European Commission

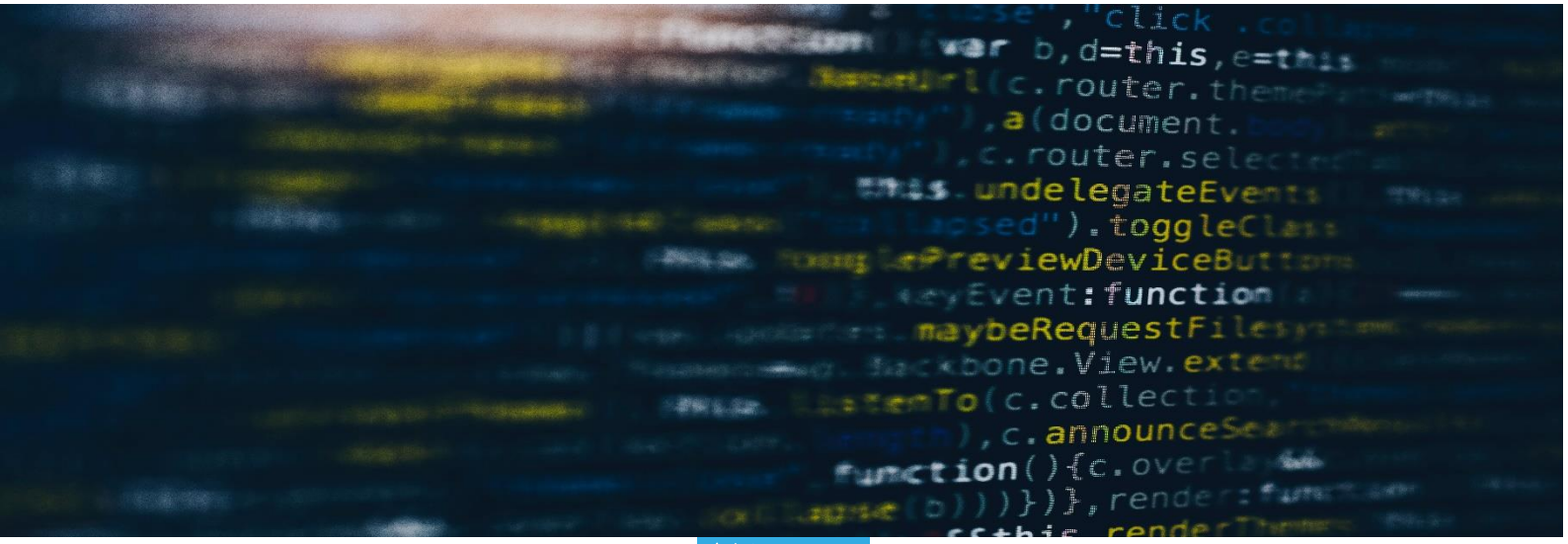
JRC CONFERENCE AND WORKSHOP REPORT

Enlargement and Integration Workshop

“Digital Transformation, Data and AI in the Western Balkans”

Edited by Delipetrev B., Idrizi B., and Chukaliev O.

2022



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EU Science Hub
https://ec.europa.eu/jrc

JRC129903

PDF ISBN 978-92-76-53599-7 doi:10.2760/863985

Luxembourg: Publications Office of the European Union, 2022

How to cite this report: Delipetrev, B., Idrizi, B., Chukaliev, O., *Enlargement and Integration Workshop "Digital Transformation, Data and AI in the Western Balkans"*, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53599-7, doi:10.2760/863985, JRC129903.

Contents

Abstract

This report contains a set of extended abstracts presented at the workshop "Digital Transformation, Data and AI in the Western Balkans", that was held between 9 and 11 December 2021 in Skopje, North Macedonia. The workshop aim was to discuss Europe's ambition to become the world-leading region for developing and deploying cutting edge, ethical and secure AI, data and digital transformation services and to promote a human-centric approach in the global context. It concluded that this agenda is also important for the Western Balkan (WB) region, which can, in turn, adopt and benefit from these emerging technologies. The workshop objectives were:

- Update participants on the EU's policy on digital transformation, data and Artificial Intelligence.
- Discuss about the main factors that can help or hinder the introduction of digital transformation in Western Balkan countries.
- Present the state-of-play, opportunities, trends and likely impacts of Digital transformation, Data and AI in the Western Balkans.
- Discuss on the added value of the adoption of digital technologies and AI including the drivers, enablers, barriers, and risks and related mitigation actions, specific to the Western Balkans context.
- Discuss regional differences in the attitudes towards digital technologies and AI.

The workshop hosted 102 participants from 12 countries including EU Member States: Bulgaria, Croatia, Slovenia and Italy; candidate and potential candidate countries Albania, Bosnia and Herzegovina, Kosovo (This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence), North Macedonia, Serbia and Turkey; European neighbourhood policy countries associated to Horizon 2020: Moldova and Ukraine. During the three workshop days, participants discussed the state of play of digital transformation in the respective countries, the implementation of AI in education, society, public services, business, exchanged good practices, established partnerships, and ultimately learned from each other.

Acknowledgements

This JRC Report is based on the materials and presentations delivered during the workshop “Digital Transformation, Data and AI in the Western Balkans" that was organised by the European Commission Joint Research Centre (JRC) in collaboration with the Food and Agricultural Organisation of the United Nations (FAO), the United Nations Global Geospatial Information Management (UN GGIM) and the University Ss Cyril and Methodius in Skopje (UKIM). The workshop was opened by H.E. Julian VASSALLO, Deputy Head of EU Delegation to North Macedonia, followed by Carlos TORRECILLA SALINAS, Head of Unit at the European Commission Joint Research Centre, Jeton SHAQIRI, Minister of Information society and administration, North Macedonia Government, Prof. Dr. Nikola JANKULOVSKI, Rector of University Ss Cyril and Methodius in Skopje and Mr. Trajan ANGELOSKI, President of Macedonian Chambers of Commerce. The workshop had more than 100 participants from WB and EU representing the public sector, civil society, academia and business, which exchanged good practices and established partnerships.

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The report is edited by Blagoj DELIPETREV, Bashkim IDRIZI and Ordan CHUKALIEV.

1 Introduction

The convergence of Digital Transformation, Data, and Artificial intelligence has made a profound transformation of our economy and society. Digital Transformation, Data, and Artificial Intelligence are pillars of modern society and together with the European Green Deal are the flagship priorities of the EU. Many applications from these technologies have started entering our daily lives, from image recognition, machine translation and autonomous systems that are increasingly deployed on the web, commerce, industry, and government.

EU's ambition is to become the world-leading region for developing and deploying cutting edge, ethical and secure AI and Data services as well as to promote a human-centric approach in the global context. Western Balkan (WB) countries, as EU candidate and accession countries, should adopt, benefit, and collaborate in these emerging initiatives with their partners from the EU. Within this context, the European Commission's Joint Research Centre (JRC) in collaboration with the Food and Agricultural Organisation of the United Nations (FAO), the United Nations Global Geospatial Information Management (UN GGIM), and the University Ss. Cyril and Methodius in Skopje (UKIM) have organized the workshop "Digital Transformation, Data and AI in the Western Balkans" in Skopje, 9-11 December 2021. The workshop was opened by H.E. Julian VASSALLO, Deputy Head of EU Delegation to North Macedonia. The workshop gathered 102 participants from WB and EU representing the public sector, civil society, academia, and business.

The workshop program had 47 presentations on the impacts of digital technologies, data and AI from global, regional, national, and local perspectives. The abstracts of these presentations are included in this JRC report. Chapter 2 is divided into nine groups of abstracts:

- Data and Artificial intelligence as drivers of digital transformation with examples from European Commission, FAO, World Bank. UN GGIM and University Ss Cyril and Methodius in Skopje.
- Data and Artificial Intelligence.
- Data and geospatial intelligence.
- Digital transformation of land administration institutions and NSDI.
- Start-ups & companies in Artificial Intelligence and geospatial software.
- Data, digital transformation, and AI in public institutions.
- Blockchain, Economy and Society.
- Digital transformation and Artificial intelligence in Education.
- Data, digital transformation, and AI in public institutions.

Chapter 3 describes the identification of good practices and added value in WB countries derived from the 28 papers and abstracts presented at the workshop. Finally, Chapter 4 presents the workshop conclusions.

2 Conference highlights

2.1 Data and Artificial intelligence as drivers of Digital Transformation

2.1.1 A European approach to data sharing

Alexander KOTSEV, European Commission, Joint Research Centre.

- The European Strategy for Data published by the European Commission in February 2020, devising a European way of data sharing and establishing a single market for data through sector-specific data spaces.
- A transition from a purely open to a shared data is emerging that would facilitate the sharing and combined use of data at European scale.
- A common European data spaces framework would allow the free flow of data with and varying degree of accessibility and interoperability across sectors and borders.
- The JRC supports the EU Strategy for Data by identifying appropriate governance models, sustainability approaches for data sharing, technical building blocks, relevant standards, and by evaluating social and economic impacts.
- Contribution of public sector data is achieved through INSPIRE, an infrastructure for spatial information in Europe representing one of the biggest geospatial data sharing initiatives in the world.
- INSPIRE offers a rich ecosystem of tools providing geospatial data sharing, data availability improvement, and monitoring of the available information from the member states.

The green and digital transition, combined, are among the top priorities of the European Union. Those two dimensions are interlinked and dependent on each other. Therefore, the European Commission has taken the lead to drive them together (referred to as a twin transition). Numerous legal and financial instruments are in place that define the principles and focus investments on recovery and resilience efforts based on European values and legal frameworks. Specifically, the European Green Deal[1] recognises the potential of digitalisation to achieve the environment and climate aims and the need to develop and leverage greener digital technologies. In addition, the European Strategy for Data defines a vision for the establishment of a single market for Data in Europe based on domain-specific data spaces in strategic sectors such as mobility, agriculture, public sector. A dedicated Green Deal data space is also foreseen in the Strategy fully in line with the European Green Deal priorities. Several legislative initiatives aim at making the European strategy for data a reality (Figure 1).

[1] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

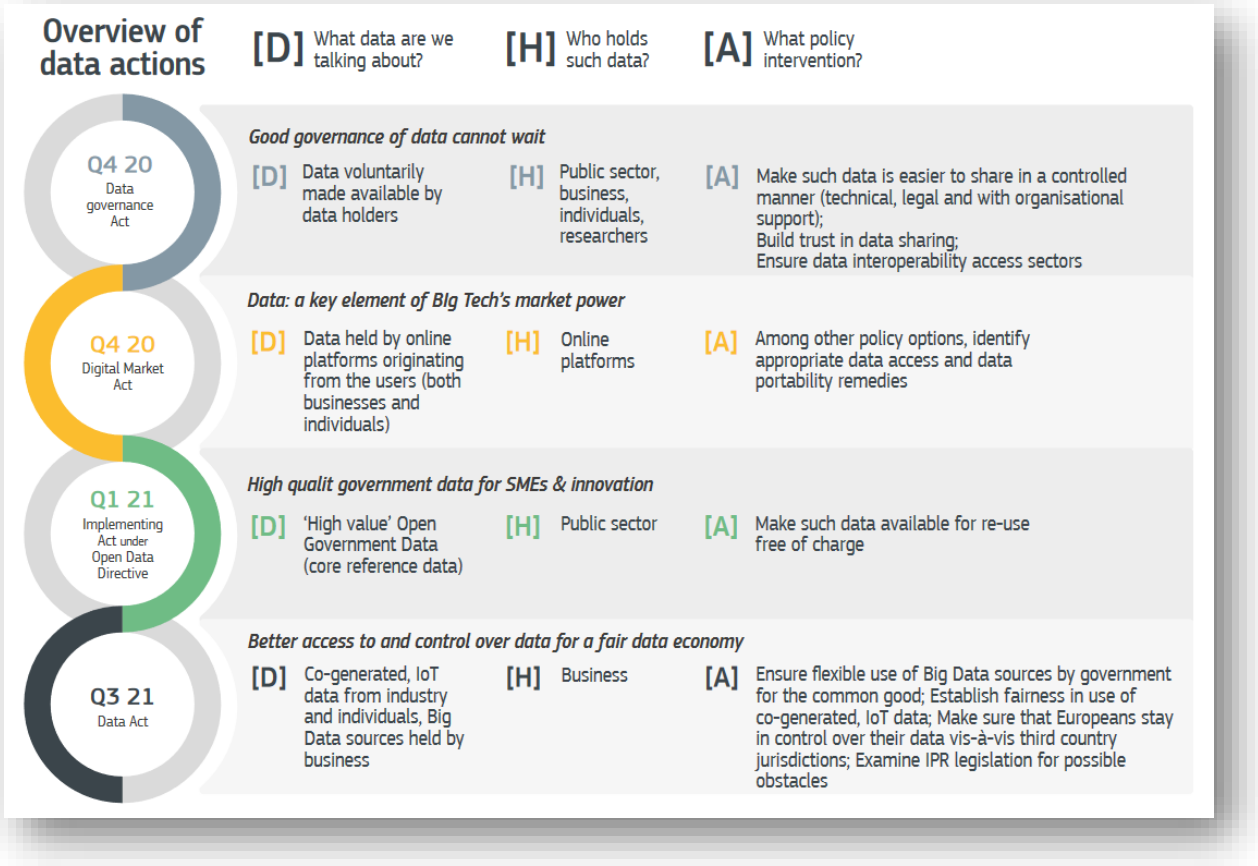


Figure 1. Legal initiatives implementing the European Strategy for Data. Source: European Commission, 2020

Importantly, interoperability plays a key role in the strategy for the exploitation of the data value within the envisioned common European data spaces in all the EU strategic sectors. Together with data availability, quality, governance and literacy, the strategy identifies interoperability as a key barrier holding the EU back from realising its full potential in the data economy. Under the headline ambition 'Europe fit for the digital age', the Communication Shaping Europe's digital future also presents an enhanced interoperability strategy for EU governments to ensure coordination and common standards for secure and borderless public sector data flows and services. The need for action in this area was identified by the Council of the European Union in its June 2019 Conclusions on the future of a highly digitised Europe beyond 20204 and has come to the fore as the COVID-19 crisis and the response to it have unfolded. The development of a new EU interoperability strategy and the associated revision of the European Interoperability Framework (EIF) go hand in hand with other initiatives at the EU level that are crucial for the world of location data. Those include:

- the INSPIRE Directive (European Union, 2007), which is currently under evaluation with a possible revision in 2022. Through a complex legal, technical and organisational framework, the Directive has identified interoperability requirements for location data sharing across all components (data, metadata and services) to establish an EU-wide Spatial Data Infrastructure (SDI) to support environmental policies. INSPIRE represents one of the largest location data sharing effort ever undertaken and is seen as a reference example by many countries and organisations all over the world that intend to establish SDIs from the local to the national and international level (Kotsev et al., 2021).
- the Directive on public access to environmental information, which can be reviewed together with the INSPIRE Directive in 2022.
- the Open Data Directive, aims at maximally reusing the INSPIRE Directive, introducing the notion of high-value datasets (to be fully identified and described in an upcoming implementing act), and addressing the aspect of legal interoperability through the focus on the (open) licensing of data.

- the above-mentioned European Strategy for Data (European Commission, 2020b) and its common European data spaces as an overarching data sharing framework, including data from public administrations, businesses, research, and citizens; and
- Copernicus, the EU's Earth Observation programme managed by the European Commission, which delivers high volumes of location data and products free of charge and under an open access licence to maximise the reuse; Copernicus services target six key areas(atmosphere, marine, land, climate change, security and emergency) with direct impacts on several EU policies.

