county offices as citizen can do applications online; furthermore, the system also allows for online payments via mobile money or credit/debit cards and the citizens can track the progress of their application online. The produced

documents such as SBP and receipt are digitally signed and QR code enabled for ease of validity verification. The system allows for generating instant reports and viewing a breakdown of various category collections.

The pilot project was successful; however there were challenges such as introducing the county officers to an automated system, change management especially for the citizens and changes in the financial gazette during the pilot which led to delays in implementation. The period of the pilot was also a bit short; some modules such as housing, land and property rates were not fully developed. Change management for county staff proved to be a challenge. However on explaining the benefits over the pilot period changed the officers' attitudes towards the system. Eight hour a day on-site support was provided for the county officials for the period of the pilot.

The CountyPro system emerged the winner and the consortium was awarded the contract to deploy the system in the whole county of Kiambu and to improve the modules that were not fully developed during the pilot. This system can also be replicated to other counties by modifying it to meet their requirements and needs.

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# JOINT ASSESSMENT OF SOFTWARE SERVICE QUALITY PROPERTIES

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## ABSTRACT

The new method introduced in this paper calculates the level of satisfaction of several jointly estimated quality properties of a particular web service. It gives a theoretical frame enable to assess strength of different nonfunctional characteristics. The method is applicable both to measurable or immeasurable properties. It is summarized in an effective assessment algorithm and illustrated through a numerical example.

## KEYWORDS

Web services, Quality of service, Theory of fuzzy sets, Probability theory.

## 1. INTRODUCTION

Nowadays the service-oriented technology is preferred as promising and effective solution especially in the context of rapidly spreading cloud computations. One of the problems having the highest importance is the web service assessment process concerns not only functional, but also non-functional properties of the web services. The research focus is on development of software systems ensuring certain quality of service (QoS). QoS is the ability to provide different priority or to guarantee a certain level of performance.

The QoS aware selection is a challenging problem (Li, 2009; Shao, 2007; Wang & Chen, 2008; Sathya, 2010) especially in the case of different services presenting equal functionality. The client problem is to select the service having best quality. However, the behavior of the web services with respect to its QoS is difficult to be predicted as it depends on various factors such as availability of the network connection or corresponding application server, the number of simultaneous invocations of the same web service. On the other hand, the client's choice is a result of subjectivity of its own understanding about the desired quality of the offered resources (Xiong & Fan, 2007). As it was already shown this occurrence could be mathematically formalized via the theory of fuzzy sets (Benouaret, 2012; Amdouni, 2012; Abbaci, 2011).

Recently introduced concept of software service quality estimation is based on the probability of the measured quality data and fuzzy sets to account for the client preferences. Further quality is assessed through criteria that summing up the membership degrees of both measured quality property and client preferences. The methodology was generalized in an algorithm enable to compare the quality of several services presenting equal functionality according to a given nonfunctional characteristic (Georgieva & Petrova-Antonova, 2014). The common drawback of this approach is that the assessment is done according only to one quality property. However, the open problem of the real practice is how to estimate the quality of a software service assuming several different quality properties. Often they have contradictory effect to the whole service behavior. Improving quality through one nonfunctional characteristic the quality in the sense of other characteristic could be decreased.

The new method introduced in this paper calculates the level of satisfaction of several jointly estimated quality properties of a particular web service. It gives a theoretical frame enable to assess strength of different nonfunctional characteristics. The method is applicable both to measurable or unmeasurable properties. It is summarized in an effective assessment procedure.

## 2. JOINT QUALITY PROPERTIES ESTIMATION

Measured values of a certain QoS property recorded for a period of time in the history log can be considered as a possible outcome. Each outcome value can be associated with a number corresponding to its incidence of appearance. These numbers are values of a random discrete variable described by a Probability Mass Function (PMF) (Devore, 2008). PMF captures the probabilities of the values that the random variable can take. If  $x$  is any possible value of a discrete random variable  $X$ , the value of PMF of  $x$ , denoted by  $p(x)$ , is the probability of the event  $\{X=x\}$  consisting of all outcomes values that give rise to a value of  $X$  equal to  $x$ :

$$p(x) = P(\{X = x\}). \quad (1)$$

However, some software qualities are unmeasurable and thus, their PMF could not be estimated. For instance, the QoS metrics that reflect the subjectively experienced quality as usability, reliability, efficiency and ect., are in fact the acceptable cumulative effect on client satisfaction of all imperfections affecting the service (Franken, 1996). These qualities could be only empirically assessed according to the subjectivity of the client's perception sensed during the service use. Usually such assessment is not exactly defined as it consists some uncertainty. The power mathematical tool enable to formalize this subjectivity in the knowledge is the theory of fuzzy sets (Klir & Yuan, 1995).

The concept of fuzzy set (FS) allows partial set membership rather than a crisp set membership or non-membership. It is formulated by a membership function, which numerically represents the degree to which a given element belongs to a fuzzy set. Formally a fuzzy set is defined as follows: a fuzzy set  $A$  defined in a universe  $U$  is a set of ordered pairs,  $A = \{(x, \mu_A(x)), x \in U, \mu_A(x) \in [0,1]\}$ , where  $\mu_A(x)$  is the degree of membership of the element  $x$  in  $A$ . Thus, the membership function is seen as a mapping  $\mu_A(\cdot): X \rightarrow [0,1]$ . As  $\mu_A(x)$  approaches 1, the element  $x$  increasingly belongs to the fuzzy set  $A$ . Often, the fuzzy set is identified with its membership function i.e. if we say that the fuzzy set  $A$  is given then we mean that its membership function  $\mu_A(x)$  is known. Commonly the shape of the membership function is identified as a standard function as triangular, trapezoidal, Gaussian or other, determined using expert knowledge. Alternatively it could be calculated via data analysis. In case of unmeasured property of QoS the membership function could be estimated empirically according to the client perception of the service quality. The membership function could be provided in continuous or discrete form. Since the information for QoS property is collected as a set of discrete values measured during a given period of time, the discrete membership functions are applicable to web service assessment problem.

The general problem is how to estimate the quality of the software service accounting for several measurable and unmeasurable quality properties. Often the different properties have contradictory effect to the service behavior. Improving quality through one nonfunctional characteristic the quality in the sense to other characteristic is decreased. For instance, increasing the service reliability and safety then its response time could be decreased. Therefore the assessment of the service quality is a question of a certain compromise.

Let us assume that we have  $n$  number of quality properties  $x_i$  that determines nonfunctional characteristics of a software service. Let each property has been performed as a fuzzy set  $Q_i$ ,  $i=1,n$  represented by a respective membership function  $\mu_{Q_i}(x_i)$ . If the quality is measurable the membership function is identified as the respective PMF obtained by the equation (1) for the log data accumulated for a certain time period. In case of unmeasurable quality the subjective assessment of the client or clients perception is used to determine the membership function  $\mu_{Q_i}(x_i)$ . If mixed - measurable and unmeasurable qualities have to be estimated then the membership functions should be equalized in order to avoid the scaling problem.

The joint relation of all interested service qualities could be estimated according to the Cartesian product of the fuzzy sets  $Q_i$ . The Cartesian product of the fuzzy sets  $Q_i$ ,  $i=1,n$  defines a new fuzzy set  $Q$  of their cross product:

$$Q = Q_1 \times Q_2 \times \dots \times Q_n. \quad (2)$$

The FS  $Q$  is a set of all pairs that consists a tuple of quality properties' values  $x^j = (x_1^j, \dots, x_n^j)$  and its membership degree  $\mu_Q(x^j)$ . That membership degree represents the strength of the relationship of the qualities values of the respective tuple  $x^j$ . It is calculated as a minimum of the membership degrees of the constituent qualities membership degree values:

$$\mu_Q(x^j) = \min_{i=1,n}(\mu_{Q_i}(x_i^j)). \quad (3)$$

The joint quality of the software service could be assessed according to the obtained degree values (3). An  $\alpha$ -cut of the fuzzy set  $Q$  at a certain level  $\alpha \in [0,1]$  selects the tuples that have strength larger than that prescribed value:

$$Q_\alpha = \{x^j, \mu_Q(x^j) \geq \alpha\}. \quad (4)$$

The value of  $\alpha$  could be specified in the context of the resolved particular task. From a practical point of view as a larger  $\alpha$  is chosen then most preferable values of the composing qualities are found. Therefore the largest  $\alpha$  value finds best quality values enable to optimize the service behaviour.

### 3. METHOD DESCRIPTION

The presented above theoretical investigations serve as a base for summarizing procedure enable joint assessment of web service qualities. Let us assume that for an interested service a number of  $n$  quality properties  $x_i$  have been selected.

**Step 1** Set the data for all interested service qualities. Choose a time period for the history log accumulation for the measured properties. For the unmeasured properties under empirical data analysis specify the respective membership function that captures the client(s) preferences.

**Step 2** Perform each property as a fuzzy set  $Q_i, i=1,n$  represented by a respective membership function  $\mu_{Q_i}(x_i)$ . More specifically:

*For the measured properties:* Calculate the PMF for each property through statistical data analysis. The information available in the history log about the incidence of the QoS values is processed according to equation (1) in order to obtain their probability  $p_i(x_i)$ . Further interpret  $p_i(x_i)$  as fuzzy membership degrees.