References

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS "A European strategy for data" COM(2020) 66 final https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0066

Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32003L0004

DIRECTIVE (EU) 2019/1024 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 June 2019 on open data and the re-use of public sector information https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L1024

Kotsev, A., Minghini, M., Cetl, V., Penninga, F., Robbrecht, J. and Lutz, M., INSPIRE - A Public Sector Contribution to the European Green Deal Data Space, EUR 30832 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-41565-7, doi:10.2760/062896, JRC126319

Kotsev, A., Minghini, M., Tomas, R., Cetl, V. and Lutz, M., From Spatial Data Infrastructures to Data Spaces: A Technological Perspective on the Evolution of European SDIs, ISPRS INTERNATIONAL JOURNAL OF GEO-INFORMATION, ISSN 2220-9964, 9 (3), 2020, p. 176, JRC120143

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on European data governance (Data Governance Act) (Text with EEA relevance) {SEC(2020) 405 final} - {SWD(2020) 295 final} - {SWD(2020) 296 final} 2020/0340(COD) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0767

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on harmonised rules on fair access to and use of data (Data Act) (Text with EEA relevance) {SEC(2022) 81 final} - {SWD(2022) 34 final} - {SWD(2022) 35 final} https://ec.europa.eu/newsroom/dae/redirection/document/83521

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on European data governance (Data Governance Act) (Text with EEA relevance) {SEC(2020) 405 final} - {SWD(2020) 295 final} - {SWD(2020) 296 final} https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0767

2.1.2 Geospatial Information and the role of Cadastre agencies in responding to the government policy drivers. FAO and World Bank support

Rumyana TONCHOVSKA, Food and Agriculture Organization of the United Nations, Kathrine KELM, World Bank Group, Andrew COOTE, ConsultingWhere LTD.

- "The Integrated Geospatial Information Framework (IGIF) provides a basis and guide for developing, integrating, strengthening and maximizing geospatial information management and related resources in all countries." – UN-GGIM. The development of Country-level Action plan is important to set up priorities, guide investments, monitor the progress and facilitates donors' coordination.
- The key issues in IGIF implementation are data quality and completeness, Insufficient human capacity at all levels, poor access to financing, lack of sustainable business models, immature cybersecurity, unwillingness to share data and make data open, among others.
- The World Bank developed a methodology and templates to facilitate the preparation of IGIF compliant country-level Action Plans. The methodology includes: baseline assessment, geospatial alignment to the government policy drivers, socio-economic analyses and Action and investment plan. Templates are available.
- Land Administration data and platforms are critical for responding to crises, including COVID-19 pandemic, post crises recovery and for economic development. The World Bank and FAO are currently supporting the implementation of large-scale land governance and NSDI projects with a total amount of above 2+ billion USD.

Today's challenges are many, complex and interlinked. To name just a few: the global health crises; climate change and the increased intensity and frequency of natural disasters; rapid urbanization; ever increasing demand for natural resources; increased food, water and energy insecurity; emerging violent conflicts; large migration, and the list goes on.

Much of data needed to respond to those challenges are location based data. "Covid-19 pandemic not only created new social, economic and health challenges, but reinforced the pre-existing obstacles, such as lack of timely fundamental data and enabling technologies to measure and monitor what is happening where, when, and how." –UN-GGIM.

Of the fourteen Fundamental Data Themes identified by the UN-GGIM as critical for every nation the majority are maintained by the Cadastre and mapping authorities. For example, in Serbia eleven out of the fourteen Fundamental Data Themes are under the Republic Geodetic Authority responsibility.

A recent study in UNECE region shows that 50 million people in the region live in informal settlements. In Serbia, 4.5 million buildings are not registered in Cadastre and 25% of the registered buildings have been significantly changed. In 2017, Serbia reported that 50% of population has no addresses. This is one of the obstacles for economic development, social inclusion, climate change mitigation, responding to crises among others.

On a positive note, the Covid-19 pandemic led to accelerated digitization, and elevated digitalization to a higher policy priority across the board: New e-services, incl. mobile services - implemented faster than ever; Increased used of e-services – In Croatia for example the use of e-services for property registration went up from 5% to above 60% during the pandemic; Governments recognised the benefits of the Geospatial platforms and Geospatial data. In India, by liberalizing and democratizing geospatial data early this year, a direct impact of about $1 trillion is expected to be created by 2030.

The 4th Industrial Revolution is leading to an explosion in the volume of geospatially referenced data. The evolving user demand and the dynamic business environment make it necessary to integrate frontier technology including AI, ML, automatic change detection, 5G, etc. with geospatial data and technology.

At the Europe level, the countries from Eastern Europe and Central Asia region are using the EU INSPIRE Directive, the data technical specifications and the experience of the EU Member states to advance the development of their NSDIs. The process of data harmonization in most of the countries is slow and there is a need of greater geospatial innovation. Collecting, analysing and disseminating good practices, for example in using AI and ML, could speed up the data acquisition, facilitate data sharing and contribute to the creation of new digital products and services.

At the UN level, the UN GGIM committee of experts meetings and the first United Nations World Geospatial Information Congress in China in 2018, have substantively improved the understanding of the role of geospatial information management, innovation and related technologies. India is going to host the second United Nations World Geospatial Information Congress (UNWGIC) in 2022.

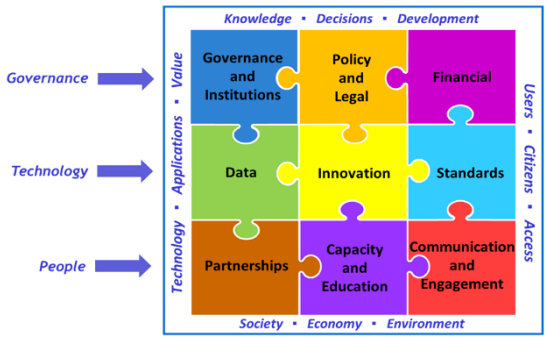


Fig. 1: IGIF Strategic Pathways

UN-GGIM together with the World Bank and other partners developed the Integrated Geospatial Information Framework (IGIF) **and an** Implementation Guide**,** covering GOVERNANCE, TECHNOLOGY and PEOPLE, organized in nine strategic pathways

The World Bank together with FAO and other partners, notably as the Norwegian Mapping Authority Kartverket, are supporting various countries to develop their national or sub-national action plans in line with the IGIF. The methodology for development of country level action plans includes several steps: Step 1: Initial baseline assessment; Step 2: Geospatial alignment to the government policy drivers; Step 3: Socio-economic and environmental impact assessment to help decision makers to decide on the top priorities and Step 4: Development of action and investment plans with KPIs and risk management measures. Templates have been developed for each of these deliverables and are now freely available.

The experience from the developed Action Plans shows that land data is usually a top priority data sets, no matter if government key focus is on climate change mitigation; social and environmental protection; health; infrastructure development; green growth; response to crises, including covid-19 pandemic or economic development.

In Serbia, the development and the implementation of the country level action plan is ongoing under the World Bank funded Real Estate Management Project with the FAO and other donors support. In July 2021 a socio-economic benefit analyses in Serbia shows the rate of return of investments in SDI 5:1 during the next 10 years.

In Mongolia, the socio-economic benefits analyses, completed in 2019, provided justification for financing by the World Bank and integration of geospatial investments in the new Digital Development Project with a vision: Geo-driven eGovernment and innovation that empowers efficient and effective use of geospatial information towards national sustainable development and economic growth. – planned to start in 2022.

In Moldova, Georgia, Kyrgyzstan and Ukraine, the Norwegian Mapping Authority – Kartverket is providing support to the development of IGIF compliant country level action plans in close coordination with the World Bank and FAO. In Georgia, the NSDI work is linked to the ongoing support under the World Bank funded project. In Moldova, the work on the development and the implementation of the country level action plan is linked to several ongoing projects: the World Bank funded Land Registration and Property Valuation Project, which has a large NSDI component; the EU funded Twining project with Croatia, Poland and the Netherlands, focused on the NSDI support and the USAID funded project, which supports the NSDI capacity development at the local level. Ukraine and Kyrgyzstan are exploring the possibility for financing the implementation of the country level action plans through the World Bank and other mechanisms by reviewing their business models.

Key challenges in building the NSDI:

- Lack of understanding of NSDI importance. This requires development of strong business cases and alignment to the government policy drivers as well as development of Communication and Engagement Strategies;
- Data quality and Completeness, which requires development of data standards, data digitization, innovation, using AI, ML, crowdsourcing, automatic change detection, using drones, LiDAR, high and Very high resolution satellite imagery, amongst a multitude of other emerging technologies;
- Insufficient Human Capacity to Implement IGIF/NSDI at all levels;

- Lack of willingness to share data;
- Poor access to financing;
- Lack of sustainable business models;
- Immature cybersecurity measures;
- Protecting Personal Data and Enforcing Intellectual Property Rights;
- Linking geospatial and statistical data (Census data are often not location based);
- Lack of willingness to make data open;
- Lack of capacity how to use the big data for decision-making.

Therefore, the developed action plans need to identify the key risks and include risks mitigation measures, set up KPIs (key performance indicators) to monitor and measure objectively the implementation and has to include an investment plan with cost and time estimation and possible sources of financing.

The World Bank and the FAO are currently supporting the implementation of large-scale land governance and SDI projects, funded by the World Bank with a total amount of above 2+ billion USD. The Bank and FAO support to the NSDI includes development and implementation of NSDI policy and legal framework; development and implementation of NSDI Action plans; development and implementation of NSDI business plans and business models to ensure sustainability of investments; development of national data standards, based on the international standards; data digitization, data collection, including acquisition of HR and VHR satellite imagery, orthophotos and data quality improvement; development of ICT systems for property registration and cadastre, ICT systems for infrastructure cadastre; ICT systems for the Register of Spatial Units, including Address Register; NSDI Geoportals and its interoperability with Open Data portals and wider e-Government portals; Cybersecurity; implementation of innovative solutions, using crowdsourcing, ML, AI, drones, HR and VHR satellite imagery, as well as development of new e-services and digital products; support to capacity development and knowledge exchange; building partnerships with universities, local municipalities and others; awareness raising. In most of the countries, where the World Bank is financing NSDI components, there are additional financing by other donors, the central and the local governments.

The development of NSDI Action plans and investment plans are important to set up priorities, guide the investments, avoid overlapping, monitor the progress and facilitate donors' coordination. The NSDI implementation is part of wider e-Government programs and is critical for decision making process, responding to crises, including the COVID-19 pandemic and making progress towards achieving the SDGs.

2.1.3 Data-centric artificial intelligence

Blagoj Delipetrev, European Commission, Joint Research Centre.

- "Bigger is better" is a dominant paradigm in AI, especially in deep learning (DL) models.
- (NLP) DL models have grown from millions parameters in 2010s, billions few years ago, and trillions today.
- DL models are often trained on all data available without quality assurance.
- Quality data is a necessity to build responsible AI.
- Shift from model-centric to data-centric approach in AI.
- European commission AI act and data act provides a framework for a trustworthy AI system requirement with focus on technical robustness and safety, diversity, non-discrimination and fairness, societal and environmental wellbeing, and accountability.

The rise of AI has led to a massive investment in computing infrastructures, production of bigger datasets and training of gigantic deep learning (DL) models. The main hypothesis "bigger is better", is still dominant, especially in DL models.

The trend of "bigger is better" is mostly visible in Natural Language Processing (NLP) where models have grown from millions of parameters in 2010s, billions of parameters a few years ago, and trillions of parameters today. These immense NLP models are trained on all data available, scraping all accessible text data on the internet. Because the data is not curated or validated for quality, sometimes the results are unreliable.

The DL models have a remarkable progress mainly due to open-source code and open publications. DL frameworks and software tools had significantly simplified the process of training and validating DL models. Moreover, with transfer learning, models are freely shared and only fine-tuned for specific applications. DL models can be relatively easily scaled and shared among projects in various domains producing high quality results.

A simple analysis of AI publications in ArXiv and papers in the main AI conferences clearly demonstrate that the research community is mostly focused on the AI models. The data part was and still is relatively neglected. There are many reasons for this situation, starting from the concept of how every AI competition is made, or how AI progress is evaluated, where the goal is to increase the model performance on an already established dataset. There is an obvious need for a change.

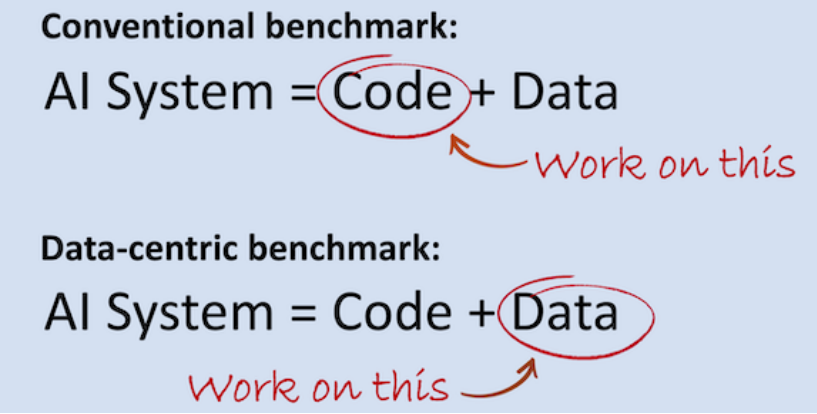


Figure 1. Model-centric and data-centric approach in AI

The data-centric AI approach tries to move the focus on data instead of code and models, as shown in Figure 1. Data is a key ingredient and often takes most of time and effort in building a real-world AI system. The data collection process, aggregating, combining, labelling, pre-processing, quality evaluation and data governance are key steps in building a quality AI system. Training models with low quality polluted data will produce significant degradation of AI system performance.

As industries of all types continue to adopt AI solutions, a fundamental shift is needed to truly unleash AI's full potential. The focus should be on developing systematic engineering practices for improving datasets. In other words, a paradigm shift is needed to move from a model-centric approach to a data-centric approach. By

adopting a data-centric AI approach, diverse industries have already seen improvements in deploying AI and deep learning–based solutions in manufacturing scenarios compared to traditional, rules-based implementations.

The data-centric AI will gain in importance as the European Union is preparing a comprehensive and overreaching legislation on artificial intelligence and data. The European Commission's proposed AI Act and Data Act, combined, provide a framework for a trustworthy AI system requirement with focus on technical robustness and safety, diversity, non-discrimination and fairness, societal and environmental wellbeing, and accountability. AI systems will need to be built on solid foundations and provide quality services. For this purpose we need to move from big data to good data and contribute to a more responsible AI.

References

Delipetrev, B., Tsinaraki, C. and Kostic, U., Historical Evolution of Artificial Intelligence, EUR 30221 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-18940-4 (online), doi:10.2760/801580 (online), JRC120469.

Fedus, W., Zoph, B. and Shazeer, N., 2021. Switch transformers: Scaling to trillion parameter models with simple and efficient sparsity. *arXiv preprint arXiv:2101.03961*.

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL "LAYING DOWN HARMONISED RULES ON ARTIFICIAL INTELLIGENCE (ARTIFICIAL INTELLIGENCE ACT) AND AMENDING CERTAIN UNION LEGISLATIVE ACTS" COM(2021) 206 final 2021/0106(COD)

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on European data governance (Data Governance Act) (Text with EEA relevance) {SEC(2020) 405 final} - {SWD(2020) 295 final} - {SWD(2020) 296 final} 2020/0340(COD)

2.1.4 Digital transformation and Artificial Intelligence from regional and national perspective (UN GGIM Europe and Slovenia)

Tomaž PETEK, Surveying and mapping authority of the Republic of Slovenia

- Digital Transformation is the profound transformation of organisational activities, boundaries and goals to leverage the opportunities of digital technologies.
- The UN Global Geospatial Information Management identified the impact of several trends and disrupting technologies on the geospatial data management and divided them into separate drivers.
- Due to low AI-Maturity in National Mapping and Cadastral Agencies, there are numerous AI-policy initiatives at EU and national levels with many systems being developed.
- Commission's research and innovation policy on AI focuses on developing trustworthy AI solutions that have positive impacts on society and economy, increasing public and private investments.
- A spatial information system – PIS will be established in Slovenia next year, which is a technical solution for electronic business in procedures in the field of construction of facilities.
- The Ministry of the Environment and Spatial Planning is involved in the development of a common European data space for a green agreement, resulting in a strategic and action plan for the digital transformation of space and the environment (eMOP) through 2021 – 2027.

The presentation covers some activities from the UN GGIM Europe work program and their relation to UN Member States where we would like to encourage them for active participation in future geospatial information management have been explained. Here the focus will be done on the importance of regional cooperation (western Balkan for example/ in the field of establishing digital ecosystem for the planet and the European Green Deal as an integral part of EU Commission's strategy to implement the United Nation's 2030 Agenda.