*For the unmeasured properties:* Determine the membership degree values of the fuzzy sets that map each value  $x_i$  to a membership degree  $\mu_{Q_i}(x_i)$ .

**Step 3** Estimate the Cartesian product of the fuzzy sets  $Q_i, i=1,n$  according to equations (2) and (3).

**Step 4** Apply the  $\alpha$ -cut equation (4) to select the tuples  $x^j$  that has strength in the utmost.

**Step 5** By maximal  $\alpha$  values specify the most preferable values of the interested qualities to optimize the service behaviour.

### 4. PRACTICAL EXAMPLE

The above given estimation procedure is proved for a web service, which quality is assessed jointly for two important properties. First one is the throughput (TP), which measures the rate of service processing. Large values of TP are interested. Response time (RT) is another quality property that gives information about how quick the service is performed. Small RT values are preferred. Measured data accumulated in the history log are useful for estimation of both web service qualities.

Let us consider a software service that capture information for TP and RT values in its history log. These values are given in Table 1 in the first column and first row, respectively. Within a certain time period the probability in each appeared value could be easily estimated. The obtained probability values define PMF for the two properties. The two PMF are treated as fuzzy sets  $Q_{TP}$  and  $Q_{RT}$  having the membership degrees given in the second column and row of the Table 1.

Cartesian product  $Q = Q_{TP} \times Q_{RT}$  of the two fuzzy sets is calculated according to the equation (2). The obtained results are presented in the table. Each cell represents the membership degree of the respective pair  $(TP_i, RT_j), i=1,5, j=1,6$  of the cross product. As it was underlined the membership grade defines the strength of relationship between the properties values of the respective pair. The highest value is 0,378 (in bold) that maximizes the  $\alpha$ -cut levels. Thus, two pairs are separated (179955, 1,17) and (179955, 1,18) that determine the best QoS quality combination values, namely TP=179955 and RT=1,17 and 1,18.

Table 1. Values of cross product of Throughput and Response Time

		RT[ms]						
		1,17	1,18	1,19	1,20	1,26	1,27	
TP [bps]	$Q_{TP}$	$Q_{RT}$	0,378	0,378	0,156	0,044	0,022	0,022
<b>162540</b>	0,012		0,012	0,012	0,012	0,012	0,012	0,012
<b>168345</b>	0,096		0,096	0,096	0,096	0,044	0,022	0,022
<b>174150</b>	0,771		<b>0,378</b>	<b>0,378</b>	0,156	0,044	0,022	0,022
<b>179955</b>	0,096		0,096	0,096	0,096	0,044	0,022	0,022
<b>185760</b>	0,012		0,012	0,012	0,012	0,012	0,012	0,012

## 5. CONCLUSION

A new method of joint assessment method of different quality properties of a particular web service is introduced in this paper. It calculates the level of satisfaction of several jointly estimated quality properties based on the fuzzy sets property description and applying the cross product to find the strength of the relationship between the properties values.

The method provides a good theoretical frame and proposes an algorithm enable to assess strength of different nonfunctional characteristics. It is applicable both to measurable and only empirically assessable quality properties. The method efficiency was illustrated through a numerical example. Further practical implementations are under future work to investigate and prove the method vitality.

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# **SOCIAL MEDIA IN POLITICAL COMMUNICATION IN MEXICO: AN EMPIRICAL STUDY IN LOCAL ELECTORAL INSTITUTIONS**

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## **ABSTRACT**

Present study shows partial results of an exploratory research, regarding the use of social media tools in 32 electoral local institutions in México, which are responsible for organizing local elections (municipal presidents, governors); promote democratic culture and increase public participation. By designing an evaluation framework to obtain information about social media condition, it is recognized insufficient benefits acquired, due to the lack of critical factors in the implementation process. A discussion is proposed, in order to identify these factors and define measures to improve current conditions.

## **KEYWORDS**

Social media, ICT, electoral local institutions, political communication.

## **1. INTRODUCTION**

Information and Communication Technologies (ICT) revolution have changed not only common people's lives but the interaction between citizen, stakeholders and governments (Kumar, Mukeri, Butt and Persaud, 2007; Chun, Shulman, Sandoval and Hovy 2010). In this regard, it is required a new model of participation; in the search of increased flexibility in public management, ICT inclusion in daily public activities has been seen as an alternative to reduce communicational gap among citizens and government (González, 2012).

ICT and internet driven applications are creating new communications forms between governments and its audiences. ICT can be used to offer information to citizens, in policy decision and making process, and to increase citizen participation by creative collaboration (van der Graft, Svensson, 2006; Gil-García, Chun and Janssen 2009).

On the other hand, in Mexico there are 32 electoral local institutions, which are in charge of managing elections in all municipalities of the country: they are responsible for municipal Presidents, local Representatives, and Governor's elections. They are also committed to enforce democracy offering certainty, transparency and legacy in every election. By organizing electoral processes, plebiscites and referendums, they try to encourage citizen participation. Additionally, they have been given the task of promoting the vote, compliance of political obligations and enforcement of political rights among citizens. As seen, Electoral local institutions are direct interlocutor between people, parties, political associations and government in democratic topics.

Considering there is limited research on use of ICT in government, or e-Government, particularly in Latin American countries (Kumar *et al*, 2007; Luna-Reyes, Hernández and Gil-García, 2009); is also been argued that public organizations tend to be late adopters of new technologies and are perpetually behind the technology-diffusion curve (Moon, 2005), and particularly, social media impact in government is quite immature (Withaar, Ribeiro and Effing, 2013), in order to offer a more comprehensive scenario about social media tools incorporation in Mexico's local electoral organizations, present research has been conducted in referred 32 institutions, to determine which social media tools are employed and main practices associated to it.



## 2. SOCIAL MEDIA AND E-GOVERNMENT: FACTORS OF SUCCESS.

Social media refers to the group of tools designed for social interaction (Bertot, Jaeger and Hansen, 2012) and combine Web 2.0 technologies and services, such as blogs with social collaboration, micro blogs, wikis, chats, social networking, photo and video sharing, podcasting, etc. Dadashzadeh (2010) points out that the emergency of Web 2.0 has transformed Internet and passive users and put in motion a new dynamic context of prime movers, who want to share the contents they produce.

Difference between traditional media –radio or tv, devoted to massive and unidirectional contact or from one to many- is that social media allows reciprocity and communication from many to many. Social media facilitates bidirectional, immediate and massive communication, no matter distance and location; these characteristics improve communication effectiveness, which explains the rapidly assimilation in everyday life. Use of social media increases public value and credibility, if correctly adopted in social groups and shows a new pattern to enhance communicative processes in public organizations (González, Pérez, 2012).

There are many existing social media instruments in México, but according to Mexican Internet Association (AMIPCI, 2013) the most important of them, in terms of the number of users and traffic are: Facebook, Twitter and YouTube.

Paying heed to these indicators, social media seems to be an ideal resource for build up communicational process in public organizations; however, in order to produce the intended results, some parameters or criteria have to be acknowledged when political communicational strategy is defined (Sandoval-Almazán and Gil-García, 2012).

The first of this criteria consist in offering to practitioners the possibility of generate contents susceptible of been shared (Chun *et al*, 2010; Bertot *et al*, 2012). Social media expansion has brought to the fore a proactive user, which is not only passively connected to internet obtaining data; instead, is an output producer, interacting and sharing with other people. Another consideration in the assembly of functional social media program is a continual construction of people involvement, a growing community of users.

It is also important to get appropriate design and creation of an aesthetic environment, functioning as a presentation card and giving a succinct but precise idea of the main intention of public organizations (Iruzubieta, 2012). Last parameter is immediate and constant response (Chun *et al*, 2010). If government or public organizations are unable to accomplish interaction as practitioners do with other people, the effect is a drift of interest to other users. Organizations need to create contents with added value; this can be achieved by turning citizen and stakeholders into collaborators and partners in information creation as well as promoting interesting experiences for audiences.

In current research, the goal is to building up an evaluation framework that embarks these criteria among others, so as to obtain a more information about social media condition and appropriation in Mexico's local electoral organizations.

## 3. METHOD

An exploratory study was conducted by examining all 32 Electoral local institutions in Mexico. In order to obtain homogeneous conditions, the research was guided in a non election period, from January to February 2013, considering that during election period the real interaction would be contaminated by boots or fake communications and would give a biased reading obstructing the comparison.

The observation included the 32 portals or websites, inferring that if were a formal instrument or any institutional use of social media, would be showed in it. It was taken into account that on line presence, refers portals or web pages with social media links. The review gave priority to Facebook, YouTube and Twitter, being - as mentioned above - the social media tools with largest number of users.

From the perspective that assessment frameworks should combine multiple techniques or guidelines to obtain new information within this field, a measurement matrix based in the criteria previously described was designed, added with other some considerations -see Table 1- acquired from experience. This instrument was composed with indicators related to Online presence, Social media links, Response, Involvement, Leaders engagement, Contents, Frequency of publications, and Main use and was applied to social media tools linked to institutional web sites.