In the second part of the presentation, I cover some ongoing activities in Slovenia where we prepare programs for resilience and recovery. Within this program our Ministry dedicated some actions for digital transformation of processes on spatial planning and environmental protections. These processes will be supported with geospatial data and updated and renewed spatial data infrastructure where capacity building and awareness raising will play important role. We also plan to be established data centres of excellence for integration geospatial data and spatial planning processes at local communities with governmental level.

References

Participants at SPATIAL II project financed by MATRA mechanism - National mapping and cadastral agencies from the region **(**https://www.katastar.gov.mk/wp-content/uploads/Tekovni%20proekti/spatial_2/Proposal%20SPATIAL%20II%2020191129.pdf**)**
Participants at GeoBizz http://geobiz.eu/partners/ or before BEST SDI projects – network of Academic institutions from the region

2.1.5 AI landscape in Croatia

Vlado Cetl, Danko Markovinovic, University North, Croatia.

- Artificial Intelligence (AI), Deep Learning (DL), and Spatial Artificial Intelligence (GeoAI) are the most recent advancements in the geospatial domain.
- Croatia has developed a first draft for a national AI strategy for the period 2021-2025, which is expected to be adopted by the end of 2021.
- AI and digital transformation are recognized as key drivers for economic boost and as such implemented in the Croatian recovery and resilience plan 2021.
- Croatian AI association has developed a CROAI Strategy which aims at focusing on human-centric AI and making Croatia the world's friendliest human-centric AI R&D environment.
- The growth in the Croatian AI ecosystem is evident, with the increase from 170 to 341 organisations listed on the Croatian AI Landscape in one year duration.

Artificial intelligence (AI) is our present, and its widespread use in all areas of life is our unquestionable future. We already use AI on a daily basis, even though we may not even be aware of it. AI algorithms have become an integral part of our lives. Examples are applications on our smartphones that recognize our voice or face, product selection and ranking on websites or social networks (news feed), pages and applications for translation into other languages, communication with customers in banking etc. In this paper/presentation we would like to present current AI landscape in Croatia with ongoing and future activities.

AI has become an area of strategic importance and a key driver of economic development that can provide solutions to many societal challenges. However, the socio-economic, legal and ethical characteristics must be carefully considered. The European Commission (EC) has therefore proposed a regulated approach to artificial intelligence and robotics, which addresses the technological, ethical, legal and socio-economic aspects of strengthening the EU's research and industrial capacity and putting artificial intelligence at the service of European citizens and the economy (EC, 2021 - 1).

In the geospatial domain, AI, deep learning (DL), and spatial artificial intelligence (GeoAI) are the most recent additions. When combined with location, these emerging innovations are leading the technology environment toward exciting capabilities. GeoAI is the product of combining AI and the geoinformation systems (GIS). GeoAI's growth has opened up unprecedented opportunities for both the public and private sectors. It has the potential to be a critical component in contributing to global economic growth and social change, as well as opening previously unattainable opportunities (Das, 2021).

In April 2021 (EC, 2021 - 2), EC published a proposal for a Regulation on a European approach to artificial intelligence (Artificial Intelligence Act), which continues the work of the High Level Expert Group (AI HLEG), a White Paper on Artificial Intelligence and a number of European Parliament resolutions adopted in October 2020 on ethics, responsibility, copyright, artificial intelligence in criminal matters, education, culture and the audio-visual sector.

Croatia is among the EU countries that are late in adopting a national AI strategy. The Croatian Government is currently working on it. A working group consisting of experts from academia, business, civil society and the public sector has been appointed to develop the AI strategy. The working group has finalised a first draft of the National plan for the development of artificial intelligence, including policy measures and actions for the period 2021 to 2025. A final version of the strategy is expected to be completed by the end of 2021 (EC AI Watch, 2021). Nevertheless, in July 2019 a document called "Artificial Intelligence Potential for Croatia" was presented. This document was written by the Croatian Employer's Association (HUP) and Association for Information and Communication Activities (HUP ICT, 2019). The purpose of the document was to define the starting points that would form an integral part of the AI strategy, taking into account the potential that Croatia as a country has.

The application of AI in public administration in Croatia is still in its infancy, although projects that explore the possibilities of using AI e.g. in the field of health, are emerging. There is however much more activities in private sector. One of the key players for the improvement and widespread of AI in Croatia is the Croatian AI association or (CroAI) (China – CEE Institute, 2020). CroAI believes that AI will be one of the main driving forces of change for the next 20 years and, therefore, their mission is to ensure that Croatia gives a significant contribution to the shaping of the world into a better place. Their vision is for Croatia to become a leading destination for exploring how human-centric AI innovation can benefit humanity (CroAI, 2021 - 1).

CroAI, was founded in 2019 and brings together leading companies and startups in the field of AI in Croatia. Their strategy has three key focus points. The first one is to focus on human-centric AI by designing ways how smart machines integrate into the world of humans so that we find it empowering instead of demeaning. The second one is to make Croatia the world's friendliest human-centric AI R&D (research & development) environment. The third point is to concentrate human-centric AI talent in Croatia.

CroAI initiated in 2020 the first overview of AI landscape in Croatia, i. e. the visualisation of all stakeholders in the domestic AI market, from companies and startups to the wider Croatian AI ecosystem. Such research is a necessary precondition to send out a clear message about the current situation regarding AI, but also the potential of the Croatian AI scene, especially since the ecosystem is wide because it includes people and institutions of different profiles and orientations. The findings from 2020, presented on AI2FUTURE Conference in October 2020 (AI2FUTURE, 2020) showed about 70 Croatian AI startups identified, and the landscape of the Croatian AI ecosystem consisted of a total of 170 companies, startups and organisations. The results also showed that about 80 percent of these startups were located in the City of Zagreb and the surrounding area. The share of women in the role of founders or co-founders stood at about 14 percent. The exercise was performed again in 2021 and the results were recently presented in Croatian AI landscape v 2.0. (CroAI, 2021 - 2). The growth in Croatia's AI ecosystem is evident.

Croatia has recognized the importance of the development of artificial intelligence and is also one of the signatories of the EU Declaration on Cooperation in the Field of Artificial Intelligence (EC, 2018). The adoption of national AI strategy is a next step. It is also important to mention that the AI and digital transformation are recognised as a key drivers for economic boost and as such implemented in the Croatian recovery and resilience plan which was adopted by EC in July 2021 (Croatian Government, 2021).

References

AI2FUTURE, 2020. *AI2FUTURE Conference 2020*. [online] Available at: https://ai2future.com/, [Accessed 30 October 2021].

China – CEE Institute, 2020. *Croatia economy briefing: Economic Development and Croatian AI Regulatory Framework.* [online] Available at: https://china-cee.eu/2020/10/19/croatia-economy-briefing-economic-development-and-croatian-ai-regulatory-framework/, [Accessed 30 October 2021].

Croatian Government, 2021. *National Recovery and Resilience Plan*. [online] Available at: https://planoporavka.gov.hr/, [Accessed 30 October 2021].

CroAI, 2021 - 1. *CroAI, the Croatian Artificial Intelligence Association*. [online] Available at: https://www.croai.org/, [Accessed 31 October 2021].

CroAI, 2021 - 2. *Croatian AI Landscape v 2.0*. [online] Available at: https://www.croai.org/landscape, [Accessed 31 October 2021].

Das, A., *Study on Opportunities and Challenges of Collaboration for Geospatial Services*, Cetl, V., editor, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-40674-7, doi:10.2760/070456, JRC126087.

EC, 2018. *EU Declaration on Cooperation on Artificial Intelligence*. [online] Available at: https://knowledge4policy.ec.europa.eu/ai-watch/croatia-ai-strategy-report_en, [Accessed 30 October 2021].

EC AI Watch, 2021. *Croatia AI Strategy Report*. [online] Available at: https://knowledge4policy.ec.europa.eu/ai-watch/croatia-ai-strategy-report_en, [Accessed 30 October 2021].

EC, 2021 - 1. *A European approach to artificial intelligence*. [online] Available at: https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence, [Accessed 30 October 2021].

EC, 2021 - 2. *Artificial Intelligence Act*. [online] Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1623335154975&uri=CELEX%3A52021PC0206, [Accessed 30 October 2021].

HUP ICT 2019. *Artificial Intelligence Potential for Croatia.* [online] Available at: https://www.hup.hr/EasyEdit/UserFiles/Ivana%20Zlatari%C4%87/hup-ict-de-ai-potencijal-umjetne-inteligencije-za-hrvatsku.pdf, [Accessed 31 October 2021].

2.2 Data and Artificial Intelligence

2.2.1 Student Academic Performance Prediction-Regularly and During a Pandemic

Ivan CHORBEV, Vlatko NIKOLOVSKI, Dimitar TRAJANOV, Petre LAMESKI, University Ss Cyril and Methodius in Skopje, Faculty for Computer Science and Engineering, Skopje, North Macedonia.

- Educational Data Mining and Learning Analytics is a result of the rise of digital trends and technology in education.
- A DNN model was developed for academic performance prediction based on data acquired from the Learning Management System (LMS) at the Faculty of Computer Science and Engineering – Skopje, using the demographic, economical and academic profiles of the students.
- To maximise the model accuracy, the dataset was divided in two time periods that represent the timeline before and after the COVID pandemic.
- The presented model demonstrates that students have better academic performance before the pandemic.
- The joint distribution of the different features defined by the model presents a baseline for localization of students that face difficulties in academic terms.
- Students that have lower value of taken exams and higher value of number of achieved credits are the ones that have worse academic performance overall.

The rise of digital trends and technology in education enabled the use of data mining, machine learning, statistical and predictive techniques in Educational data sets, known as Educational Data Mining and Learning Analytics. Educational Data Mining includes tasks for clustering, predictions as well as discovers relationships and patterns in academic data.

This case study presents a Deep Neural Network – DNN model for academic performance prediction based on data acquired from the Learning Management System (LMS) at the Faculty of Computer Science and Engineering - Skopje. Obtained data contains information that describes the demographic, economical and academic profiles of the students. The DNN model provides a direct connection between the data in academic terms of reference for two time periods that represent the timeline before and after the pandemic.

Data used in this research was obtained from the Learning Management System (LMS) at the Faculty of Computer Science and Engineering - Skopje. The system stores large amount of data regarding the attending students and their continuous academic advance. However, as most LMS systems, the data is very specific to the domain of academic progress providing very poor information for variety of feature extraction methods. The biggest challenge is to provide an effective methodology for data processing in order to extract valuable indices that could reveal further patterns and relations as a base for a better understanding and decision-making processes.

The proposed framework has been derived from different Educational Data Mining processes and consists of six main stages: data acquisition; data preparation; statistical analysis; data processing; data mining; and evaluation. Each of the stages is very important and requires deep understanding of the domain to be able to provide solid base for lucrative analyses.

Obtained data contains information that describes the demographic, economical and academic profiles of the students. Following the rules of the framework for modelling, raw data is initially filtered and divided into groups to locate the areas of uncertainty. The initial filtering prepares data for the statistical analysis stage that aims to discover hidden indices, trends and patterns. The Data processing stage extracts possible features and determines their numerical and categorical ranges, while fine-tuning the data for the data mining process. The data mining process develops a multiple regression deep neural network that predicts academic performance of the students. Finally, results are evaluated in order to fine-tune and improve the accuracy of the DNN model.

To improve the process of building a suitable DNN model for prediction and maximize its accuracy, we extracted two new features (StudentRatioBefore and StudentRatioAfter) that pose as an estimator of the academic performance of the students for the period before and after the pandemic.

The joint distribution of the new features defines a normalized mathematical connection of the academic performance between the two periods. In order to reduce the noise in the features (StudentRatioBefore and StudentRatioAfter) that is provided by the linear dependence of the number of exams and courses for a student, two new categorical features are presented to the model.

ExamsNotTakenBefore - difference between the number of courses enrolled and number of exams taken in the period before the pandemic.

Furthermore, the feature Age does not provides any significant statistical role in the model as a numerical value. In addition, the numerical domain of the feature Age was transformed into categorical domain, based on the statistical analysis that the mean value of the values is 25. So, the domain of the feature was transformed into canonical, where values bellow 25 are replaced with the label YOUTH and values above 25 are replaced with the label ADULTS.

The DNN model presented in this paper aims to predict the academic performance of the students during the pandemic. The academic performance of a single student record in the processed dataset is presented by the ExamsNotTakenAfter feature. The relationship presented in the ExamsNotTakenAfter feature describes the academic performance which is constrained by the ExamsNotTakenAfter feature to reduce the noise of the linear dependence.

In addition, the DNN model implements prediction based on multiple-input regression. The model contains multiple layers:

- Normalization input layer.
- Two hidden, nonlinear, dense layers using the rely nonlinearity.
- A linear single-output layer.

The final DNN model predicts reasonably well. Figure shows the errors of the model when predicting on the test set. Join distribution of the (StudentRatioBefore and StudentRatioAfter) features shows that the academic performance is slightly decreasing during the pandemic. Feature values of SumCredits, PeriodOfStartingStudies and ExamsNotTakenBefore have the highest impact of the model output.

The presented model has a high prediction accuracy of academic performance between two defined periods in time frame of semesters. The model shows that students have better academic performance before the pandemic. The joint distribution of the different features defined by the model presents a baseline for localization of students that face difficulties in academic term. In addition, students that have lower value of taken exams and higher value of number of achieved credits are the ones that have worse academic performance overall.

References

Almarabeh, H.: Analysis of students' performance by using diferent data mining classiffiers. International Journal of Modern Education and Computer Science 9(8),9 (2017)

Aluko, R.O., Daniel, E.I., Oshodi, O.S., Aigbavboa, C.O., Abisuga, A.O.: Towards reliable prediction of academic performance of architecture students using data mining techniques. Journal of Engineering, Design and Technology (2018)

Alyahyan, E., D□usteg□or, D.: Predicting academic success in higher education: literature review and best practices. International Journal of Educational Technology in Higher Education 17(1), 3 (2020)

Anuradha, C., Velmurugan, T.: A comparative analysis on the evaluation of classification algorithms in the prediction of students performance. Indian Journal of Science and Technology 8(15), 1{12 (2015)

Asif, R., Merceron, A., Ali, S.A., Haider, N.G.: Analyzing undergraduate students' performance using educational data mining. Computers & Education 113, 177{194(2017)

Bramer, M.: Principles of data mining, vol. 180. Springer (2007)

Daniel, B.: B ig d ata and analytics in higher education: Opportunities and challenges. British journal of educational technology 46(5), 904{920 (2015)

Hamoud, A., Hashim, A.S., Awadh, W.A.: Predicting student performance in higher education institutions using decision tree analysis. International Journal of Interactive Multimedia and Artificial Intelligence 5, 26{31 (2018)

Kantardzic, M.: Data mining: concepts, models, methods, and algorithms. John Wiley & Sons (2011)

Lundberg, S.M., Lee, S.I.: A unified approach to interpreting model predictions. In: Guyon, I., Luxburg, U.V., Bengio, S., Wallach, H., Fergus, R., Vishwanathan, S., Garnett, R. (eds.) Advances in Neural Information Processing Systems 30, pp. 4765{4774. Curran Associates, Inc. (2017), http://papers.nips.cc/paper/7062-aunimated-approach-to-interpreting-model-predictions.pdf

Mesaric, J., Sebalj, D.: Decision trees for predicting the academic success of students. Croatian Operational Research Review 7(2), 367{388 (2016)

Mueen, A., Zafar, B., Manzoor, U.: Modeling and predicting students' academic performance using data mining techniques. International journal of modern education & computer science 8(11) (2016)

Pechenizkiy, M., Calders, T., Vasilyeva, E., De Bra, P.: Mining the student assessment data: Lessons drawn from a small scale case study. In: Educational Data Mining 2008 (2008)

2.2.2 Using A.I. to protect vulnerable Internet users at Human-Computer Interaction level

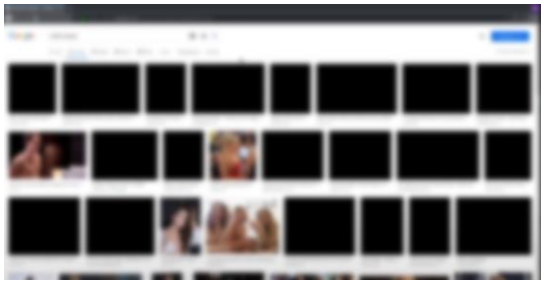
Aleksandar JEVREMOVIC, Singidunum University, Faculty of Informatics and computing, Belgrade, Serbia.