Table 1. Criteria for social media evaluation in local electoral institutions in Mexico

Organization:					
On line presence	YES			NO	
Web sites					
Social media					
Social media link	YES	NO	Broken	Error	
Twitter					
Facebook					
You Tube					
Response	Content shared	Immediatly	Unidirectional	Feedback	
Twitter					
Facebook					
You Tube					
Involvement	Number of registred voters				
Twitter	# Followers	# Following			
Youtube	# Suscription	# Reproduction			
Facebook	#Friends	# Likes			
Leaders engagement					
Executive , officer participation	YES			NO	
Contents	Text	Photography		Multimedia	
Twitter					
Facebook					
You Tube					
Frecuency of publications	Daily	Weekly	Biweekely	Montly	Irregular
Twitter					
Facebook					
You Tube					
Main use	Information	Promotion	Interaction	Transaction	
Twitter					
Facebook					
You Tube					
Observations:					

It was noticed that the social media design or profile was not homogeneous in every electoral organization; in view of the above, a general observations section was encluse.

A subsequently comparison was made between the number of users and the number of registered voters (people over 18 reenrolled in the Federal Electoral Institute IFE in 2013 in each state) to determine the degree of acceptance of social networks among citizens. It was expected to find out government executives and officers engagement of by active participation -post or comments-.

The analysis attempted to uncover the kind of interaction showed by every institutional website or social media tool, if there was content susceptible of been shared (or even shared), the immediacy of the responses, and the feedback.

Although the measurement matrix provided a well-structured questions for indicate current situation and appropriation in Mexico's local electoral organizations, does not cover the especial characteristics of each social media tool.

However, by developing this evaluating framework we aim to help the understanding of the use of social media as part of E- government in México.

#### **4. RESULTS, DISCUSSION AND CONCLUSIONS**

It was confirmed online presence in the 32 institutions referred. Regarding social media tools used, the results show 75 % of local electoral institutions using Facebook, 68.7% Twitter and YouTube only 46.8%.

The review and comparison in the number of users and the number of registered voters, shows that the number of users interacting with electoral institutions is limited. The executive and officers participation is almost nonexistent.

Data showed number of users is not representative of all citizens or potential audience. For example, the State of Mexico has 11,170,669 citizens registered in the electoral roll, while the number of Facebook users is 5160 and 276 on Twitter. In Distrito Federal, there are 7,784,140 registered voters; 3197 are Facebook users and 3453 Twitter followers. This Institute has reached the highest number of users in the country.

There was not systematic approach tending to the increase of the virtual community; in fact, there was not a declared strategy focus on social media at all.

With respect to the main use of the tool, most institutions used them as a mean of spreading information and activities, however, considering the number of users identified, this is also an inefficient way for information diffusion. Although electoral organizations understood the practice of social media as a way to extend government services, information was simply placed, in a static, rigid mode, showing the lack of awareness of the tools potential. No participation was observed in the generation of new content. The interaction is also restricted. The local institutions in Distrito Federal, Nuevo León, Tabasco and Oaxaca respond and give feedback to users who ask them or consult on topics; however, in Tabasco and Oaxaca the reply is not immediate, which compromise the validity and relevance of the practitioner requested information and interest. This seems to diminish the creation of public value of its contents, because is not causing interest among users, possibly due to the absence of direct and meaningful communication.

In social media, every organization must be able to present an attractive design to their audiences; this means not only proper use of language and visual elements such as photographs and graphics or a good use of aesthetic elements, not present in most of the electoral institutions.

To generate an appropriate profile also involves projecting the image, identity and reputation of public organization. It implies the correct and appropriate use of tailored messages for an specific audience, thus generating a more interactive experience, enhancing functionalities of social media, which was not observed in most of the entities described, except in Distrito Federal.

In brief, it appears that use of social media is conducted in the traditional way, the concept of one-way communication. This implicates that the application of a set of financial and technical resources are not being effective, because they do not promote citizen engagement in e-Democracy, e Participation or e-Voting.

It is desirable, a political communicational strategy redefinition, acknowledging parameters as described. Nevertheless, bureaucratic changes and administrative reforms are ineffective unless control mechanisms exist; then it would be a matter of additional research to find out in what extent, electoral institutions have developed such controls and are the cause of failure in the use of the tools described in the enhancement of E-government.

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# **Reflection Papers**



# ESCIENCE 2.0 – IMPACTS OF WEB 2.0 TO SCHOLARY COMMUNICATION

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## ABSTRACT

The intention of this paper is to outline how Internet and Web 2.0 have changed scholarly communication and to point out current and prospective developments towards a more Open Science. Opportunities, recommendations and dilemmas for researchers in eScience are elaborated.

## KEYWORDS

Scholarly Communication, Open Science, research performance indicators, scientific crowdsourcing.

## 1. INTRODUCTION

Scholarly communication covers all activities for dissemination of research content towards different target groups and includes as well knowledge transfer via public relations work as making research results available to a respective research community. The Internet and Web 2.0 have changed scholarly communication in recent years and researchers seem to disagree on pros and cons of this development.

This paper is divided into three sections: it begins by describing the paper based scholarly communication culture and how Web 2.0 has affected scholarly communication culture in general and academic careers in particular. Chapter 3 introduces into Open Science and investigates the most appropriate social software channels and platforms and their application possibilities. Chapter 4 points out pro and cons of these developments and summarizes resulting recommendations for eScience 2.0.

## 2. PAPER BASED SCHOLARY COMMUNICATION AND WEB 2.0

From the viewpoint of research communities scholarly communication has been primarily based upon scientific journals and proceedings for decades. Researchers have been expected to publish as many papers as possible, a competition that has already been criticized (Binswanger 2014). Journal rankings (e.g. <http://www.scimagojr.com>), the acceptance rates of conferences and the number of citations have determined the quality of publications in particular. Merely positive results of research have been communicated when they were complete enough to fill a full scientific paper.

Figure 1 visualizes this paper based scholarly communication culture. A handful of reviewers have determined the scientific value of papers and the scientific communication process has focused mainly on these publications as well (Bartling and Friesike, 2014, p7). As a result of this communication process, preliminary results, non productive ideas and intermediate conclusions have often been dismissed and never communicated.

The ongoing establishment of commercial online journals has made publications increased available via the Web. However, for a long time, publishing rights have been secured exclusively by the publishing houses and readers or their institutions had to pay for access or subscription no matter paper-based or in electronic format.

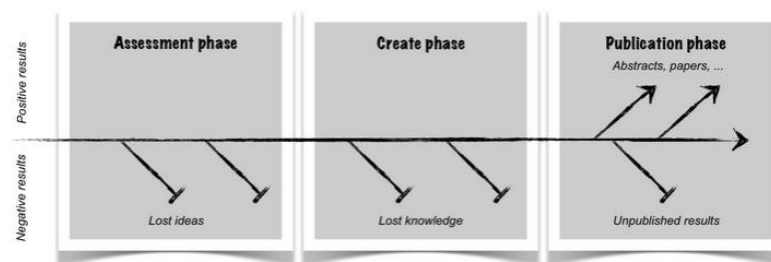


Figure 1. Paper based research (Bartling and Friesike 2014, p9)

Within the last decade collaterally dissatisfaction with the established scholarly communication system has been growing because of rapidly rising subscription prices, concerns about copyright, latency between results and actual publications, and restrictions on what can be published and how it can be disseminated (Van de Sompel et al. 2004). To overcome this so called ‘scholarly communication crisis’ and to improve the scholarly communication process the Open Access initiative has been considered as a first step into the direction of opening science (Tatum and Jankowski 2013).

There exist two different ways for going Open Access: Golden Open Access (publish paper in an Open Access journal) or Green Open Access (publish paper in a non-Open Access journal but also self-archive it in an Open Access repository). There are several major directories of Open Access journals, most notably Directory of Open Access Journals (doaj.org). To be published in high quality open access journals a fee is to be paid by the author, institution or research funder to cover the costs associated with the publication. So Open Access publication costs have to be funded and calculated within research projects. Also EU has determined under HORIZON 2020 that each beneficiary must ensure open access to all peer-reviewed scientific publications relating to its result (EU Commission, 2013). There is a running discussion about the quality of Open Access journals. The main argument against Open Access journals is the possible damage to the peer review system, diminishing the overall quality of scientific journal publishing. But whereas about 10% of journals are golden over 90% are already green, what means that publishers have given their authors the green light to self-archive (at least) pre-reviewed paper versions (Harnard et al 2008). The most notably directory of Open Access Repositories is OpenDOAR (opendoar.org).

Making journals and proceedings available online via the Web created the basis for academic search engines and citation databases like Google Scholar, IEEE Xplore, PubMed or SciPlore.org. Automatically determined research key performance indicators based on amount and citations of papers arose. To increase their paper citations, some researches already started to make their papers visible at the best to the research community online and to ensure that they are optimally indexed and displayed in academic search engines results. To achieve that, researchers have not only to describe research results for the research community but also to pay attention to academic search machine optimization (Beel, Gipp and Wild, 2010).

Google Scholar for example automatically indexes full texts of scholarly literature. Optimization for Google Scholar indexing can be achieved e.g. through

- keyword analysis and the optimal use of keywords in title, abstract, keyword list and text
- Scholar friendly structure of the paper
- use of meta data
- references to the paper e.g. from Open Access repositories, personal or institutional homepages

Based on citation data collected in citation databases research performance indicators like h-index or i10-index are calculated automatically (Bornmann and Daniel 2007). Citation indices are based on the productivity and citation impact of a scientist.