- In the CASPER project, the possibilities for the application of AI to filter the content displayed to the user and the content sent by the user via the Internet were examined.
- The software developed in the CASPER project, involves monitoring and analysing user-computer interactions, including visual and audio communication.
- Experimental use of pilot software confirmed that AI can be successfully used to protect vulnerable categories of users from inappropriate content and malicious activities on the Internet.
- Special attention in software design is paid to the protection of user privacy, as well as the preservation of potential evidence in cases where there is a basis for prosecution.
- For more efficient implementation of the proposed solution, it is necessary to develop additional specialised modules, i.e., to support a wider range of threats and additional languages.

Today, the Internet is used in very different ways, by a very broad range of different user types. Apart from the way they use the Internet, users also differ greatly in the types of potential dangers on the Internet to which they are more vulnerable. For example, exposure to types of content such as pornography, nudity, indoctrination, cyberbullying, etc. can be dangerous for children and young adolescents. On the other hand, for the elderly, these threats are not relevant, but fake news or scams are. In all these cases, one of the best solutions is the constant presence of a technologically savvy supervisor who can prevent access to content and activities that they classify as inappropriate or harmful. However, such persons, e.g. children's parents or technologically more experienced offspring, are usually unavailable for all-day supervision. In this paper, we present ways to apply artificial intelligence for the described purpose of protecting vulnerable types of users, which we have identified as optimal and tested them within the Next Generation Internet funded project, Casper. One of the specifics of our approach refers to the implementation of a system for classifying the suitability of content at the level of human-computer interaction. Such application-agnostic approach enables coverage of a wide range of Internet services, as well as a priori elimination of attacks based on specific coding techniques in order to bypass existing security solutions.

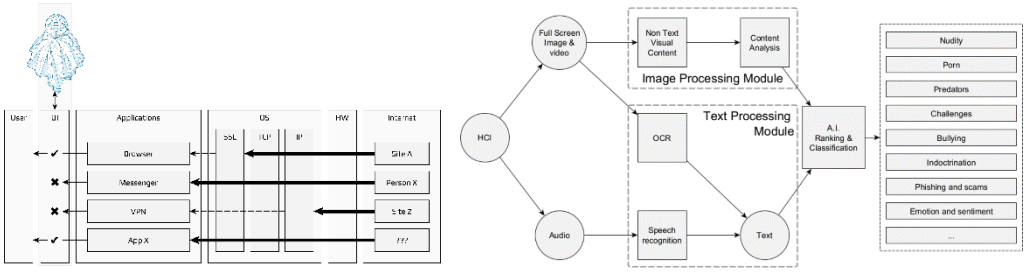
There are many solutions to protect users from threats coming from the Internet. Some solutions, such as antivirus software, are more focused on the technical protection of computers and data than on the protection of the user. Some solutions, such as the filtered DNS service, aim to prevent access to sites with potentially inappropriate or dangerous content. Some solutions, such as browser plug-ins, provide a certain level of protection only in the application for which they were developed, i.e. they cannot be used in other applications. Most software today uses encrypted communications, so filtering at lower levels - such as the kernel level - is not possible. Within the CASPER project, a team of researchers (from Serbia, North Macedonia, and Portugal) examined the possibilities for the application of artificial intelligence to filter the content displayed to the user (but also the content sent by the user via the Internet). Various algorithms from the domain of artificial intelligence were used, related to computer vision, text recognition, content classification, etc. The application of the mentioned method has successfully enabled the detection of inappropriate content in communication through various applications, and in certain scenarios, it also provides close to real-time protection.

To test the basic hypothesis, that artificial intelligence, applied at the level of human-computer interaction, can be used to protect vulnerable groups of users from inappropriate content and malicious actions, we developed a software prototype. The scope of the software, shown in Figure 3, involves monitoring and analyzing user-computer interactions, including visual and audio communication. Both directions of communication are monitored, from the computer / Internet to the user, and from the user to the computer / Internet.



Figures: 1) NGI/Casper poster; 2) Example of protecting user from nudity/pornography content;

The method of analysis of the recorded data is shown in Figure 4. Segmentation is performed on the visual data, followed by extraction of textual data (using OCR algorithms). Also, the text is extracted from the audio content using speech-to-text algorithms. Content obtained in this way is classified in selected modules, i.e. inappropriate or malicious content is detected. For example, pornography, nudity, etc. can be recognized in the graphic content, and cyberbullying or the activities of Internet predators can be recognized in the textual content.



Figures: 3) Network architecture; 4) Content analysis and classification workflow;

In case of detection of problematic content, appropriate activities are initiated, which can be aimed at immediate protection of users or at alerting parents or caregivers. For example, the user may be protected from visual content (example in Figure 2) but not from audio content that has already been played. Special attention in software design is paid to the protection of user privacy, as well as the preservation of potential evidence in cases where there is a basis for prosecution.

Experimental use of pilot software confirmed the basic hypothesis that artificial intelligence can be successfully used to protect vulnerable categories of users from inappropriate content and malicious activities on the Internet. In addition to testing the original concept, the performance of the solution was analyzed and optimized in order to enable real-time user protection. The results achieved so far prove the concept and encourage further research and development in this direction. For more efficient implementation of the proposed solution, it is necessary to develop additional specialized modules, i.e. to support a wider range of threats, as well as to support additional languages from the region and the EU. The modular architecture of the proposed solution enables incremental evolution and expansion of a set of functions.

References

https://ieeexplore.ieee.org/document/9541357
https://www.ngi.eu/news/2020/04/23/ngi-the-people-building-the-internet-of-tomorrow/
https://digital-strategy.ec.europa.eu/en/events/ngi-technology-deep-dive-workshop-web-summit-2019
https://www.ngi.eu/blog/2020/03/27/whos-ngi-aleksandar-jevremovic-introduces-caspar-to-protect-children-online/
https://wiki.geant.org/download/attachments/227803235/NGI_Trust%20case%20study_CASPER-2.0%20-%20An%20AI-based%20ghost%20protecting%20children%20from%20online%20threats.pdf?version=1&modificationDate=1628677312342&api=v2

2.2.3 Climate risk assessments using large climate datasets: AI perspective

Andrej CEGLAR, Andrea TORETI, European Commission, Joint Research Centre.

- This study presents an example of how AI can be used to support climate change adaptation in the global durum wheat sector.
- The developed machine learning algorithm enabled construction of a predictive model integrating large datasets, thus providing information on future climatic suitability for durum wheat growth globally.
- Climate change is expected to significantly increase drought and heat stress risks over all current durum wheat production regions, but most significantly in southern Europe, the Maghreb, and the Middle East.
- The supply–demand equilibrium will be challenged by the substantial loss of suitability for rainfed spring durum wheat in Northern America, currently the main durum wheat exporter to Europe.
- The central European and Asian regions, followed by north-western United States, might become essential for providing stable grain production and food security in the future.

Crop growth and development are crucially dependent on weather conditions preceding and occurring during the growing season. Crop yield quantity and quality are negatively affected by unfavourable climate conditions and extremes such as heat stress and drought. Projected climate changes point to the urgent need of adapting and of increasing the preparedness to these harmful events. In this context, sectorial climate services can effectively support and inform agricultural decisions, making the agricultural production more resilient, sustainable and efficient.

Today, agricultural management can benefit from an unprecedented availability of data, in particular climate data on different time scales, ranging from past to future. Agro-climate services represent an important intermediate agent translating data into actionable information for different stakeholders such as plant breeders, agro-economists and farmers. Recent advances in Artificial Intelligence offers an excellent but challenging opportunity to exploit large climate datasets and produce actionable information.

In this study we present an example of how AI can be used to support climate change adaptation in the global durum wheat sector. Climate change could result in completely unsuitable areas for durum wheat cultivation, as it has been already anticipated for the 'Fertile Crescent' in the Middle East, where wheat was domesticated. Thus, a socio-economic urgent question has emerged on whether durum wheat cultivation will still be profitable and sustainable under future climate conditions despite efforts in optimizing and adapting agro-management practices. Shifting cultivation over new climatically suitable areas, emerging because of climate change, might represent the most effective route of adaptation. To assess the potential of shifting cultivation, we develop a climate suitability model for durum wheat based on supervised machine learning algorithm and assess the impact of climate change on future global suitability.

The suitability model is based on Support Vector Machines, a widely used classification algorithm for nonlinear binary classification, modified to efficiently deal with highly unbalanced datasets. As a class separation method, the SVM seeks for optimal separating hyperplane between two classes. Here, key input data represent current regional distribution of durum wheat areas and future climate projections of a set of bioclimatic variables relevant for durum wheat. The latter ones were obtained from five CMIP6 climate simulations, statistically downscaled and bias-adjusted in the framework of the Inter-Sectoral Impact Model Intercomparison Project (https://esg.pik-potsdam.de/search/isimip). The model simulations used for this study are based on the SSP126, SSP370 and SSP585 scenarios.

Climate change is expected to significantly increase drought and heat stress risks over all current durum wheat production regions, but most significantly in southern Europe, the Maghreb, and the Middle East. Increasing risk of climate extremes will translate into increased risk of yield losses in the Mediterranean, with CO2 fertilization effect likely not being able to counterbalance the negative trend. Our study clearly demonstrates the importance of limiting global warming to levels well below 2 °C at the end of the century, which would substantially limit the loss of suitable areas globally for both, winter- and spring-sown durum wheat. The supply–demand equilibrium will be challenged by the substantial loss of suitability for rainfed spring durum wheat in Northern America, currently the main durum wheat exporter to Europe. The central European and Asian regions, followed by north-western United States, might become essential for providing stable grain production and food security in the future.

The proposed machine learning algorithm, building on essential climate variables, can be considered as a first step towards the assessment of suitability (not just from a climate point of view) for global durum wheat areas. The machine learning algorithm used in our study enabled us to construct a predictive model integrating large climatic datasets, thus providing useful information on future climatic suitability for durum wheat growth globally. This study shows that machine learning algorithms can effectively be used to produce actionable information, however with caveats and limitations that need to be addressed.

References

Ceglar, A., Toreti, A., Zampieri, M., Royo, C., 2021. Global loss of climatically suitable areas for durum wheat growth in the future. Environmental Research Letters, 16, 104049.

2.2.4 Applications of Deep Learning Based Semantic Segmentation of Images

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- Deep convolutional neural network is demonstrated on two problems: semantic segmentation of agricultural images for weed detection and semantic segmentation of garbage in images.
- Weed segmentation is important since it allows detection of weed infestation in agricultural plantations and enables farmers to perform targeted herbicide application.
- Garbage detection is important to create applications that would allow easier reporting of littered sites to the authorities and increase the public awareness about the problem.
- Using transfer learning methods improved the model accuracy for weed segmentation, and showed great potential for application of this method using cheap sensors on farms.
- The algorithm for garbage detection achieved high accuracy for classification of different garbage types, allowing the potential deployment of this system on cloud network.

In recent years, there were many applications of semantic segmentation of images and videos. The goal of semantic segmentation in computer vision tasks is to label image pixels with specific labels that define on which region of the image, those pixels belong. One of the major breakthroughs in semantic segmentation was initiated by the introduction of the convolutional neural networks, specifically with the introduction of the U-net architecture, V-net architecture and other deep convolutional neural network architectures that have significantly increased the accuracy of the segmentation.

In this work we present the results of the application of deep convolutional neural network architectures on two problems, the semantic segmentation of agricultural images for weed detection and the semantic segmentation of garbage in images. Both tasks are of exceptional importance for the North Macedonia economy.

The task of segmenting the weed from images is an important part of the Unmanned Aerial Vehicles (UAV) and Unmanned ground vehicles (UGV) systems for precision agriculture. The specific task of weed segmentation is important since it allows detection of weed infestation in agricultural plantations and enables farmers to perform targeted herbicide application. This is especially important since the expenses for herbicides are significant, and their reduction will reduce the production price and the competitiveness of the agricultural produce and at the same time, make the production more environmentally friendly.

The task of garbage detection is especially important in developing countries where the public consciousness about littering is not highly developed. The idea behind tackling this problem is to create applications that would allow easier reporting of littered sites to the authorities and at the same time, educate the population and increase the public awareness about the problem.

The first problem of weed detection in images describes a novel RGB based dataset for Carrot-Weed segmentation. The dataset is taken from images in the fields near Negotino and is publicly available and the work also describes a proposed architecture as a method for solving the task of semantic segmentation of those images. The dataset is taken under variable light conditions to intentionally simulate different weather conditions for the weed detection process. It consists of 39 images which were manually labelled. The dataset is collected using RGB cameras which are cheaper and more accessible for the regular agricultural holdings in North Macedonia. For this problem we have used both RGB and image transformations to HSV and Lab and the SegNet architecture to train a segmentation model.

In this work, we created and labelled a small dataset with real images that contain garbage, and used transfer learning using existing models such as TernausNet and SegNet which were pre-trained on the VGG16. In this work, we have collected a dataset and labelled it using seven classes: Non-garbage (NG), Plastic (PL), Metal (ME), Paper (PA), Glass (GL), Other (OT). In this dataset, there is a problem of high level of imbalance in the pixel distributions of garbage and non-garbage pixels which is normal for these types of images. To increase the number of training samples we have also used Image Augmentation which is implemented in the Keras library.

We have obtained very good results using the state-of-the-art methods for image segmentation.

For the task of plant/weed segmentation, we have obtained 64% accuracy without application of augmentation or transfer learning. It is important to say that SegNet overfitted the dataset with over 95% accuracy of the segmented pixels in the training phase. With the introduction of the transfer learning methods, the results were significantly improved. For this research we have obtained the Microsoft AI for Earth grant and applied Cloud based architecture for automated weed control method which was successfully deployed online. The results

showed great potential for application of this method in real world farms, using cheaper sensors. Additional work is needed to prepare systems like this for real world application such as collecting larger datasets and educating farmers on the potential of the application of AI in agriculture.

For the task of garbage detection in images, we have achieved an average DICE coefficient of 0.62. Some of the garbage classes such as "glass" were exceptionally difficult to segment, however, the proposed method successfully detected garbage in images which is enough for the intended application. The intention is to deploy this system in the cloud as a service and allow users to use it to detect garbage in images using mobile applications. The expected impact is that the awareness of the people will increase, and we will produce a faster reporting mechanism that would alert authorities immediately of the existence and location of litter in some areas.

Both approaches give contribution towards digital transformation of the respected industries and offer a great perspective on reducing the environmental impact of herbicides and litter. The contribution of AI algorithms towards resolving the tasks is evident and in future, more efficient and more accurate implementations are expected based on the speed of development of novel deep learning architectures and approaches.

References

Ronneberger, O., Fischer, P. and Brox, T., 2015, October. U-net: Convolutional networks for biomedical image segmentation. In *International Conference on Medical image computing and computer-assisted intervention* (pp. 234-241). Springer, Cham.

Milletari, F., Navab, N. and Ahmadi, S.A., 2016, October. V-net: Fully convolutional neural networks for volumetric medical image segmentation. In *2016 fourth international conference on 3D vision (3DV)* (pp. 565-571). IEEE.

Lameski, P., Zdravevski, E., Trajkovik, V. and Kulakov, A., 2017, September. Weed detection dataset with RGB images taken under variable light conditions. In *International Conference on ICT Innovations* (pp. 112-119). Springer, Cham.

Despotovski, A., Despotovski, F., Lameski, J., Zdravevski, E., Kulakov, A. and Lameski, P., 2020, September. Towards Cleaner Environments by Automated Garbage Detection in Images. In *International Conference on ICT Innovations* (pp. 56-63). Springer, Cham.

Iglovikov, V. and Shvets, A., 2018. Ternausnet: U-net with vgg11 encoder pre-trained on imagenet for image segmentation. *arXiv preprint arXiv:1801.05746*.

Simonyan, K. and Zisserman, A., 2014. Very deep convolutional networks for large-scale image recognition. *arXiv preprint arXiv:1409.1556*.

Chollet, F., et al.: Keras (2015). https://github.com/fchollet/keras. Accessed 30 May 2019

Lameski, P., Zdravevski, E., Trajkovik, V. and Kulakov, A., 2017, July. Cloud-based architecture for automated weed control. In *IEEE EUROCON 2017-17th International Conference on Smart Technologies* (pp. 757-762). IEEE.

Microsoft AI for Earth, https://www.microsoft.com/en-us/ai/ai-for-earth (Accessed 15.10.2021)

Lameski, P., Zdravevski, E. and Kulakov, A., 2018, September. Review of automated weed control approaches: An environmental impact perspective. In *International Conference on Telecommunications* (pp. 132-147). Springer, Cham.

2.2.5 Digital Transformation of Administration, Assessing their Digital Skills and Devising a Model for Improving the Proficiency

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- The study assesses the technological enablers of digital transformation, the digital skills and competencies of administration and define their proficiency levels.
- A survey was conducted as an instrument to analyse the employers skills in the usage of digital platforms, word processing, publishing, communication and collaboration, social media platforms.
- The results showed that when young workers have the necessary skills, they tend to establish and maintain strategic relationships to provide critical information and improve their work status.
- Having strategic skills can also improve the self-esteem and life satisfaction of young graduates.
- When young people have digital skills, it has also been observed that psychosocial variables increase.

The focus of the research study is on analyses of the key parameter indicators needed for digital transformation of the public administration. Assessment and evaluation of the digital skills and competencies of administration was realized in order to define their proficiency levels and afterwards to be able to offer a solution for a better development in administrative work. Every individual is meant to have a certain level of proficiency in digital skills. However, the current education system has fallen short of providing our future generations with the basic understanding of what it takes to succeed in a digital environment. Therefore, the goal of this paper is to assess the technological enablers of digital transformation, the digital skills and competencies of administration and define their proficiency levels. Based on the findings, the study suggest recommendation and ways by which universities can improve on their curriculum for public administration so that students are better equipped when they enter the workforce. Digital competency is a term used to describe the skills and knowledge required to be digitally literate. Given the widespread use of digital technologies across the administration, competencies are needed to properly drive the digital change. Technologies are increasingly complex, di-verse and with a fast-paced evolution that requires governments to increase efforts to keep the skillsets of public officers updated, but also to anticipate the needs associated with emerging change. The assessment in the form of strategic digital skills from an educational viewpoint that is an essential measurement of the required skills and key performance indicator of the future workforce.

Digital literacy is not just about knowing how to use computers or smartphones - it includes many different skills such as using social media net-works or using mobile payment apps, knowing how to create content online, understanding cybercrime and safety issues etc.

Peter Drucker is famously quoted as saying, "You can't manage what you can't measure." Drucker's axiom embodies the recent spike in efforts to define, measure and assess digital skills — steps essential toward building and managing a digitally skilled workforce.

The main skills that all adults should have so that we can safely and effectively take part in digital life.

Digital literacy is a set of skills and competencies which enable people to use digital technology in ways that create value for themselves and others. The following will assess the digital skills and competencies of administration and de-fine their proficiency levels. Digital literacy can be assessed to determine the proficiency levels of an individual. The assessment should measure the digital literacy skills and competencies, identify gaps in knowledge and recommend ways to fill them.

The assessment should be conducted by professionals who are knowledgeable in the field of digital media communication, learning design, educational assessment or instructional design.

Digital skills and proficiency, which are fundamental for human development, have been a matter of intense debate for decades. The proficiency levels of the digital skills depend on how well it applies to an individual's work.

Any knowledge worker in today's world needs to have a basic proficiency in digital skills. And this is not just true for college graduates but also for high school graduates. Digital skills and proficiency, which are fundamental for human development, have been a matter of intense debate for decades. The proficiency levels of the digital skills depend on how well it applies to an individual's work.

Any knowledge worker in today's world needs to have a basic proficiency in digital skills. And this is not just true for college graduates but also for high school graduates. Digital skills and competencies are essential for today's work-force in order to meet the needs of an ever-changing digital environment.

Digital literacy is a vital skill for all professionals, but it is especially important for administration professionals because their jobs focus on day-to-day operations within a business. This means that they need to be able to read and understand instructions, instructions, and manuals written in digital formats. They also need to know how to use different software programs and applications that are prevalent in the workplace.

An assessment of digital skills should take into account five different levels: foundation, intermediate, advanced, specialized, and professional. It should also include a variety of tasks relevant to the individual's job responsibilities such as using email, using social media platforms like Facebook or Twitter, or creating documents with different word processing. There are many different ways to assess the digital skills of an administration.

Analyses were further carried out through IBM SPSS Statistics. Descriptive statistics and correlations between variables were firstly calculated. Tau-equivalent reliability, also known as Cronbach's alpha or coefficient alpha, is the most common test score reliability coefficient for single administration. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach's alpha is a coefficient of reliability (or internal consistency).

Table 1 shows descriptive statistics, Cronbach's alpha (α) and the matrix of correlations of Skills and Competences, which were used to carry out multiple regression analyses. Two multiple regressions were performed on the digital skills considered as independent variables and subsequently as dependent variables, Time to Finish the Task (TFT), Correctness Level (CL), Number of Errors (NE), Self-Esteem (SE) and Satisfaction (S).

Table 1. Multiple regression, Digital Skills and Competences

	Skills		**Competences**	
	B	**α**	***B***	**α**
Information and data literacy	16.563	4.721	7.635	3.238
Communication and collaboration	0.153	0.042	0.061	0.051
Privacy and Security	0.217	0.557	0.003	0.071
Digital content creation	0.069	0.065	0.015	0.015
Problem solving	0.346	0.186	0.155	0.174
Time to Finish the Task (TFT)	0.159	0.052	0.067	0.052
Correctness Level (CL)	0.047	0.246	0.061	0.120
Number of Errors (NE)	0.046	0.035	0.045	0.035
Self-Esteem (SE)	0.304	0.237	0.007	0.074
Satisfaction (S).	0.243	0.309	0.152	0.133
	$R^2 = 0.29$		$R^2 = 0.139$	
	$F = 7.13$, $p < 0.001$		$F = 3.54$, $p < 0.01$	

$*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

The analyses of the key parameter indicators needed for digital transformation of the public administration and the impact on Digital Skills and Competencies has been analysed, and insights and results have been provided. Our method shows that finding out whether different ways of participating in this assessment can lead to the realization of Competencies is novel. For this reason, we consider digital skills as a relevant factor. The results show that when young workers have the necessary skills, they tend to establish and maintain strategic relationships to provide critical information and improve their work status. This means that young people should know how to identify the correct information to connect with their inner circle to actively plan an activity and to

consciously participate in a group to achieve a specific goal. The aim is for them to know whom to add as friends to their contacts based on the information shared by these people so that when they know how to work together through specialized apps, they get social capital. Having strategic skills can also improve the self-esteem, life satisfaction, and SW of young graduates. This means that when administrator workers acquire the strategic skills necessary to use to achieve specific goals, they feel better because they have a more positive image of themselves. The security that strategic digital skills provide can also encourage them to feel more satisfied with their lives. When young people have these digital skills, it has also been observed that psychosocial variables increase, this variable considers indicators such as social support, perception of support, feelings, business, and community awareness.

References:

Kemp, S (2021). Digital 2021: Global Digital Overview. Datareportal.com, published 15 March 2020, https://datareportal.com/reports/digital-2021-global-overview-report

Commission, E. (2017). New report shows digital skills are required in all types of jobs, https://ec.europa.eu/digital-single-market/en/news/new-report-shows-digital-skills-are-required-all-types-jobs

Jashari, X., Fetaji, B., Nussbaumer, A., &Gütl, C. (2020, February). Assessing Digital Skills and Competencies for Different Groups and Devising a Conceptual Model to Support Teaching and Training. In International Conference on Remote Engineering and Virtual Instrumentation (pp. 982-995). Springer, Cham.

Ahmad, M., Murray, J.: Understanding the connect between digitalisation, sustainability and
performance of an organisation. IJBEX 17(1), 83–96 (2019)

Wedlake, S., Keyes, D., & Lothian, K. (2019). Digital Skill Sets for Diverse Users: A Comparison Framework for Curriculum and Competencies. Available at SSRN 3427252.

EC (2014). Measuring Digital Skills across the EU: EU wide indicators of Digital Competence. https://ec.europa.eu/digitalagenda/en/news/measuring-digital-skills-across-eu-eu-wide-indicators-digital-competence

Eurostat. (n.d.-a). Individuals who have basic or above basic overall digital skills by sex (tepsr_sp410). Retrieved 25 May, 2021, from https://ec.europa.eu/eurostat/cache/metadata/en/tepsr_sp410_esmsip2.htm

Van Deursen, A.J.A.M., Helsper, E.J. &Eynon, R. (2014). Measuring Digital Skills. From Digital Skills to Tangible Outcomes project report. Available at: www.oii.ox.ac.uk/research/projects/?id=112

Redeker, D. & Sturm, I. (2019). ICT skills in small island developing states: ICT capacity building, economic opportunities and brain drain. ITU Digital Insights, 73–84

2.2.6 Crop yield forecasting based on machine learning in North Macedonia

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- The work aims to develop a ML model to predict the wheat yield based on historical climate data in a specific time frame in the Pelagonia valley in North Macedonia.
- The algorithms for feature selection showed that the precipitation, vapour pressure and minimum temperature have high significance on the wheat yield.
- PCA analysis showed that approximately 96 percent of the total variability of the dataset is explained with the first two principal components.
- The climate conditions in the early steam elongation growth stage was proved to be most significant for the wheat yield prediction.
- Using LS Boost regression model resulted in high accuracy of wheat prediction even with limited dataset.

The weather conditions during the year are crucial factor influencing the crop growth, and the crop productivity is highly affected by the climate conditions in the different growth stages of the crop. Recently, the availability of historical climate and yield data benefits the studies in the sector of agricultural sciences and food, and in particular the use of Artificial Intelligence methods in the big data analysis offers a significant opportunity to provide practicable information and actions.

The objective of the present work is to develop a Machine Learning (ML) model to predict the wheat yield based on historical climate data in a specific time frame in the Pelagonia valley in North Macedonia, as a region with second highest wheat yield in the country. The preliminary result of the research evaluates whether using ML methods is feasible with this aim, and whether it provides any advantage over the currently employed methods for wheat yield forecasting. The advantage of using ML methods for crop yield forecasting is to avoid utilizing numerous parameters used today in the biophysical crop models and furthermore to avoid the manual calibration of these parameters for different regions.

Daily climate data was provided in the year range 2005 – 2019. The model input was the climate data taken in the specific timeframe whereas the model output was the estimated wheat yield per year. In the investigated region, seven climate parameters per day were provided in the defined year range. The climate parameters were: maximum daily temperature, minimum daily temperature, average daily temperature, vapour pressure, precipitation, reference evapotranspiration, and solar radiation. The input parameters in the model were the climate parameters calculated as average in a moving window of ten days with an overlap of five days.

Two different methods were used for selecting the input parameters. In the first method, the scope was to select only the climate parameters whose variability is significant to the variability of the output. To perform this investigation two methodologies were used: univariate feature ranking for regression using F-tests, and Neighbourhood Component Analysis (NCA). Both methods for feature selection showed the same result, concluding that the precipitation, vapour pressure, and minimum daily temperature are input features with predominant importance to the wheat yield. The impact of these significant features can be explained evidently. The agriculture North Macedonia is water-limited, therefore crop production relies on the water amount. Thus, the precipitation represents an important factor for the plant especially in its growth. Furthermore, the temperature accumulation at which the plant is subjected has significant impact on the crop growth and if the slope of the rise of the temperature accumulation is too steep the plant will quickly pass through the growth stages and there will not be sufficient time for some of the processes to be fully completed (ex. lower biomass accumulation, etc.). The Principal Component Analysis (PCA) was employed as a dimensionality-reduction method in order to reduce the dimensionality of the input data set. PCA analysis showed that approximately 96 percent of the total variability of the dataset is explained with the first two principal components.

The second part of the research was employing the Pearson correlation method to select the appropriate time frame of 10 days which accurately predicts the annual production of wheat. The climate conditions in the period between 3 and 12 April was proved to be most significant for the winter wheat yield prediction in Pelagonia area. This corresponds with early steam elongation growth stage of the winter wheat. Some experiments with applying the irrigation only in this period resulted with significant yield increase. Thus, as a water-limited

agriculture evidently the amount of precipitation in the early steam elongation growth stage contributes to the amount of the of wheat productivity.

Finally, to build the ML model, LS boosting algorithm was used since it is an appropriate algorithm in the case of regression model when the dataset is limited. The dataset was divided in two parts: for training the model and for testing the model. Two different models were developed based on the two different methods for input selection. Both LS Boost regression models resulted in high accuracy of wheat prediction even with limited dataset, both on the training and on the testing dataset.

The research study proved the feasibility of using ML methods to complement the models that already exist for accurate wheat yield prediction, providing significant advantage due to the easiness to calibrate the ML model parameters. Further research will be done on testing the model in different regions in the country, using historical data prior to 2005, as well as developing more sophisticated machine learning models.

References:

Baigorria, G.A., Jones, J.W. and O'Brien, J.J., 2008. Potential predictability of crop yield using an ensemble climate forecast by a regional circulation model. Agricultural and Forest Meteorology, 148(8-9), pp.1353-1361.

Crane-Droesch, A., 2018. Machine learning methods for crop yield prediction and climate change impact assessment in agriculture. Environmental Research Letters, 13(11), p.114003.

Ceglar, A., Chukaliev, O., Duvellier, G. and Niemeyer, S., 2013. Water requirements for maize production in Europe under changing climate conditions. In Proceedings of International Conference on Climate Change Effects Impacts World 2013 (pp. 78-86).

Chukaliev, O., 2017. Review of the research in crop water requirement and its use in the Republic of Macedonia. Contributions, Section of Natural, Mathematical and Biotechnical Sciences, 37(1).

Ghadge, R., Kulkarni, J., More, P., Nene, S. and Priya, R.L., 2018. Prediction of crop yield using machine learning. Int. Res. J. Eng. Technol.(IRJET), 5.

Palanivel, K. and Surianarayanan, C., 2019. An approach for prediction of crop yield using machine learning and big data techniques. International Journal of Computer Engineering and Technology, 10(3), pp.110-118.

Salchow, E. and Lal, R., 2001. Relating crop yields to physiografic attributes in Ohio through principal component analysis. Sustaining the global farm. Washington: International Soil Conservation Organization, pp.272-276.

Suryanarayana, T.M.V. and Mistry, P.B., 2016. Principal component regression for crop yield estimation (p. 65). Singapore: Springer.

Van Klompenburg, T., Kassahun, A. and Catal, C., 2020. Crop yield prediction using machine learning: A systematic literature review. Computers and Electronics in Agriculture, 177, p.105709.

Veenadhari, S., Misra, B. and Singh, C.D., 2014, January. Machine learning approach for forecasting crop yield based on climatic parameters. In 2014 International Conference on Computer Communication and Informatics (pp. 1-5). IEEE.

Yadav, R.R., Sisodia, B.V.S. and Kumar, S., 2014. Application of principal component analysis in developing statistical models to forecast crop yield using weather variables. Mausam, 65(3), pp.357-360.

2.3 Data and geospatial intelligence

2.3.1 Digital landslide susceptibility map of North Macedonia

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- A digital map of landslide susceptibility for the territory of North Macedonia is developed, mapping landslide-prone areas.
- The methodology includes frequency ratio of landslide events (FR), calculated in form of LSI values, and then fed into semi-quantitative Analytical Hierarchy Process (AHP) weighting matrix.
- The results showed very high susceptibility areas are mostly near the roads in vulnerable terrain.
- The prepared map does not provide information regarding the temporal probability, the magnitude, or the possible landslide propagation regions.
- The designed map can be used to minimise or avoid future risks and damages, and speed up the compilation of landslide inventory maps.