Google Scholar is without fee and in competition with fee required citation databases like Science Citation Index (SCI) and Scopus and indexes also grey literature (not formally published papers) in its citation counts. As a result the citation indices of a scientist can vary depending on the underlying citation database. Therefore, it is important to keep in mind optimization as research performance indicators are of increasing importance for researchers and are used in some research areas to determine the quality of the total published work of a scientist.



### 3. THE POTENTIAL OF WEB 2.0 FOR OPEN SCIENCE

Despite of this progress towards more open research the Open Access initiative furthermore has been based on paper based research results. To move beyond Open Access and today's research performance indicators to a broader Open Science culture where also ideas, preliminary even negative results, conclusions and thoughts can be communicated at much earlier stages of research (see figure 2), additional means to disseminate knowledge between researchers are needed. In the following we introduce the most appropriate social software channels and platforms for academic networking, eCooperation and the publication of thoughts and results.

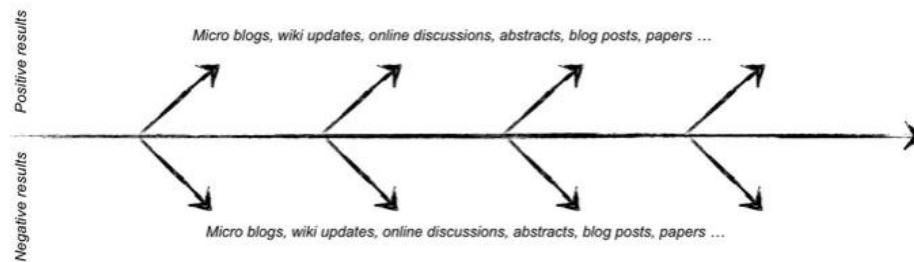


Figure 2. Open Science using novel publication methods (Bartling and Friesike 2014, p10)

Although some social networking platforms like Facebook are very popular there is little real research networking taking place there. Facebook is used in the academic world rather for public relations communication than for academic networking. However, scholars are increasingly using blogs and microblogs to communicate their ideas and news but also to share, follow or retweet others, to comment issues of common interest, to link content using hashtags and also to recommend and cite articles. Although all these quotations are different from traditional citations they can be seen as a legitimate conduit of scholarly impact. However, neither algorithms calculating performance indicators nor research communities have appreciated these blogging efforts until jet.

Even though social platforms like Xing, LinkedIn or Viadeo are focusing business networking and especially LinkedIn also allows the upload of scientific publications and endorsing of skills these tools are used by researchers mainly for profiling purposes without any specific scientific character. For scientific purposes special academic networking platforms have emerged linking and empowering scientists. ResearchGate is the biggest academic network dedicated to science and research and has about 4 million users mainly in the sciences. It incorporates many elements of the familiar social networking platforms mentioned above like profiling, following other researchers and their work, endorsing skills, bookmarking favorites, feedback and the ability to share news and updates easily. Furthermore, ResearchGate offers these additional crowdsourcing benefits to researchers:

- (1) Connection of researchers around selected topics and specializations;
- (2) Upload and sharing of publications (pre- or post- review copies, links) and datasets. Publications are automatically found and indexed from a number of major literature databases for example arXiv, PubMed, NASA, IEEE or CiteSeer and in most peer-reviewed journals;
- (3) Request of a copy of a paper if the paper is not freely available;
- (4) Contribute to scientific questions; obtain support for one's own science (online discussions);
- (5) Seek and build new collaborations;

Academic networks like ResearchGate or Academia.edu use the knowledge of the scientific crowd and bring forward the degree of formal and informal communication in earlier stages of research substantially.

Researchers are encouraged not only to upload successful results on these academic networks but also results from failed projects or experiments. Non-peer-reviewed materials, datasets and intermediate results can be added through manual file upload.

As there also exist risks in crowdsourcing science (Schildhauer and Voss 2014) sometimes it does make sense for researchers to switch to closed community networking tools. Collaborative work on research content and accompanying communication is supported in the following forms: (1) Cloud storage services like Dropbox, OneDrive or Google Drive focusing the storage and versioning of jointly used files (2) Wiki systems focusing on functionalities for collaborative content creation and (3) Frameworks for integrated team

collaboration like MS Sharepoint, Alfresco or Confluence. These Web 2.0 tools are suited in different ranges to support group communication and collaboration throughout all research phases from project initiation to project management and project documentation.

#### 4. CONCLUSION

Open Access initiatives and the power of scientific crowdsourcing tools are changing scholarly communication and can help scientists to openly share and discuss research issues throughout the entire research process and to make their body of work more visible within their research community in a highly networked online space. This is particularly relevant for young scientists developing their career network.

But the power of Web2.0 in scholarly communication is a two-edged sword. Although exchange of ideas and preliminary results and optimal collaboration throughout the overall research process is very important for the quality of research results the reputation of scientists today is still determined fundamentally by amount, quality parameters and citation number of papers published in journals or proceedings. Crowdsourcing and blogging efforts are of real benefit especially for young researchers but have not been rewarded in research evaluation yet. This situation is hopefully going to change soon.

Open Access publications have a significantly higher citation impact than non-Open Access publications and increase the citation indices that way. So it can be recommended to self-archive all publications with (co)authorship, to register on academic search engines and academic networks. Via personal accounts on ResearchGate and Google Scholar search machine indexed publications and citations are automatically integrated in the individual academic network profiles. This boosts the visibility of the scientific work and creates a valuable foundation for online connection, knowledge sharing, communication between experts, mentoring and the initiation of collaborations within this community.

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# DIGITAL DIVIDE AND ICT DEVELOPMENT IN RURAL AREAS IN THE CZECH REPUBLIC

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## ABSTRACT

The paper presents the selected aspects of the analysis of state and development of information and communication technologies (ICT) in rural regions of the Czech Republic. The aim of the solution is to capture current trends in the use of ICT in general (ICT adoption) with an emphasis on selected areas (broadband, social networks, e-Government, used categories of technical resources, used software, mobile communications, etc.). The research is focused on business entities in the agrarian sector. The goal of the research is to provide current and wide view of these problems, that are not satisfactorily and systematically solved in the Czech Republic, which should lead to several contributions as described in the paper. It has mapped a number of important factors of digital divide in the Czech Republic and consequently determined the possible solutions. Research is prepared and implemented by Department of Information Technologies at the Faculty of Economics and Management of the Czech University of Life Sciences in Prague. This article is focused especially on digital divide and broadband issue.

## KEYWORDS

Information and communication technologies, ICT adoption, broadband, digital divide, digital agenda, rural development.

## 1. INTRODUCTION

The dynamics of the development of information and communication technologies (ICT) is still very high in a number of ways. New categories of computer technology, especially the category of Personal Computers (smartphones, tablets, phablets, ultrabooks, etc.) the mass appear almost everywhere. Use of social networks and other ICT tools and their integration in the context of the enterprise informatics is recent phenomenon (see the issue of BYOD, Big Data, Cloud computing, Open Data, etc.). One of the basic preconditions for efficient use of the modern technology is high-speed connectivity and its wide area availability - often connected with mobility. The development of high-speed networks has a similar revolutionary impact today as the development of electrical energy and transport networks had many decades ago.

The main research goal is a complex analysis of the status and development of information and communication technologies in rural regions of the Czech Republic including the capture of current trends in ICT adoption. The research is primarily focused on primary agricultural enterprises but in general level captures the rural regions. It is part of the wider research focus of the university and the department. The solution is carried out in the context of strategic documents of the Digital Agenda for Europe (2010), in the Czech Republic conditions in particular the document State Policy in Electronic Communications - Digital Czech (2011).

Partial research objectives are to:

- analyse the development of internet connectivity in rural areas (here operates the vast majority of enterprises) with an emphasis on broadband and solving digital divide problem,
- identify facilities enterprises by technical equipment and capture new direction of the development (mobile technical instrument, personal computer instrument, networking solutions),
- chart used software (system software, economic and counselling programs, specialized software according to business orientation - animal production, plant production, etc.)
- find out and evaluate the e-Government environment in the interest group

- define the status and current trends of the use of ICT (main use of the Internet, mobile communication, the use of industry portals, mainly used sources of information, social networks, etc.)
- compare with developed countries (EU, world) and suggest a proposal of possible solutions.

## 2. CUSTOM SOLUTIONS

The Department of Information Technologies created several surveys among target farmers. The research builds on these extensive survey investigations which were done in recent years (the first survey was realized in the period 2000-2003, the last phase took place in the period 2009-2011). According to the dynamics of development is obvious that gradually been many significant changes in the ICT adoption and development of the area of interest. Therefore it is currently dealt with further follow-up phase from 2014 to 2016.

In the earlier stages of the investigation was a group of respondents composed of more than 3000 enterprises, of which cooperated with over 1200 businesses. The return of questionnaires is based on experience from previous years over 20%, involved are larger enterprises with cultivated area of over 80 ha of agricultural land. This survey was conducted currently which was focused on finding out the development in this group of cooperating companies. Here was obtained and is processed over 300 businesses. Main part of the survey was spread mostly by email and collected with use of own software solution, however some farmers were contacted via printed letters.

In "State Policy in Electronic Communications - Digital Czech" (2011), inter alia, the need to suppress the so called digital divide between citizens of cities and citizens in rural communities. It usually rises as a result of missing opportunities to connect with high-speed Internet and through his impossibility to use available facilities and services through the Internet. The adoption terms of modern instruments of ICT in rural areas and in terms of agricultural enterprises that operate here are long-term at a lower level against many other industries and environments of medium and large places. Czech Republic in many areas generally lags compared to developed countries of the EU and the world (an important example here is primarily broadband) Europe's Digital Competitiveness Report (2012). Thanks to the project solution will be mapped out a number of important factors of the digital divide in the Czech Republic. The result will be confronted with the situation in other countries. These problems are due to its importance continuously solved by authors from many countries across the continents, see eg. Khalil M. et al. (2013), Townstend L. et al (2013), Prieger J.E. (2013) or Sefika., M.R. and Mavetera, N. and Mavetera, C.G. (2012), in the Czech Republic and especially Šimek P. et al (2008) or Vaněk J. et al (2011).

Theoretical and practical solution brings several contributions for the society in Czech Republic:

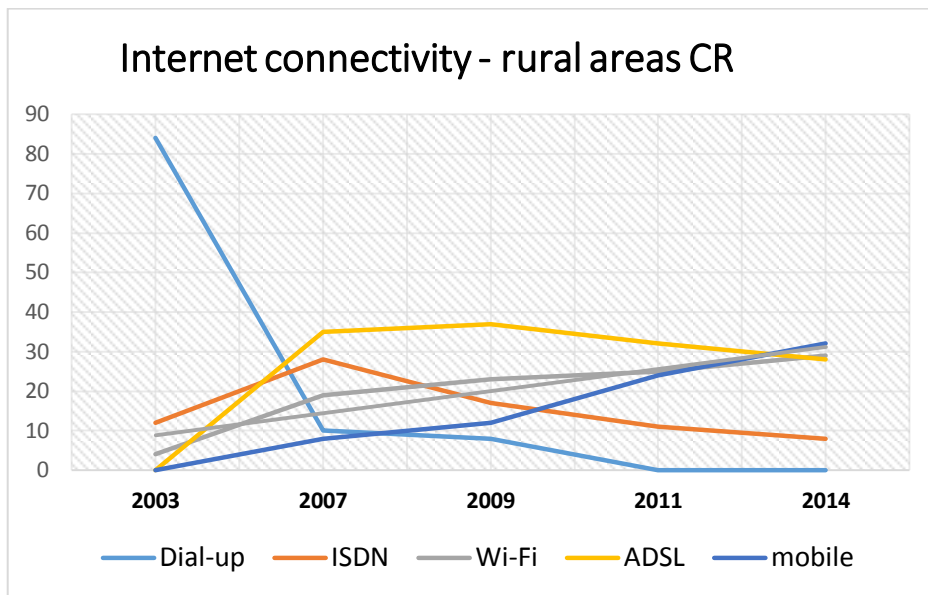
- filling the information gap in area of the analysis of the state and the development of information and communication technologies (ICT) in enterprises in agricultural production in the Czech Republic (in general in rural areas), including capturing current trends of ICT adoption, all in the context of EU environment and other developed countries,
- direct confrontation material and the declared content of National Policy in Electronic Communications - Digital Czech reality environment of rural areas,
- publish the obtained results and solutions to wider professional community.

This research is expected participation of the Ministry of Agriculture CZ, which has a considerable interest on mapping the current situation in the solved area. The project is implemented in cooperation with other selected sector departments (ASZ, AK, or SZIF).

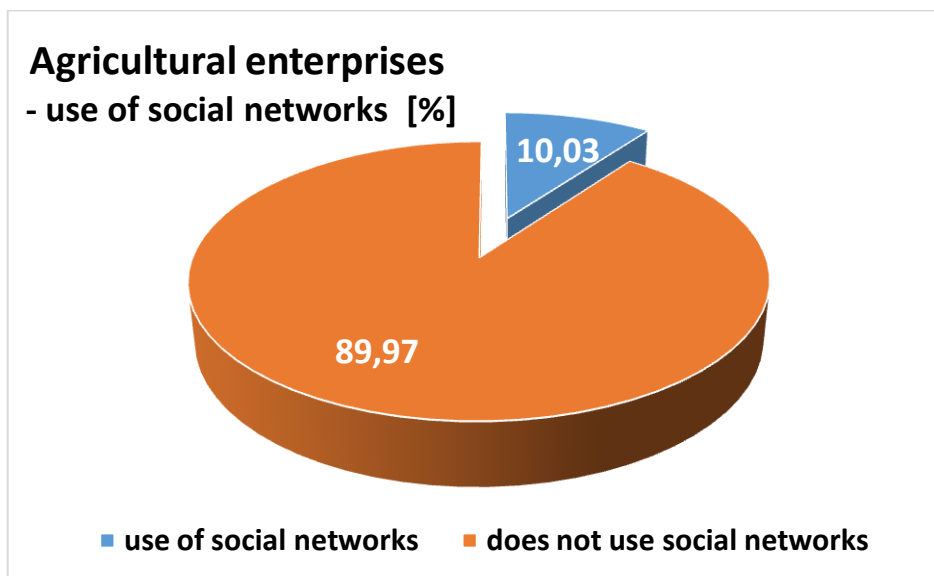
During the project solving is mainly used scientific methods of analysis and synthesis. The very methodical procedure involves in initial analysis of the current state of ICT development and the possibility of adoption corporate environment with regard to rural businesses and primary agricultural production. It is based also on the results and experiences of previous carried out investigations.

First, it is always carried out detailed design plan (content) investigation, methodically selected the appropriate target group. It is also necessary to update and verify the database reference companies develop an extensive program support (management survey, the way and form of questioning, websites, data validation, generation output, etc.). Then follows the pilot testing and gradual implementation of its own investigation, data processing and final presentation of results.

Detailed results of the investigation and the findings are published continuously. Some of the results are shown in following figures.



Graph 1. Internet connectivity in rural areas CR (2003- 2014)



Graph 2. Agricultural enterprises - use of social networks (5/2014)

### 3. CONCLUSION

Basic limiting condition for the development of the information society (solving the digital divide) in the Czech Republic is still the high-speed connectivity. The Czech Republic has long-term absence of national development strategies of the high-speed connection. This area, which is worldwide and within the EU devotes considerable attention in recent years, has been neglected and left without any real support. It currently has resulted in further deepening of the digital divide between urban and rural areas, but also deepening the differences between the Czech Republic and other developed countries.

In the countryside is used relatively available infrastructure of a telephone networks where is in many cases to able to realize an ADSL (or VDSL) connectivity. But there are a number of locations where it is not possible at all. In the case of ADSL, there is a standard maximum speed of 6 Mb / s but in many cases far less. According to the Czech statistical office overall the number of telephone lines in the Czech Republic continuously decreases (since 2000 in residential buildings on third) but in the rural areas is this kind of connection for those reasons still significant.

Development of the main types of connectivity to the survey results (2003 - 2014) shows Graph 1. There is no disclosure connectivity through cable television (DOCSIS) and satellite connection. These technologies have not been investigated until recently. It turns out, however, that even DOCSIS has a significant proportion on the rural area which is 2% according to an investigation, satellite connection then just 5%.

The solution could be a newly constructed LTE infrastructure which should theoretically be directed first to the rural areas. But reality of the Czech Republic is rather the opposite - there are covered first large residential complexes. Full coverage of the Czech Republic is expected until 2018.

Previous text shows the reasons, why Wi-Fi is currently a basic connectivity technology in rural areas, although it is not a primary intention. Wi-Fi even currently ranks the first place in the whole country.

## ACKNOWLEDGEMENT

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# Posters





# CHANGE IN THE INTERFERENCE CAUSED BY STRESSFUL EVENTS: EFICACY OF AN INTERNET-BASED INTERVENTION PROGRAM

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## ABSTRACT

Emotional disorders (ED) are one of the most common health problems worldwide. People suffering from ED often use maladaptive emotion regulation strategies and have low coping behaviour that contribute to the presence of symptoms. It is important to develop strategies to promote coping and emotion regulation in people exposed to high levels of stress. Information and Communication Technologies (ICT) can help us in this task. The Internet-based programs are effective. We have developed an Internet-based intervention based on classical CBT techniques which also includes positive psychological strategies to improve coping and positive mood. One hundred and twenty four participants who were having minimal, mild or moderate depression symptoms and experiencing at least one stressful event in their lives that produces interference, were randomly assigned in two groups: a group was assigned to the intervention program and a waiting list control group. The aim of this work is to present the evolution in the scores of the interference pre to post and the statistical differences between groups.

## KEYWORDS

Emotional disorders, Internet, Information and Communication Technologies, Interference, Stressful events

## 1. INTRODUCTION

ED (Anxiety disorders and Mood disorders) are one of the most common health problems worldwide, and their economic costs are very high. There is a significant relationship between depression, stress, and coping. Also, people with emotional disorders often use maladaptive emotion regulation strategies and have low coping behaviour that contributes to the presence of clinical symptoms (Barlow et al, 2011). Because of this, it is important to develop strategies to promote emotion regulation and coping abilities in people exposed to high levels of stress. The meta analytical studies on evidence-based CBT treatments delivered via the Internet show that these approaches are effective (Andrews et al, 2010). We have developed an intervention program that is self-applied via the Internet and tries to help people in the prevention of depression and anxiety symptoms, and in promoting coping ability and emotion regulation. The program is based on classical CBT techniques, such as behavioural activation. However, it also includes other positive psychological strategies to improve coping and positive mood (Riva et al, 2012). We applied this intervention program in people who lived a stressful event that produces interference. The aim of the present work is to present the evolution in the scores of the interference compared to a waiting list control group.