The territory of North Macedonia is highly exposed to various natural hazards including landslides, which are common on the valley slopes, where Neogene lacustrine sands and sandstones are superimposed over inclined impermeable clay and schist layers. In more compact weathered rocks (igneous, limestone, marble), rock falls, rockslides, debris flows, and other gravitational processes occur (Milevski & Dragicevic, 2019). In addition to the natural factors, increased human impact (road-cuts and heavy constructions on steep terrain) significantly contribute to the activation of landslides resulting in economic damages and even casualties. In that regard, a good and accurate landslide susceptibility map is necessary for any land use planning purpose. A landslide susceptibility map identifies areas that are subject to landslides and is measured from low to high. The landslide susceptibility map takes into account where the landslides occur and what causes them (slope, soil type, and the impact of the flow of water in an area). In that sense, this research is an attempt to prepare an accurate digital map of landslide susceptibility for the territory of North Macedonia. The prepared map does not provide information regarding the temporal probability, the magnitude, or the possible landslide propagation regions, but only defines possible areas of activation. The advantage is the efficient, cost-saving and above all, wide-area identification of hazard zones.

Modelling and mapping landslide-prone areas on a regional scale is a very complex task, because of many natural and anthropogenic factors related to landslide processes. For that reason, all available data, maps, reports from the media, etc., for landslide occurrences in North Macedonia in the past decades are collected. This was a very important step to prepare landslide inventory and to determine the most significant triggering factors. A spatial dataset (inventory) that represents former and recent landslides (presented as point features) is the most critical information layer to implement quantitative statistical analysis for LS assessment. In this work, 6 causative factors were considered: slope, lithology, land use, plan curvature (convexity), distance from streams, and distance from roads. Although there are no standard guidelines for selecting these parameters, the nature of the study area, the scale of the analysis, and data availability were taken into account (Carrara et al., 1995). Keeping in mind the large area extent and the very small landslide inventory, a combination of frequency ratio (Fr) and Analytical Hierarchy Process (AHP) is used. Firstly, the frequency ratio of landslide events in each factor class is calculated in form of LSI values. These values were considered as the basis for the relative rankings of factor classes which are then used in the AHP weighting matrix. The final LSI map is calculated by summing up the values of all six parameters, i.e. by summing the values for each single grid cell of all 6 digital layers. Next, we classified these continuous values into five classes: very low, low, medium, high, and very high landslides susceptibility zones (Milevski et al., 2019).

Final maps of quantitative LSI and semi-qualitative AHP approaches are similar, but some considerable differences are present also. Namely in the LSI map, very high susceptibility areas are mostly near the roads in vulnerable terrain (steep slope, unstable rocks, and weak vegetation). This is because of the high LSI value for the 0-50 m road buffer zone calculated from the training landslide set, which influences the resulting map also. Both GIS-based classifications (quantiles and natural breaks) show good accuracy of the implemented LSI model because more than 50% of the landslides in the inventory are in the class of high and very high landslide susceptibility. Regionally, most of the area with high and very high landslide susceptibility in North Macedonia is extended over hilly terrains and in mountain foots, on the side of valley bottoms in gorges, and on the sides of depressions and basins which are usually covered with Neogene lacustrine sediments. Thus, according to the maps, the areas in the central part of the country (Tikveš depression), the north-east part on the hillslopes of

Osogovo and Bilino mountains, and upper Bregalnica catchment and the foothills of Šara Mountain are among the most susceptible to landslides.

This study was aimed at assessing the landslide susceptibility at a regional scale, in this case in North Macedonia. LSA is a crucial step to prevent landslides in places where this could be expected or to minimize its damages. At a regional scale, statistical methods are generally considered the most appropriate for LS mapping because they are objective, reproducible, and easily updatable (Guzzetti et al., 2006). By applying a bivariate statistical analysis, implemented in a GIS environment, the relationships between landslide events and geo-environmental factors were assessed and shown on the susceptibility map. There are two advantages of the implemented approach. First, it uses clear and logical criteria for analysis, and the second it is based on empirical data about real landslide events. However, without sufficient landslide inventory, statistical approaches can be combined with semi-quantitative methods like Analytical Hierarchy Process (AHP) which taken separately is subjective in its scope.

The ultimate goal of producing a reliable and accurate LS map, or indicative hazard map for landslides that will cover the entire country is not only to indicate endangered areas but to take actions and activities toward prevention and decreasing of the hazard risk itself. If applied properly, such maps are suited for minimizing or avoiding future risks and damages. Therefore, it can be used for decisions in spatial planning before land use designations, for forestall planning strategies (e.g. designation of protective forests), and in hazard zoning of the disaster management authorities. The results of this research are of great importance because they will speed up the compilation of landslide inventory maps. That is especially significant when climate change forecasts and its consequences in terms of increased landslide frequency are considered. Nevertheless, in North Macedonia, national funds are primarily used for recovery from damages by landslides, and much less for prevention, and especially in producing quality mass-movement susceptibility models and maps.

References

Carrara, A.; Cardinali, M.; Guzzetti, F.; Reichenbach, P. 1995. GIS Technology in Mapping Landslide Hazard. In Geographical Information Systems in Assessing Natural Hazards; 135-175.

Guzzetti, F.; Reichenbach, P.; Ardizzone, F.; Cardinali, M.; Galli, M. 2006. Estimating the quality of landslide susceptibility models. Geomorphology 81 (1-2), 166-184.

Milevski I., Dragicevic S., Zorn M. 2019. Statistical and expert-based landslide susceptibility modeling on a national scale applied to North Macedonia. Open Geosciences, Vol. 11-1, 750-764. DOI: https://doi.org/10.1515/geo-2019-0059.

Milevski I., Dragicevic S. 2019. Landslides Susceptibility Zonation of the Territory of North Macedonia Using Analytical Hierarchy Process Approach. CONTRIBUTIONS, Section of Natural, Mathematical and Biotechnical Sciences, MASA, Vol. 40, No. 1, 115–126

2.3.2 Rapid urbanization effect on Land Surface Temperature using Remote Sensing Technologies in Goggle Earth Engine

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- The study uses the Google Earth Engine capabilities to manipulate big digital data to investigate the temperature differences in the center of the city of Skopje from 1986 to 2021.
- A total of 668 satellite images were analysed, and land surface temperature (LST) has been retrieved for every Landsat image in the defined time frame.
- The results show a drastic increase of mean LST temperature in Skopje city center: it is 32.8°C in 1986 – 2009, and 36.6°C in 2010 – 2021.
- The results obtained in this area are of great importance for urban development.

Worldwide, rapid population expansion has resulted in rapid urbanization in the previous few decades. Although urbanization is beneficial to developing countries, it can have detrimental consequences for the environment and human health (Morefield et al., 2018). Higher temperatures are one of the side consequences of urbanization, coupled with the densification of built-up regions, rise in impervious surfaces, and absence of green spaces (Bristow et al., 2012). When compared to the average temperature of green space and residential regions, the variations in solar radiation heating in built-up areas, particularly near roadways, commercial and industrial domains, are the primary contributor to increasing air and surface temperatures (Leal Filho et al., 2018, Santamouris et al., 2011). Changing the natural land cover with heat-absorbing surfaces is one the most significant contributor to the phenomenon of Urban Heat Island (Leal Filho et al., 2018). Due to a lack of dense meteorological stations in urban areas, information on changes over time may be unavailable. With the technological development in the remote sensing community, different satellite remote sensing instruments equipped with thermal sensors have been used to map and monitor Land Surface Temperatures (LST) (Chen et al., 2006, Zha et al., 2003, Van der Hoeven and Wandl, 2018).

The differences in the LST and the formation of UHI worldwide (Alqasemi et al., 2021), and also in the city of Skopje, has been a subject of researches in the past few years (Kaplan, 2019, Mileski and Kaplan, 2019, Kaplan et al., 2018). However, the studies generally use a small number of satellite images, and thus the results are limited. For instance, the area affected by UHI in the center of Skopje has increased from 8.4°C to 15.6°C in 1999 and 2018, respectively. These results have been obtained with two Landsat satellite images. Google Earth Engine (GEE), a cloud-based platform for planetary-scale geospatial analysis which allows to process a variety of geographical data at scale and handle large geographical datasets, is one of the most valuable technological enable of digital transformation dealing with big digital data, offering different deep learning techniques for spatial analysis (Ahady and Kaplan, Kaplan and Aghlmand, 2020).

This study uses the GEE capabilities to manipulate big digital data to investigate the temperature differences in the center of the city of Skopje from 1986 to 2021. As a study area, approximately 100 ha over the city center of the city of Skopje has been selected. For the purpose of the study, for every Landsat image from 1986 to 2021 over the study area, LST has been retrieved (Ermida et al., 2020). Thus, a total of 668 satellite imagery has been analyzed. As the temperature difference is expected to be the highest in the summer period, the average LST from June to October have been analysed.

The results of the analyses showed that after 2006, the LST in the Skopje city center had increased drastically. Also, while the minimum mean temperatures were up to 26°C, after 2010, the minimum temperature has been noted to be 35°C, or 9°C higher than the minimum temperatures before that year. Significant difference has been noticed in the maximum values.

It should be noted that Skopje city center went through rigorous changes after 2010, where the structure of the study area has been completely changed with rapid urbanization between 2010 and 2014 (https://en.wikipedia.org/wiki/Skopje_2014). Considering the mentioned rapid urbanization, the results have been analysed, setting the year 2009 as a threshold of the LST data. Thus, while the mean temperature in 1986 – 2009 is 32.8°C, the mean temperature in 2010 – 2021 is 36.6°C, or 3.8°C higher than before.

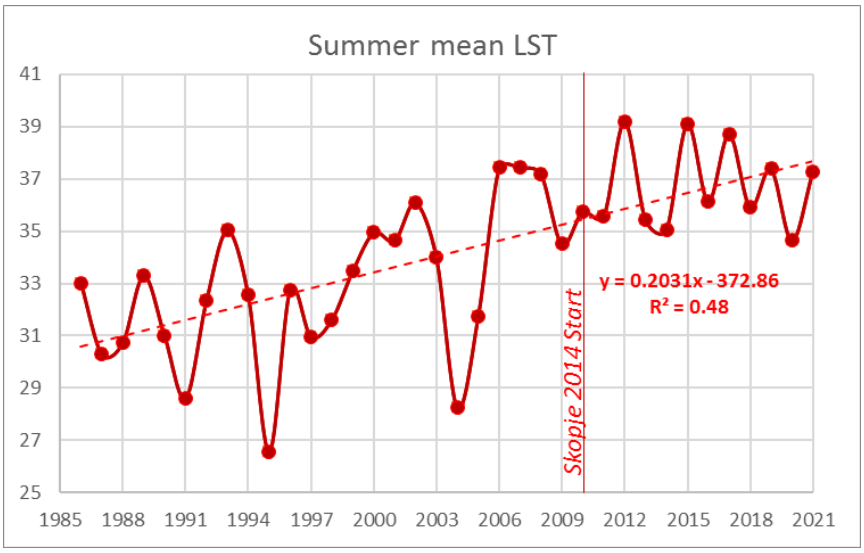

Figure 1. Summer mean LST in the city center of Skopje.

The results indicate a high difference in the temperature in the study area. The analyses were only possible due to the recent developments in the remote sensing community and the GEE platform, enabling the use of digital data for environmental analyses and solutions. As one of the most significant geospatial digital data, remote sensing technologies enable the digital transformation of many data that are generally challenging for collection and analysis. With GEE, a new digital era has begun in the remote sensing research field. The challenges of pre-processing and analysing satellite imagery have been resolved. Also, deep learning has been widely used over remote sensing data providing valuable information and results. The results obtained in this area are of great importance for urban development for city planners, environmental engineers, and administrators for sustainable city planning.

References

AHADY, A. B. & KAPLAN, G. Classification comparison of Landsat-8 and Sentinel-2 data in Google Earth Engine, study case of the city of Kabul. *International Journal of Engineering and Geosciences,* 7, 24-31.

ALQASEMI, A. S., HEREHER, M. E., KAPLAN, G., AL-QURAISHI, A. M. F. & SAIBI, H. 2021. Impact of COVID-19 lockdown upon the air quality and surface urban heat island intensity over the United Arab Emirates. *Science of The Total Environment,* 767, 144330.

BRISTOW, R. S., BLACKIE, R. & BROWN, N. Parks and the urban heat island: a longitudinal study in Westfield, Massachusetts. Proceedings of the 2010 Northeastern Recreation Research Symposium, 2012. 224-230.

CHEN, X.-L., ZHAO, H.-M., LI, P.-X. & YIN, Z.-Y. 2006. Remote sensing image-based analysis of the relationship between urban heat island and land use/cover changes. *Remote sensing of environment,* 104, 133-146.

ERMIDA, S. L., SOARES, P., MANTAS, V., GÖTTSCHE, F.-M. & TRIGO, I. F. 2020. Google earth engine open-source code for land surface temperature estimation from the landsat series. *Remote Sensing,* 12, 1471.

KAPLAN, G. 2019. Evaluating the roles of green and built-up areas in reducing a surface urban heat island using remote sensing data. *Urbani izziv,* 30, 105-112.

KAPLAN, G. & AGHLMAND, M. 2020. Integration of Sentinel-1 and Sentinel-2 for Classification of Small Urban Areas in Rural Landscape aided by Google Earth Engine.

KAPLAN, G., AVDAN, U. & AVDAN, Z. Y. Urban heat island analysis using the landsat 8 satellite data: A case study in Skopje, Macedonia. Multidisciplinary Digital Publishing Institute Proceedings, 2018. 358.

LEAL FILHO, W., ICAZA, L. E., NEHT, A., KLAVINS, M. & MORGAN, E. A. 2018. Coping with the impacts of urban heat islands. A literature based study on understanding urban heat vulnerability and the need for resilience in cities in a global climate change context. *Journal of cleaner production,* 171, 1140-1149.

MILESKI, T. & KAPLAN, G. Urban Heat Island Effects Over the Urban Security: Case Study of the City of Skopje. INTERNATIONAL SCIENTIFIC COMMITTEE/INTERNATIONAL SCIENTIFIC CONFERENCE URBAN SECURITY, 2019. 69.

MOREFIELD, P., FANN, N., GRAMBSCH, A., RAICH, W. & WEAVER, C. 2018. Heat-Related Health Impacts under Scenarios of Climate and Population Change. *International journal of environmental research and public health,* 15, 2438.

SANTAMOURIS, M., SYNNEFA, A. & KARLESSI, T. 2011. Using advanced cool materials in the urban built environment to mitigate heat islands and improve thermal comfort conditions. *Solar Energy,* 85, 3085-3102.

VAN DER HOEVEN, F. & WANDL, A. 2018. Hotterdam: Mapping the social, morphological, and land-use dimensions of the Rotterdam urban heat island. *Urbani izziv,* 29.

ZHA, Y., GAO, J. & NI, S. 2003. Use of normalized difference built-up index in automatically mapping urban areas from TM imagery. *International Journal of Remote Sensing,* 24, 583-594.

2.3.3 Toward the creation of the national cadastre of degraded areas in Serbia and North Macedonia

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- The research aims to define and specify areas degraded by human impact in Serbia and North Macedonia by selecting two municipalities as study areas.
- Complex GIS of the human impact on the landscape changes are established with Digital Elevation Models (DEM) and satellite imagery in combination with relevant cartographic data.
- Results show that Loznica and Kriva Palanka have valuable natural resources, but are very susceptible to degradation in the latest decades.
- The models demonstrate that a large part of the municipalities will be under human pressure and natural hazard risk in the next period, hence requiring suitable preventive measures.
- The methodology can serve for national-scale mapping of degraded areas and monitoring of change representing a cross-section of the current state of environmental degradation in the selected area.