## 2. METHOD

We have developed an Internet-based program. The program is a multimedia (video, image, etc.) interactive program which allows the individual to learn and practice adaptive ways to cope with depressive symptoms and confront daily problems. It is designed for optimal use on a PC, but it can also be used on a tablet. The

therapeutic components of the program are: Motivation for Change, Psycho-education, Cognitive Restructuring, Behavioural Activation, Positive Psychology strategies, and Prevention of Relapse. The intervention protocol consists of eight interactive modules. The program starts with a 'Home module' that explains what the Intervention program is, its goals, who can benefit from it, terms and conditions, and who we are. Next is the 'Welcome module', which informs users about the content of each module and explains how to benefit from it. The content of the eight modules has been designed to break the vicious cycle of stress, isolation, depressive or anxiety symptoms, poor coping, and poor functioning (self-efficacy). It teaches a range of skills based on the positive psychology approach, with the main goal of promoting resilience. One hundred and twenty four participants who were having minimal, mild or moderate depression symptoms (score of not more than 28 on the Beck Depression Inventory-II (BDI-II)), and experiencing at least one stressful event in their lives that produces interference (unemployment, debts, legal issues) were randomly assigned to two groups: a group was assigned to the intervention program and a waiting list control group.

### 3. RESULTS

Analyses were carried out with those participants who at post-treatment were still living stressful events identified in the pre-treatment. The number of participants who were still living each stressor at post-treatment are shown in Table 1.

Table 1. Number and percentage of each present stressor in the lives of the participants at post.

Stressful event	N(%) post
Unemployment	83 (66.94%)
Other unemployed relatives	63 (50.81%)
Debts	45(36.29%)
Disease (own or other relatives)	71(57.26%)
Conflicts (work / family)	59(47.58%)

Note. N (%) = Number and percentage of each stressor at post-treatment.

Means and standard deviations of interference scores for all stressful events are displayed in Table 2. ANOVAs results indicated that the group effect was not significant in any of the variables, while the time effect and interaction effect were significant for all stressors (Table 3).

Table 2. Means and standard deviations of scores on the scale of interference (range 1 "no or less interference" to 10 "lot of interference") reported by participants at pre and post-treatment.

DV	Condition	N	Pre		Post	
			M	SD	M	SD
Unemployment	Interv	48	8.33	1.81	4.94	3.53
	WL	35	7.66	1.97	7.38	1.99
	Total	83	8.05	1.90	5.97	3.20
Other unemployed relatives	Interv	35	7.04	2.20	3.65	3.06
	WL	28	5.63	2.35	5.98	1.95
	Total	63	6.41	2.36	4.69	2.86
Debts	Interv	27	6.60	2.72	4.20	3.06
	WL	18	5.20	2.05	5.15	2.16
	Total	45	6.04	2.54	4.58	2.75
Disease (own or other relatives)	Interv	45	6.41	2.36	4.23	3.08
	WL	26	6.04	2.65	6.03	2.38
	Total	71	6.27	2.46	4.89	2.96
Conflicts (work / family)	Interv	30	6.48	2.25	4.23	2.99
	WL	29	5.75	2.14	6.14	2.09
	Total	59	6.12	2.21	5.16	2.74

Note. DV=Dependent Variable; Pre=Pre-treatment data; Post=post-treatment data; Interv=intervention group; WL=waiting list control group.

Table 3. Analysis of variance of interference caused by different stressors pre to post treatment.

DV	Group Effect			Time Effect			Interaction Effect		
	F	p	n2p	F	p	n2p	F	p	n2p
Unemployment	3.35	0.071	0.040	45.91	<0.001	0.362	32.87	<0.001	0.289
Other unemployed relatives	0.82	0.370	0.013	17.97	<0.001	0.228	27.30	<0.001	0.309
Debts	0.11	0.742	0.003	8.85	0.005	0.171	8.14	0.007	0.159
Disease (own or other relatives)	1.52	0.222	0.021	13.01	0.001	0.159	12.86	0.001	0.157
Conflicts (work / family)	1.14	0.289	0.020	10.20	0.002	0.152	20.46	<0.001	0.264

Note. DV=Dependent Variable

#### 4. CONCLUSION

The data obtained in the pre-post comparisons of interference caused by the different stressors indicate that for those participants who performed the intervention their perceived interference was significantly reduced compared to the waiting list control group. All analyzed participants were still living stressful events at post-treatment. Therefore, we can hypothesize that one of the main objectives of this intervention program was fulfilled, that is, to provide strategies to promote coping abilities and emotional regulation for coping with difficult situations.

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# SEMANTIC CLASSIFICATION OF TEXT MESSAGES USING THE CONCEPT OF COMMUNITY IN SOCIAL NETWORK ANALYSIS

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## ABSTRACT

In this study, we attempted to classify the massive amount of text data written in a BBS based on the extent of co-occurrence of words within each message. The concept of community in social network analysis was used for classification, and through a simulated annealing algorithm, the community and connection component to which each word belonged was identified. As a result, the semantic consistency in each connection component and community was established to a certain extent.

## KEYWORDS

Social Network Analysis, Community, Connection Component, Semantic Classification, Overview of Messages.

## 1. INTRODUCTION

The demand for an automatic grasp of the overview of massive text messages is increasing as utilization of BBSs, LMSs, SNSs, among others in educational activities becomes more prevalent, and the amount of available computerized text data from these activities increases. In Japan, as morphological analysis has become more easily available, keyword frequency has begun to be used as a metric for simple analysis (Matsukawa et.al. 2002). Furthermore, cluster analysis and social network analysis of keywords have recently increased in popularity.

Cluster analysis is a method used to find groups of words with high similarity. It is often used to obtain groups of words based on co-occurrence of words, and then provides a visualization of these groups through a dendrogram (Fushikida 2012). This method is useful to ascertain groups of topics in text messages, but the large number of keywords renders the dendrogram too large and complex to obtain a complete picture or to grasp a full understanding of the individual groups of words with high similarity.

In social network analysis, visualization of the connection of words based on co-occurrence of words is frequently used (Oshima et.al. 2012). This method is also useful to grasp the keywords that are related each other, but the large number of keywords causes the same kind of problem as in cluster analysis, rendering a too large and complex visualized network.

To avoid this problem, this project focused on the concept of community in social network analysis. Community is the subgroup with high cohesion in a connected component in the network, and many methods to identify community have been recently developed. By using these methods, we can recognize the community to which each word belongs based not on a visual judgment but on a certain mathematical criteria. In this study we attempt to extract several groups of topics from message written in BBS utilizing the concept of community in social network analysis.

As to the semantic classification of documents, there have been sophisticated approaches such as LSA (Latent Semantic Analysis) (e.g., Kuralenok and Nekrest'yanov 2000) or Topic Model (e.g., Blei et.al. 2003), and the result of this study might be expected to be similar to theirs. However, this study tries to present an alternative approach employing the framework of social network analysis, and therefore may achieve distinctive results.

Table 1. Procedure of analysis

1 morphological analysis
2 making a frequency matrix based on co-occurrence of words in each message
3 making a similarity matrix using Jaccard index
4 making a adjacency matrix (round off the value of similarity matrix, replace the value below criterion to zero, etc.)
5 loading an adjacency matrix using R and igraph
6 identifying each connection component
7 identifying community and betweenness of each word using simulated annealing algorithm
8 saving output

## 2. METHOD

A total of 109,314 messages posted between April 1 and 2011 to March 31, 2011 on a BBS operated by a Japanese educational company for parents who have 7-11 month children was chosen as the analytical target. The procedure of analysis detailed in Table 1. Through morphological analysis, we obtained 19,318,763 words, of which 46,982 were unique. We selected the top 9000 most frequent keywords whose parts of speech were verb, noun, adjective, adverb, or adnominal adjective. Using these keywords, we created a 9000 by 9000 frequency matrix, verifying the co-occurrence relation of each word in each message. If co-occurrence in a message was found, we added 1 to the appropriate place in the matrix. No weight was given in cases where the same word appeared multiple times in a message.

To obtain a similarity matrix from the frequency matrix, we calculated the Jaccard index  $Jaccard(i,j)$  from the following formula. In this formula,  $m(i)$  refers to the number of messages that contain word(i),  $m(j)$  refers to the number of messages that contain word(j), and  $m(i,j)$  indicates the number of message that contain both word(i) and word(j).

$$Jaccard(i,j) = m(i,j) / \{m(i) + m(j) - m(i,j)\}$$

The Jaccard index value ranges from 0 to 1, and we can conclude that elements have a certain extent of relevance when the value is around 0.1. As social network analysis deals with integer matrices, we decupled and round off the similarity matrix values, replacing those under 1 with 0. In this process, words that did not have relevance with more than two other words were removed from data set.

Using R and igraph, this matrix was loaded as an adjacency matrix, and the betweenness centrality of each word and the communities in which each word belonged were calculated with respect to each connected component. We used a simulated annealing algorithm in order to identify community. The result was obtained as a table in a text file. The R commands used for this analysis are shown in Table 2. These commands were determined by reference to Sato (2013).

Table 2. R Commands

```
library(igraph) # Read package
d <- as.matrix(read.table("data.txt", sep="," , header=T)) # Read data
g <- graph.adjacency(d, mode="undirected", weighted=TRUE) # Convert to an adjacency matrix
dcg <- decompose.graph(g) # Divide into connection components
sp.df.all <- c() # Set the data frame to contain results
for (i in 1:length(dcg)){
  set.seed(1) # Set the seed
  bw <- betweenness(dcg[[i]]) # Betweenness of each word in each connection components
  sp <- spinglass.community(dcg[[i]]) # Identify the community using a simulated annealing algorithm
  sp.df <- cbind(i, as.data.frame(sp$names), as.data.frame(sp$membership), as.data.frame(bw))
  sp.df.all <- rbind(sp.df.all, sp.df) # Combine the results
} # Save the results to a file
colnames(sp.df.all) <- c("i", "NodeName", "Community", "betweenness")
write.table(sp.df.all, "Community.txt", row.name=F, col.names=T, sep=" ", quote=F, append=F)
```

## 3. RESULT AND DISCUSSION

From our text analysis, we were able to identify which connection component and community each word belonged to, as well as the degree of betweenness centrality in 403 words. There were 16 connection

components, and each connection component contained between 1 and 14 communities. The largest community consisted of 73 words, while the smallest community contained only 2. A sample of the result is displayed in Table 3. The words shown in the “included words” column are representative words of the community. Ten words were selected in order of betweenness value for each community, however additional words were added if the interpretation seemed to be difficult. From this table, we can see that connection component 1 generally consisted of semantically independent communities, while other connection components appeared to represent one meaning through all their subordinate communities. In any case, it seemed that appropriate semantic categories were selected, as even comparatively similar topics, such as “fever” and “immunization” were distinguishable. One community meaning was not clear (connection component 1, community 12), but further inspection suggests the possibility of a special case representing a general topic, as it was the largest community, and most of the contained words were very basic, such as “let,” “say,” and “I.”

Table 3. Result of analysis

connection component	community	topics	included words
1	1	breast-feeding	飲む(drink), 離乳食(baby food), 食べる(eat), 食(eating), 抱っこ(huggy), 夜(night), 5(5), おっぱい(breast), 起きる(wake up), 度(times), 寝る(sleep), 時間(time), 3(3), ミルク(milk), 7(7), 6(6), 時(hour)
1	3	fever	薬(medicine), 小児科(pediatrics), 病院(hospital), 熱(fever), 症状(symptom), 鼻水(snivel), 受診(visiting a doctor), 咳(snivel), 処方(prescription), 発熱(fever), 発疹(anthema), 高熱(high fever)
1	4	immunization	接種(inoculation), ヒブ(Haemophilus influenzae b), 集団(group), 感染(infection), ワクチン(vaccine), ポリオ(polio), 肺炎(pneumonia), 球菌(micrococcus), 打つ(inoculate), 予防(prophylaxis), 化(-ize)
1	12	unspecified wide range of topics	せる(let), 言う(say), 出る(come out), 旦那(husband), れる(can), 私(I), 子(child), 一(one), 自分(myself), 歳(age), 人(people), 2(two), 1(one), さん(Mr. or Ms.)なる(become)
1	13	baby food	野菜(vegetable), カボチャ(pumpkin), パン(berad), 人参(carrot), 混ぜる(mix), 作る(cook), ヨーグルト(yogurt), トマト(tomato), ブロッコリー(broccoli), ほうれん草(spinach)
2	1	ceremony and celebration	お祝い(celebration), ケーキ(cake), 日(day), 誕生(birth)
2	2		初節句(first seasonal festival), お雛様(hina doll), 飾る(display), 人形(doll), 雛人形(hina doll)
2	3		段飾り(stepwise display), 飾り(display), 親王(imperial prince), 飾り(displaying)
15	1	Disneyland	ランド(land), ミッキー(Mickey), アトラクション(attraction), シー(sea)
15	2		ショー(show), パレード(parade)
16	1	plane	離陸(takeoff), フライト(flight), 機内(inside an airplane), 搭乗(boarding)

Results indicate that the concept of community in social network analysis seems to be applicable for grasping the overview of massive text messages. Future research should be conducted in order to confirm the validity of these results, comparing with results for sampled messages classified by hand and with results obtained from other methods such as LSA or Topic Model.

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# HOW DO USERS IMAGINE AUDIENCES ON SOCIAL MEDIA SITES?

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## ABSTRACT

Twitter users' concerns and attitudes regarding their audiences were examined by means of an online survey to explore factors that influence the process of imagining an audience. The results showed participants' inadequate consideration regarding imagined audiences.

## KEYWORDS

Social media site, Twitter, imagined audience, privacy

## 1. INTRODUCTION

The diffusion of social media sites, including social networking sites (SNSs), Twitter, blogs, and video sharing sites, has been remarkable; clearly, these sites have permeated our daily lives. These sites are vehicles for sharing various types of user-created content (e.g., comments, photos, and videos). Frequently, shared information is related to users' daily lives. Therefore, users must know how to control the disclosure of information online to manage their privacy. Numerous studies related to privacy in the online environment have been conducted from a variety of viewpoints, such as examining risks and repercussions of information disclosure, exploring required conditions of security policies or laws regulating online information gathering, and suggesting practical functions of privacy settings. As a framework for such research studies, an understanding of users' behaviors related to managing privacy is necessary.

As many studies are pointing out, one of the difficulties in managing privacy in the online environment is the configuration of invisible audiences. It is difficult for users to imagine who has accessed their content. Bernstein et al. (2013) found that "social media site users consistently underestimate their audience size for their posts, guessing that their audience is just 27% of its true size." The discrepancy between an "imagined audience" and the "actual audience" may be related to breaches of privacy. De Wolf and Pierson (2014), by drawing on the theories of symbolic interactionism and communication privacy management theory, stated that "knowing one's audience is [the] key for the development and management of [the] privacy rule."

This study was undertaken to investigate how users of social media sites imagine audiences when they post. The findings shed light on users' behavior related to management of privacy.

## 2. BACKGROUND

Brake (2012) conducted in-depth interviews with 23 personal bloggers to investigate writers' conceptions regarding their relationships with their audiences. The results revealed that respondents did not typically use web log analysis tools (software); further, they often appeared to imagine their readers as they would like them to be rather than attempting to discern exactly who they might be. Marwick and boyd (2011) investigated how Twitter users conceptualize their audiences and address them based on their conceptions. The researchers found that some techniques of managing audiences resemble the practices of "micro-celebrities." Furthermore, personal branding practices have been observed. Both studies mentioned here focus on the "imagined audience." Bernstein et al. (2013) examined how closely users' perceptions of their audiences matched their actual audiences on Facebook. Qualitative coding of survey responses revealed that

some folk theories were employed to estimate audiences, though none of these approaches proved particularly accurate. In this paper, details of factors related to estimation of audiences are not mentioned. Litt (2012) provided a theoretical framework based on articles about imagined audiences. The framework consists of two parts: structural or macro-level factors and agency or micro-level factors. Structural factors cover social roles, social contexts, the active audience, and features of sites/services. Agency factors include social skills, motivation, and Internet skills. Litt referred to the necessity of exploring the imagined audience in more depth with a research method involving both qualitative and quantitative techniques.

The aim of this study is to reveal social media users' behavior toward their imagined audiences and factors influencing such behavior with the use of qualitative and quantitative techniques. In this paper Twitter users' concerns and attitudes about their audiences were examined through use of an online survey (quantitative method) to explore the factors influencing the process of imagining an audience.

### 3. INVESTIGATION

The survey for this study was conducted in December 2014, and university students in Japan were invited to participate after being provided information about the aim of the study and the voluntary and confidential nature of participation. A total of 127 university students enrolled in computer classes completed the applicable questionnaire. Of these, 59 of the respondents reported that they were Twitter users, and they became the main subjects for this analysis. The subjects ranged in age from 18 to 25 years, with the average age being 20.4. There were 47 male students (79.7%) and 12 female students (20.3%).

The online questionnaire included the following: 1) questions about users with whom they had interactions on Twitter, such as their followers and those whom they followed, 2) questions about attitudes and concerns related to their Twitter posts, 3) questions about imagined audiences (e.g., imagined readers of their posts), and 4) questions about attitudes toward other users' posts.

### 4. RESULTS

Regarding respondents' relations with other Twitter users, the average number was 185.0, although the range was 0–1352. Constituent users were clustered into four categories according to Stutzman and Kramer-Duffield (2010): 1) strong ties such as best friends, boyfriend/girlfriend, and family; 2) weak ties such as friends, their senior/junior, relatives, and acquaintances from the campus or part-time jobs, 3) outsiders such as friends of friends, faculty members, and university staff, and 4) online only contacts. The percentages of respondents who stated that they had interactions with those categorized into each category to all respondents are 79.7%, 86.4%, 28.8%, and 54.2%, respectively.

Regarding attitudes and concerns related to their Twitter posts, 47 (79.7%) respondents answered that they had no specific targets for their posts; five respondents (8.5%) identified their best friends as targets, and four (6.8%) identified their friends as targets. Further, 15 respondents cited that they had experience with unexpected users reading their posts. Regarding the question "Are you concerned about who reads your posts?", 49 (83.1%) answered that they were "not concerned at all" or "not concerned." Ten (16.9%) responded that they were "concerned" or "very concerned."