The basic idea of this work is to define and specify the areas degraded by human impact in Serbia and North Macedonia, with two municipalities (Loznica and Kriva Palanka) selected as key study areas. The research of degraded areas in the analysed territory, i.e. areas where a change in landscape is evident, included all changes caused by the natural-anthropogenic (soil erosion and landslides) and anthropogenic processes (mineral resources exploitation, construction of residential zones, factories, traffic infrastructure, etc.). The web platform for the Cadaster of Degraded Areas, in this sense, is one of the basic instruments of integrated environmental management at the regional and local level, i.e. a key identification of the situation for all broader and deeper views of the environment. It is about identifying all types of landscape degradation, assessing the quality and quantity of degradation, as well as the formation of GIS, or Web-platform that would allow easier monitoring of future changes concerning the recorded situation. Also, a qualitative evaluation of the obtained data was provided through a proposal of measures and activities that need to be taken to protect areas from further degradation, with proposing measures that can be implemented on the recultivation and reclamation of already degraded areas.

Nowadays, GIS became a fundamental tool for analysis of recent changes in the landscape, because it considers variations in the field by the change of a single landscape degradation (open mining, etc.) or predicts some future situation. In that aspect, aerial and satellite imagery have special significance. Also, the newest Digital Elevation Models (DEM) allows analyses of landscape changes in the last decades, using comparison with older topographic maps (from 1950-ties). Normally, all of these analyses must be carried out very carefully keep in mind the compatibility of sources. Thus, DEM and satellite imagery in combination with relevant cartographic data about population changes, anthropogenic activities, etc., make it possible to establish complex GIS of the human impact on the landscape changes.

To single out areas endangered by slope processes (soil erosion and landslides), Erosion Potential Model (EPM), is used to evaluate soil erosion and investigate its spatial distribution in the case-study areas. The method of land use (mineral resources exploitation, construction of residential zones, factories, traffic infrastructure, etc.) was done based on CORINE land cover database comparison.

Mineral extraction sites were obtained based on the open-source aerial and satellite imagery. Landslides were identified from the existing data and also based on the differences between newer DEM's obtained by remote sensing and ones derived from older topographic maps while landslide susceptibility zonation is made also. This is an important step in analysing future landslides that could trigger if conditions are favourable for the landslide process, and lead to further land degradation. When all areas that were degraded by the aforementioned processes were identified and selected, a synthesis map was made, which shows the intensity of land degradation.

As our preliminary work applied on the municipalities of Loznica and Kriva Palanka shows that they have valuable natural resources, but are very susceptible to degradation in the latest decades. Their degra¬dation is closely related to land use planning and natural hazards which were usually directly or indirectly caused by human impact on the landscape (except earthquakes which are however very rare in these areas). Particularly pronounced natural hazards in the municipalities are excessive erosion, the occurrence of landslides, torrential floods, and forest fires. The models show that a large part of the municipalities would be under human pressure

and natural hazard risk in the next period. Therefore, it is necessary to take suitable preventive measures to reduce the risk of these occurrences or limit their impact. Land-use planning must be the first step in the management of human activities, and in case of excessive erosion, biotechnical measures must be in the first line, as well as the other erosion control works.

Following the example of the EEA, all data should be published on the Internet at first only as down-loadable files, and later as an interactive map from which data for the area of interest could be down-loaded. At this point, it is ungrateful to define the type of data to be published, because it is necessary to harmonize the form with the EEA, as well as the names of all fields and metadata that must accompany the data collected by this project and similar in the future. The conducted research emphasizes the importance of the mentioned topic and problems, as well as the necessity of solving it with the use of Geographic Information Systems. The methodology and results of this work could have great application value and serve as a basis for national-scale mapping of degraded areas and monitoring of change since they represent a kind of cross-section of the current state of environmental degradation in the selected area. Also, for more rational use of land in the function of sustainable development, the development of the Land Information System of the national territory should be approached, for which the conducted research could make a significant contribution. In this regard, the EU recommendation is the development of the map of the degraded area, which is of special importance for Serbia and North Macedonia.

References

Dragicevic S., Milevski I.(2010): *Human Impact on the Landscape – Examples from Serbia and Macedonia.* Advances in GeoEcology, nº41, Global Change – Challenges for soil management (ed. M. Zlatic), ISBN 978-3-923381-57-9, CATENA VERLAG GMBH, Germany. pp. 298-309.

Dragicevic, S., Filipovic, D., Kostadinov, S., Ristic, R., Novkovic, I., Zivkovic, N., Andjelkovic, G., Abolmasov, B., Secerov, V., Djurdjic, S. (2011): *Natural Hazard Assessment for Land-use Planning in Serbia.* International Journal of Environmental Research, 5(2), pp. 371-380.

Milevski, I., Dragicevic, S., Radevski, I. (2017): *GIS and Remote Sensing based natural hazard modelling of Kriva River catchment, Republic of Macedonia.* Zeitschrift für Geomorphologie, Supplementary Issues, 61(2): 213-228.

2.3.4 Transformation of traditional agriculture on digital in the Republic of Moldova using advanced techniques

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- The research estimates suitable belts for grape and sunflower growth in Moldova with included climate change until 2050, according to the established CMIP6 prediction.
- The areas not suitable for grapes will increase by 35%, while the sunflower has better possibilities for growth.
- The most useful land for grape growth would move to the north and penetrate the territory of Ukraine in the Valley of the Dniester River, as well in the territory of Romania on the other side.
- The most valuable areas for sunflower growth will move to the territory of south-east Romania and south Ukraine.
- Climate change (1990-2020) resulted with changes in sunflower and grape fields. The effects of the temperature rise may be more dangerous in the period 2025-2050.

The Republic of Moldova has a small territory of 33,843 km2. Due to the increase of temperature in Europe by more than 1.0 °C, the number of drought periods was increased dramatically. Recently, there has been a shift in the climate of Moldova, manifested in the change of precipitation and extreme temperatures. According to this the agricultural sector in Moldova is vulnerable. The water resources in Moldova are quite limited due to pollution, degradation influenced by climate change, and unwise human activity to their biodiversity and ecosystems, availability, and accessibility. The traditional watering of crops is now reduced and depends on weather conditions in the spring and autumn. These areas are vulnerable because of the deficit of water and in the suburban areas the agricultural potential is very low of doesn't exist. Two main plants in the Moldavian agricultural sector are grape and sunflower. In Moldova, 3% of the territory belongs to grapes and, 7% of agricultural production is connected with the export of wine. The Moldavian export of wine is the 6th place in Europe and 3rd place in the region of the Black Sea. Moldova is also the 19th producer of wine in the world since every fourth active Moldavian from the agricultural sector is involved in the wine sector. The sunflower areas are planted on 9% of the territory. 12% of the export belong to the export of sunflower oil. In this research we included climate condition in the last thirty years (1990-2020) and climate prediction until 2050. This climate model we established using CMIP6 prediction (the Sixth Coupled Model Intercomparison Project). In that way changes of meteorological parameters especially air temperature and precipitations were including too. After GIS (Geographical Information Systems) procedures and Remote Sensing analysis, the following steps were numerical calculations and estimation of digital and meteorological data. The final step was the estimation of suitable belts for grape and sunflower grow with included climate changes. The areas suitable for the growth of grapes are located in the northeast and northeast parts of the country. The central city in this area is Bălți. The other four cities Dubăsari, Chișinău, Tiraspol, and Cahul will move to the belt not suitable for grapes growth. The central part of the country presents the border between two zones. In comparison with analysed areas when temperature and precipitation decrease, would decrease the areas excellent for grapes breeding by 35%. At the same time areas not suitable for grapes will increase by 35%. The sunflower has a better possibility for growth in the territory of Moldova with included climate change properties. 90% of the territory has excellent potential for sunflower growth, 0.5% suitable, 9% very marginal and 0.5% not situated. Only the areas near the city Cahul in the southwest and areas in the southeast have a low potential for sunflowers plantation. On the other hand, an increase of precipitations by 15% would decrease areas suitable for sunflower by 22.5% or 7,615 km2.

Sunflower has the following results-the excellent 52%, very suitable 5%, suitable 11%, marginal 2%, very marginal 24%, and not situated 6%. With the increase of cloudiness by 15%, almost 32% of the Moldova territory will not be useful for sunflowers' growth and plantation. The excellent areas for sunflower growth are in the territory between Bălți and Dubăsari. The low possibility of growth of sunflower is on the territories in the southeast and southwest near the city Cahul. The statistical analysis using matrices can give specific and valuable results of this research. This statistical approach can help in estimating the crops changes with the support of sophisticated digital methods. The areas of vineyards and sunflowers will move from the border of Moldova. The most useful land for grapes growth would move to the north and penetrate the territory of Ukraine in the Valley of the Dniester river. This valley has a good possibility for the plantation of grapes, even in Moldova. On the other side, the potential land for grapes growth will penetrate the territory of Romania. Sunflower territories have slightly different routes. The most valuable areas will move to the territory of south-east

Romania and south Ukraine in the triangle between cities Odesa, Izmail, and Tarutyne. If temperature will more increase and precipitations decrease. Sunflower and grape present 70% of all Moldavian agricultural potential. The changing of climate in the last thirty years (1990-2020), showed the changing of fields with sunflowers and grapes. In the last ten years (2010-2020) the increase of temperature was pronounced in the central and south-east and partly in the north part of Moldova territory. In the period (2025-2050), these effects may be more dangerous. The Republic of Moldova is an agricultural country and influenced by ecological indicators which are important for the growing of plants. The methods of GIS analysis, digitization of cadastre data of crops, and remote sensing may give satisfactory results. The Moldavian agricultural sector with the support of the European Union, must be transformed from traditional to digital in a very short time. This research showed some potential ways of that changing.

2.3.5 Digital transformation of post-earthquake damage assessment combining response spectrum concept and remote sensing data

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- The research proposes a response spectra-based post-earthquake structural damage estimation method aided by satellite-based remote sensing data, to classify the buildings after an earthquake.
- The method aims to speed up the damage assessment process of critical buildings that can cause casualties in a possible strong aftershock.
- Results show more than 50% reduction in time spent by the in-situ damage assessment teams to detect the critical buildings that can cause casualties in a possible strong aftershock, tested on an affected area in Turkey.
- The algorithm provides an optimum allocation of time and resources after a catastrophic event for the civil protection agencies and decision-makers for managing the consequences of the disaster.

Effective post-event emergency management contributes substantially to communities' earthquake resilience, and one of the most crucial actions following an earthquake is building damage assessment (Erdik et al., 2011). On-site building damage assessment interventions are dangerous, expensive, and time-consuming. Remote sensing techniques have shown great potential in localizing the most damaged regions and thus guiding aid and rescue operations in recent earthquakes. Recent studies have reported that high-resolution satellite imagery can be used to detect post-seismic building damage (Tong et al., 2012, Dong and Shan, 2013, Karimzadeh and Matsuoka, 2021, Omarzadeh et al., 2021). Furthermore, to prevent post-earthquake casualties, heavily damaged, unsafe buildings must be identified immediately since, in most earthquakes, strong aftershocks can cause such buildings to collapse. Many researchers have been focused on Convolutional Neural Networks (CNN) for object detection from remote sensing data, inspired by the success of deep learning algorithms for semantic segmentation in computer vision areas. CNN or deep learning supervised neural network, has been acknowledged as one of the most successful and widely used deep learning approaches (Amini Amirkolaee and Arefi, 2019, Tang et al., 2020). For example, CNN has been used for object detection of trees (Wang et al., 2018, Mubin et al., 2019, Timilsina et al., 2019, Ocer et al., 2020), buildings extraction (Zhang et al., 2016, Hu and Guo, 2019), ship detection (Nie et al., 2018, Nie et al., 2020) etc. The potential of the response spectrum concept for being associated with satellite-based remote sensing data and techniques for post-earthquake structural damage estimation was investigated in this study. In this respect, a response spectra-based post-earthquake structural damage estimation method aided by satellite-based remote sensing data was proposed to classify the buildings after an earthquake by prioritizing them based on their expected damage levels, in order to speed up the damage assessment process of critical buildings that can cause casualties in a possible strong aftershock. A case study application was implemented in the Bayrakli region in Izmir, Turkey, the most affected area by the Samos earthquake, on October 30, 2020.

A CNN model was applied to extract buildings from high-resolution satellite imagery to detect the buildings in the study area affected by the earthquake. In addition, satellite images were used to determine the height of the buildings. Furthermore, the equation proposed by Kaplan et al. (Kaplan et al., 2021) was used to predict the elastic fundamental vibration periods of the buildings based on the calculated heights. The critical seismic recording station near the study area was selected according to the criteria defined in this research. This station's elastic ground motion response spectra were provided from the Turkish Accelerometric Database and Analysis System (TADAS) (TADAS 2021). The obtained data were imported into a geographic information system (GIS) environment and further used for seismic damage estimation of the detected buildings. The seismic demand for the buildings was estimated by comparing fundamental vibration periods of the buildings with the response spectra of the ground motion recorded at the critical station. The buildings with fundamental periods between 0.40 and 0.65 s were labelled as "high risk" based on investigations conducted on the fundamental periods of the collapsed and heavily damaged buildings and response spectra of the recorded ground motion at the critical station (Figure 1a). Consequently, such buildings were deemed the most vulnerable to damage and should be evaluated first by in-situ damage assessment teams. In order to evaluate the results, an accuracy assessment has been made; the damage estimations made in this research were compared with the in-situ damage assessment reports prepared by the Republic of Turkey Ministry of Environment and Urbanization (Damage Reports, 2020) experts (Figure 1b).

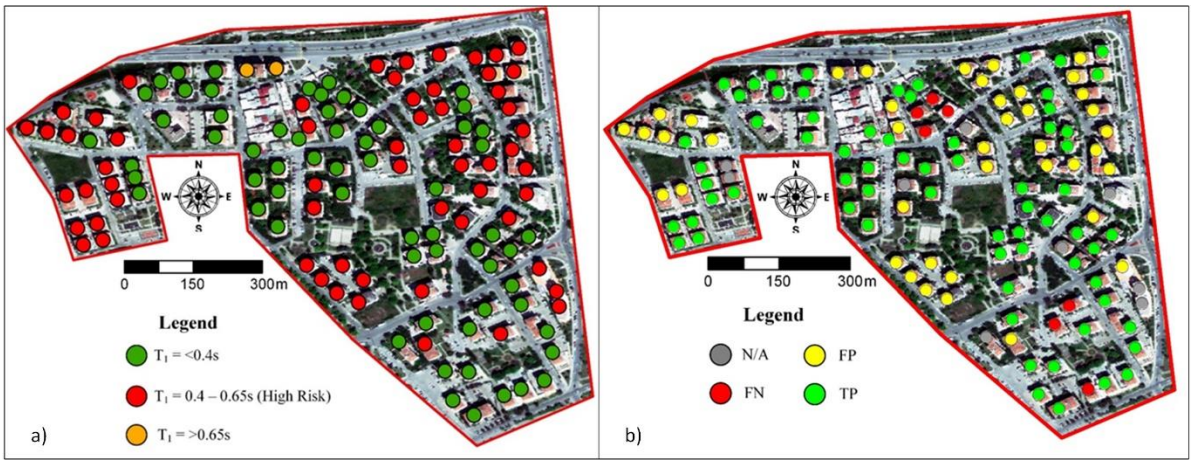

Figure 1. a) Structural damage estimation, b) Accuracy assessment of structural damage estimation in the study area

The study aims to speed up the damage assessment process of critical buildings that can cause casualties in a possible strong aftershock; from this perspective, conventionally, the number of buildings that must have been investigated after the earthquake by in-situ damage assessment experts were 127. If the proposed approach had been used, this number would have been reduced to 60. Because the proposed methodology suggests primarily investigating the potential high-risk buildings (Figure 1a) due to their relatively high seismic demand, assuming that their seismic behaviour is similar to those collapsed or severely damaged buildings in the region.

The accuracy assessment showed that the sensitivity of the method is high (91%). In addition, the necessary time spent by the in-situ damage assessment teams to detect the critical buildings that can cause casualties in a possible strong aftershock would have been significantly reduced (more than 50%) for the study area. The promising results obtained in the case study implementation of the proposed methodology demonstrate that this approach can be used to speed up the damage assessment process, prioritizing the critical buildings based on their expected damage levels. The proposed prioritization aims to provide an optimum allocation of time and resources after a catastrophic event for the civil protection agencies and decision-makers responsible for managing the consequences of the disaster. Instead of starting from the first building in the region, having a map produced by the proposed methodology would allow the decision-makers to divert the assessment teams primarily to the buildings expected to be severely damaged.