Regarding the imagined audience, respondents' estimations of size ranged from 0 to 4 billion. Further, 41 (69.5%) respondents estimated their imagined audience to be less than users with whom they had relationships; and nine (15.3%) estimated that the imagined audience was equal to those with whom they had relationships. Another nine (15.3%) estimated that their respective audiences were greater than those with whom they had relationships. Eleven categories except for no response were identified as bases of estimation (Table 1). The compositions of imagined audiences are shown in Table 2.

Regarding attitudes toward other users' posts, 19 (32.2%) respondents reported that they had pretended not to read others' posts, although they actually had read them. Regarding the question "Do you comment on others' posts?", 25 (42.4%) participants responded "not at all" or "not often," and 34 (57.6%) responded "often" or "very often." Concerning retweets, 22 (37.3%) respondents indicated their behavior as "not at all" or "not often" and 37 (62.7%) indicated that they engaged in retweeting "often" or "very often."



Table 1. Bases of estimated size of imagined audience

Bases of estimation	Number (%)
Number of followers and number followed	10 (16.9)
Characteristics of Twitter	8 (13.6)
Nothing (just a guess)	6 (10.2)
Number of replies	6 (10.2)
Number of posts (usage)	5 (8.5)
Number of friends	4 (6.8)
Guess regarding usage of others	3 (5.1)
Number of audience on other sites	2 (3.4)
Number of users on timeline	1 (1.7)
Privacy settings	1 (1.7)
Personal usage	1 (1.7)
Cue from offline	1 (1.7)
No response	11 (18.6)
<b>Total</b>	<b>59</b>

Table 2. Composition of imagined audience (except for no response)

Imagined audience	Number (%)
Strong ties and weak ties	10 (23.3)
Strong ties, weak ties, and outsiders	9 (20.9)
Weak ties	5 (11.6)
Strong ties	5 (11.6)
Strong ties, weak ties, outsiders and online only contacts	5 (11.6)
Nobody	4 (9.3)
Strong ties, weak ties, and online only contacts	4 (9.3)
Online only contacts	1 (2.3)
<b>Total</b>	<b>43</b>

## 5. DISCUSSION AND CONCLUSION

The majority of respondents in this survey had relationships with users categorized as strong or weak ties, but half of the participants indicated that their relationships were with those known only online. Although many researchers claim that multiple audiences in social media are collapsed into single contexts, respondents of the survey for the current study also had multiple audiences. However, nearly 80% (47) of respondents indicated that they typically posted without imagining a specific target, and 85% (40 of 47) indicated that they were not concerned about who read their posts. As Table 2 shows, 20 respondents imagined that comparatively close users (strong and weak ties (10), weak ties (5) and strong ties (5) )read their posts, and 50(84.7%) respondents estimated the imagined audience as less than or equal to users with whom they had relationships. Only nine individuals estimated that their audience included more users than those with whom they had relationships. Posts on Twitter can be accessed by anyone unless users change security settings; interestingly, nearly half of the survey respondents indicated that they had not changed these settings. Thus, the responses suggest that views regarding audiences reflect inadequate consideration.

Regarding the bases for size estimations number of imagined audiences, many of the responses were consistent with Bernstein et al. (2013). A number of respondents based their estimates on the number of followers and those followed and/or replies and friends (easy cues). On the other hand, a few participants described their cues as offline and their personal use of Twitter as bases of estimation. Because the survey used in this study was performed via an online questionnaire, the respondents were supposed to answer questions without considering various scenarios; therefore, in-depth interviews based on findings from this survey are needed in a future investigation.

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# ACCEPTABILITY OF AN EMOTIONAL THERAPY SYSTEM (TEO) FOR DELIVERING HOMEWORK IN THE TREATMENT OF ADJUSTMENT DISORDERS

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## ABSTRACT

Adjustment disorders (AD) are one of the most frequent psychological problems within the primary care and hospital settings. Our research team has developed and tested a 6-8 sessions Cognitive-behavioral Therapy program to treat AD supported by Virtual Reality. In order to improve this treatment protocol, an online Emotional Therapy System (TEO) has been used to deliver therapeutic homework. TEO is a completely open system that allows therapists to create and send personalized therapeutic material to patients via the Internet in an easy way. It makes possible to cover all types of needs and optimize therapy. Data about preferences before and after treatment about TEO versus the traditional homework format has already been obtained. This work in progress presents preliminary results about patients' acceptability regarding the use of TEO system in the between homework sessions

## KEYWORDS

Cognitive-behavioral treatment, Adjustment disorders, Internet, Acceptability, Homework Assignments

## 1. INTRODUCTION

Adjustment Disorders (AD) are one of the most frequent psychological problems within the primary care and hospital settings and causes a great personal suffering and a high percentage of sick leaves (Catalina et al., 2012). Our research team has developed (Botella et al., 2008) and tested in the long term (Quero et al., 2013) a Cognitive-behavioural Therapy (CBT) program for the treatment of AD which includes 6-8 weekly therapy sessions and uses an adaptive Virtual Reality system (EMMA's World). In order to improve this treatment protocol, Information and Communication Technologies (ICTs) have been transferred to the patient's home. An Online Emotional Therapy System (TEO) has been used to deliver homework assignments between sessions. TEO system allows in a simple way to create personalized therapeutic material and to present it to the patient via Internet. Data about preferences before and after treatment about TEO versus the traditional homework format have been already obtained (Quero et al., 2014). The aim of the present work is to show preliminary results about the patients' acceptability regarding the first use of the TEO system to practice homework between therapy sessions.

## 2. METHOD

### 2.1 Design and Procedure

Twelve patients (10 female; 2 male) who met diagnostic criteria for AD (DSM-IV-TR; APA, 2002) composed the sample (mean age=27.5; SD=7.98). All of them received a CBT program for this problem, with the following therapeutic components: educational component, elaboration/processing of the stressful event with EMMA's World and relapse prevention. The homework therapeutic component was applied using TEO. We developed a homework assignments protocol composed of different multimedia materials (audios, videos, texts and images) which allowed the patients to practice at home the main therapeutic contents

(Quero et al., 2012). The procedure was the following: After each treatment session, patients practiced the TEO homework session assigned by the therapist. Patients could do the homework sessions as many times as they wanted during the between sessions period. They could access it with a user and a password received by e-mail advancing in a lineal way with the support of TEO system tutorials. Once each homework session was done, they answered the following questions in the system: *To which extent did you like the activity you have done today?*, *To which extent do you believe the homework session was useful?*, *To which extent did you find the homework session easy to use?* *To which extent would you recommend this system to other people?*. In this work, acceptability data about the first time that patients did every TEO homework session along the treatment program are presented.

## 2.2 TEO System

TEO is a Web technology- based system ([www.teo.uji.es](http://www.teo.uji.es)) that includes 2 platforms: 1) Therapist platform: The therapist can manage and administer the users and the results of treatment of each user, create sessions, and customize treatment protocols using multimedia materials included in the TEO multimedia database (pictures, texts, narratives, music, and videos), view the content (see Fig 1) and assign sessions as well as treatment and assessment protocols to the patients. 2) Patient platform: Users can complete the pre-session assessment protocol, they can visualize the homework sessions assigned by their therapist and move around a virtual environment (they can choose a beach or a forest environment) at the end of each session to reflect on the session and their experience (see Fig 2).



Figure 1. Therapist Platform: Multimedia contents



Figure 2. Patient platform: Virtual Environments

## 3. RESULTS

Results showed in general high scores for all acceptability measures (see Table 1). Furthermore, ANOVAs results indicated a significant time effect for satisfaction and utility. In both cases a gradual increase is observed throughout sessions, reaching statistical significance for Sessions 2, 3, 5 and 6, compared to session 1 in the case of satisfaction and for Sessions 2, 5 and 6 in the case of utility.

Table 1. Means and standard deviations of acceptability questions reported by participants

DV	Session	M	SD	DV	Session	M	SD
Satisfaction	S1	6,08	1,73	Utility	S1	5,33	1,92
	S2*	7,83	1,27		S2*	7,50	1,68
	S3*	7,58	1,62		S3	7,75	1,29
	S4	7,75	2,05		S4	7,83	2,12
	S5*	8,83	1,40		S5*	8,42	1,16
	S6*	8,42	1,88		S6*	8,67	1,92
Easy to use	S1	8,73	1,90	Recommendable	S1	7,73	1,49
	S2	8,42	2,02		S2	8,58	1,44
	S3	8,25	2,22		S3	8,58	1,00
	S4	9,45	0,69		S4	8,00	1,95
	S5	9,33	0,65		S5	8,83	0,94
	S6	8,92	1,56		S6	8,58	1,24

Note: \* Homework sessions which were statistically significant

## 4. CONCLUSION

Data obtained in the present work indicate a good acceptance of the TEO system for practicing homework by the patients. They found the system very easy to use (scores above 8 in all sessions) and would recommend TEO to other people. Furthermore, satisfaction and utility scores reported by the patients in all homework sessions were very high and they even increased significantly throughout the therapy sessions. A good acceptance of using TEO at the patient's home implies to overcome a barrier and shows the possibility of transferring ICTs to the patient's home to deliver homework therapeutic component in this case.

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