Deep learning algorithms, remote sensing data and techniques, and big data (strong ground motion records) gathered from the Turkish civil protection agency's extensive network enabled the proposed methodology to be developed. The proposed approach allows civil protection organizations to exploit digital data (satellite images and strong ground motion records) for post-earthquake decision-making using deep learning techniques.

References:

Damage Reports, 2020. *Republic of Turkey Ministry of Environment and Urbanization Damage Assessment Inquiry* [Online]. Ankara. Available: https://hasartespit.csb.gov.tr/#!/ (In Turkish) [Accessed Last accessed: 24.10.2021 2021].

TADAS 2021. *Turkish Accelerometric Database and Analysis System (TADAS)* [Online]. Available: https://tadas.afad.gov.tr/login [Accessed Last Accessed: 01.11.2021 2021].

AMINI AMIRKOLAEE, H. & AREFI, H. 2019. CNN-based estimation of pre-and post-earthquake height models from single optical images for identification of collapsed buildings. *Remote Sensing Letters,* 10, 679-688.

DONG, L. & SHAN, J. 2013. A comprehensive review of earthquake-induced building damage detection with remote sensing techniques. *ISPRS Journal of Photogrammetry and Remote Sensing,* 84, 85-99.

ERDIK, M., ŞEŞETYAN, K., DEMIRCIOĞLU, M., HANCıLAR, U. & ZÜLFIKAR, C. 2011. Rapid earthquake loss assessment after damaging earthquakes. *Soil Dynamics and Earthquake Engineering,* 31, 247-266.

HU, Y. & GUO, F. Building Extraction Using Mask Scoring R-CNN Network. Proceedings of the 3rd International Conference on Computer Science and Application Engineering, 2019. 1-5.

KAPLAN, O., GUNEY, Y. & DOGANGUN, A. 2021. A period-height relationship for newly constructed mid-rise reinforced concrete buildings in Turkey. *Engineering Structures,* 232, 111807.

KARIMZADEH, S. & MATSUOKA, M. 2021. A Preliminary Damage Assessment Using Dual Path Synthetic Aperture Radar Analysis for the M 6.4 Petrinja Earthquake (2020), Croatia. *Remote Sensing,* 13, 2267.

MUBIN, N. A., NADARAJOO, E., SHAFRI, H. Z. M. & HAMEDIANFAR, A. 2019. Young and mature oil palm tree detection and counting using convolutional neural network deep learning method. *International Journal of Remote Sensing,* 40, 7500-7515.

NIE, S., JIANG, Z., ZHANG, H., CAI, B. & YAO, Y. Inshore ship detection based on mask R-CNN. IGARSS 2018-2018 IEEE International Geoscience and Remote Sensing Symposium, 2018. IEEE, 693-696.

NIE, X., DUAN, M., DING, H., HU, B. & WONG, E. K. 2020. Attention Mask R-CNN for Ship Detection and Segmentation From Remote Sensing Images. *IEEE Access,* 8, 9325-9334.

OCER, N. E., KAPLAN, G., ERDEM, F., KUCUK MATCI, D. & AVDAN, U. 2020. Tree extraction from multi-scale UAV images using Mask R-CNN with FPN. *Remote Sensing Letters,* 11, 847-856.

OMARZADEH, D., KARIMZADEH, S., MATSUOKA, M. & FEIZIZADEH, B. 2021. Earthquake Aftermath from Very High-Resolution WorldView-2 Image and Semi-Automated Object-Based Image Analysis (Case Study: Kermanshah, Sarpol-e Zahab, Iran). *Remote Sensing,* 13, 4272.

TANG, R., LIU, H., WEI, J. & TANG, W. 2020. Supervised learning with convolutional neural networks for hyperspectral visualization. *Remote Sensing Letters,* 11, 363-372.

TIMILSINA, S., SHARMA, S. & ARYAL, J. 2019. Mapping urban trees within cadastral parcels using an object-based convolutional neural network. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences,* 4, 111-117.

TONG, X., HONG, Z., LIU, S., ZHANG, X., XIE, H., LI, Z., YANG, S., WANG, W. & BAO, F. 2012. Building-damage detection using pre-and post-seismic high-resolution satellite stereo imagery: A case study of the May 2008 Wenchuan earthquake. *ISPRS Journal of Photogrammetry and Remote Sensing,* 68, 13-27.

WANG, Z., UNDERWOOD, J. & WALSH, K. B. 2018. Machine vision assessment of mango orchard flowering. *Computers and Electronics in Agriculture,* 151, 501-511.

ZHANG, Q., WANG, Y., LIU, Q., LIU, X. & WANG, W. CNN based suburban building detection using monocular high resolution Google Earth images. 2016 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), 2016. IEEE, 661-664.

2.3.6 Development of NSDI in Republic of Moldova through EU Twinning Project and other Donors support

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- Development of National Spatial Data Infrastructure (NSDI) in the Republic of Moldova achieved significant progress in the last 15 years thanks to donor support.
- NSDI legal framework and Prototype of NSDI Metadata Geoportal was initiated during the 1st EU Twinning project "Organization, Streamlining and Computerization Process in Mapping in the Republic of Moldova" (2014-2016)/
- The objective of the 2nd Twinning Project is to further strengthen the capacity of the Government of Moldova for implementation of the EU Association Agreement and approximation process.
- The project is focused on establishing sustainable NSDI Governance, developing NSDI Cost Recovery Model, enabling use of existing data within the NSDI, building capacity and awareness, and reviewing existing legislation on NSDI and proposed improvements.

Development of National Spatial Data Infrastructure (NSDI) in the Republic of Moldova as a European neighbourhood policy country, achieved a significant progress in the last 15 years; thanks to donor support of the European Union, Norwegian Ministry of Foreign Affairs through the Norwegian Mapping and Cadastre Authority (Kartverket), USAID and World Bank as well as Government financing. All this support has been achieved in close cooperation with the Agency for Land Relations and Cadastre (ALRC) as a the coordinating authority of Moldovan NSDI, focusing on delivery of core geospatial datasets, digital transformation, building-up technical and professional capacity, thus contributing to economic growth.

With the financial assistance from the EU, several Twinning and TAIEX actions were implemented. Twinning is an institution-building tool funded by the EU which is based on partnership cooperation between public administrations. The initial introduction of the NSDI based on the basic principles of INSPIRE, initiated during the 1st EU Twinning project "Organization, Streamlining and Computerization Process in Mapping in the Republic of Moldova" (2014-2016), has resulted, among other, with development of NSDI legal framework and Prototype of NSDI Metadata Geoportal.

The 2nd EU Twinning Project of the ALRC, "Improving Spatial Data Services in the Republic of Moldova following EU standards", was launched on the 1st of September 2020. Beside ALRC as the main beneficiary institution, there are more than 20 Moldovan public institutions, which deal with spatial data that are also involved in the project. The consortium of the partners from three EU Member States, Republic of Croatia, the Kingdom of the Netherlands and Republic of Poland provides twinning support to the beneficiary:

Croatian State Geodetic Administration, Croatian Central Finance and Contracting Agency and Faculty of geodesy, Zagreb University, The Netherlands Enterprise Agency and Dutch Cadastre and Polish Head Office of Geodesy and Cartography.

The overall objective of the Twinning Project is to further strengthen the capacity of the Government of Moldova in the context of the implementation of the EU-Republic of Moldova Association Agreement and EU approximation process. The specific objective is to enhance e-Government through improved spatial data sharing and cooperation among authorities in line with EU standards and best international practices. The value of the project is EUR 1,8 million and the implementation period is 26 months.

The support to be provided is based mainly on the EU INSPIRE Directive and is developed to address various challenges the ALRC and many other stakeholders in Moldova are facing. The project is focused on the implementation of activities listed in five components:

- Sustainable NSDI Governance established;
- NSDI Cost Recovery Model developed;
- Use of the existing data within the NSDI enabled;
- Capacity Building and Awareness;
- Existing legislation on NSDI and proposed improvements reviewed.

The results in the 1st year of successful implementation together aim in making spatial data more accessible and by default lead to avoiding the duplication of costs and efforts as well as contribute to the improvement of the state-level decision-making processes. Among the most important ones, the following results can be highlighted:

- development of strategic documents, such as a five-year State Programme and corresponding Action Plan,
- NSDI cost assessment that will serve as basis for business model development;
- development of 5 guidelines which should increase the quality of spatial data and facilitate its sharing among NSDI stakeholders: Guidelines on analogue to digital conversion, on geo-referencing, Guidelines for data specifications, on data modelling and Guidelines for creation and maintenance of metadata, all of which were presented to many Moldovan public institutions;
- support to ALRC in the development of the new NSDI Geoportal, procurement of which is financed by the WB project,
- the awareness raising on the importance of the Moldovan NSDI, has been launched by development of a Communication Plan,
- organisation and development of an extensive 35-hour online training course for over 100 participants, GIS specialists from central public authorities and Chisinau City Hall,
- Support to the ALRC in review and preparation of amendments to the NSDI Law.

Despite the on-line working conditions in this unfortunate pandemic years, the work on project was very effective and cooperation with ALRC and Moldovan NSDI stakeholders were intensive and very cooperative, which made implementation of the project's first year successful. We hope that, in the next period, the situation with covid-19 will allow us to carry out all our activities on-site.

2.4 Digital transformation of land administration institutions and NSDI

2.4.1 Application of digital transformations of data and processes for modelling the structure of land use in the conditions of open land market in Ukraine

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- Food security is one of the priorities in climate change, and optimising and adapting the structure of agricultural land use is necessary.
- Scientific approaches are developed for analysing and forecasting the boundaries and areas of crops using modern geographic information technologies, including remote sensing of the Earth.
- Developed algorithms employ AI features as machine learning, providing the possibility to collect and proceed big data amounts in a short time.
- The developed algorithm predicts the yields of crops, which gives authorities a possibility to control the data given by agricultural producers and make strategic decisions for food security.
- The system algorithm provides monitoring and analysis of land use, crops, tax revenues on a wide range of indicators.

In the context of climate change, which is becoming warmer and characterized by alternating periods of drought and rainfall, which leads to increased costs for crop cultivation and increased risk of damage or loss of crops, food security is one of the priorities. One of the ways to minimize risks and losses is to optimize and adapt the structure of agricultural land use. In Ukraine, the current system of statistical accounting of agricultural crops has significant shortcomings, and their spatial identification is actually absent. Accordingly, there is a need to analyse and forecast the structure of agricultural land use in order to ensure food security.

Effective land use in agriculture involves accurate continuous monitoring of crops and their structure, especially in the context of climate change and food security. The project provides for the development of scientific approaches to determining, analysing and forecasting the boundaries and areas of crops using modern geographic information technologies, including remote sensing of the Earth. The project is that it is based on the regional features of agriculture, detailed physiological characteristics of agricultural plants, and their interrelation in time. The project uses a large sample of data on the example of lands of the National Academy of Agrarian Sciences enterprises. The algorithms and tools developed by the project will allow not only to identify agricultural crops, to interpret their condition, but also to build optimal scenarios for the transformation of the land use structure within the framework of agricultural policy.

The purpose of the research project is to analyse and forecast the structure of agricultural land use in Ukraine, which is carried out in the context of climate change and the need to ensure food security. The project is aimed at proposing the optimal structure of crops. It is also necessary to determine the area of crops cultivation and their vegetation phases, forecast yields and determine the level of impact of the agricultural land market on the structure of land use in Ukraine.

Our project is conducted by the interdisciplinary team of specialists of the Institute of Land Management of NAAS and research farms of NAAS, engaged in research and commercial agriculture. This cooperation allows us to obtain real-time data on crop structure, vegetation phases, crop losses and technological operations. Our research team has significant experience and expertise in the field of spatial data processing, spatial analysis, informational systems, identification technologies for crops, so we are able to systematize the data received from farms. This helps us to facilitate data analysis.

There are few important components of our project. First of them is agroscouting, which plays an important role in determining the quality of performed technological operations (tillage, irrigation, harvesting, etc.); condition of crops (stages of vegetation, the presence of diseases, pests, etc.) and development of database of crop in time.

Another important component of the study is the use of remote sensing methods to analyse and control the structure and boundaries of agricultural land use. The study provides determination of the structure of crops, their condition, yield forecast using methods of classification of satellite images and AI. The peculiarity of this project is the accuracy of analysis and forecasting, which is achieved in particular by the level of detail of crop classification, which means the ability of accurate determination of individual crops, varieties of individual crops,

vegetation phase of individual crops or varieties. The classification algorithm we use is random forest tree algorithm, which gives us the highest classification accuracy.

As for the analysis of the structure of agricultural land use, in the context of lands that are in constant use of research farms, it is a matter of collecting data on crops, their cultivation and vegetation process, as well as selecting the highest quality samples of crops' polygons and their varieties in satellite images. Under samples of crops' polygons, we mean a creation of a 'digital profile' of crops. Such a 'digital profile' is a chain of median values for each relevant sentinel-2 band for the vegetation period. It helps us to classify the crops more accurate, as they can have very similar part of their 'digital profiles', but the full profiles are different. That's why we analyse the whole vegetation period. We use machine learning algorithms to collect such 'digital profiles' of different crops in different clime zones. Using AI gives us a possibility to collect and proceed big data amounts in short time. We aggregate remote sensing data in the NAAS system based on NSDI principles, which gives the possibility of obtaining electronic services.

Then the accuracy of establishing the boundaries between fields of different crops/varieties and the correlation of the relevant indicators of satellite images with the data of agroscouting and statistical reports are calculated. It is aimed at determining the economic efficiency of agricultural land use.

The conducted research allows to obtain operative reliable data on the structure of agricultural land use that has actually developed, to identify threats to food security. And with the help of agricultural and land policy to influence the elimination of such shortcomings. This primarily concerns the production of food-sensitive products of appropriate volume and quality.

Developed algorithms give us a possibility to collect and proceed big data amounts in short time, as we use such AI features as machine learning. Our algorithms predict the yields of crops, which gives authorities a possibility to control the data given by agricultural producers and as well to make strategic decisions in terms of food security. In general, our project ensures the possibility of monitoring and analysis of land use, crops, tax revenues on a wide range of indicators. As well we are able to identify the land plots, which are used without registered wright on them, so local taxes are not paid.

System developed in terms of this project can: ensure the process of determining and accruing subsidies for agricultural producers; provide agricultural business insurance; provide forecasting of gross harvest in terms of types of crops and territories; ensure environmental control of land use; ensure control over the determination and collection of taxes; provide transition to digital, spatially oriented statistics.

Conclusions. The results of the project implementation are scientifically substantiated and developed methods of: analysis and forecasting of the structure of agricultural land use; collection and processing of accounting data, statistics and agroscouting, as well as methods of systematization of these data; selection of 'digital profiles' of crops on satellite images that best characterize each crop, their variety and distinguish it from other crops or their varieties; classification of crops, their varieties and vegetation phases according to satellite images.

Developed methods of collection, processing and analysis of these data, models of correspondences and relationships of satellite images for individual crops, as well as accounting and statistical data and field experiments are able to monitor the quality of land use, analyse its structure and predict transformation for management decisions of state authorities and local governments, such as agricultural producers.

Relevant information about Ukraine.

Short analysis of the state-of-play with respect to the digital data, AI and innovative services and applications combining the above.

Currently digital transformation is one of the most important tasks of Ukrainian government. There is the Ministry of Digital Transformation of Ukraine, which creates an on-line portal called 'Дія', which means 'State and I'. This portal proposes all the state services to users, it collects all possible and relevant data from different registers, gives a person a possibility to interoperate with personal data and even works as a digital ID-Card. This portal uses such AI features as face recognition etc.

In term of spatial data, we currently create our NSDI, a part of which is the State Land Cadastre and different registers with spatial data. Also, the State Space Agency plays an important role in creating NSDI in Ukraine.-

Who are technological enablers of digital transformation with respect to the field of your expertise?

In our field of expertise the technological enablers are the Ministry of Digital Transformation of Ukraine, the State Land Cadastre and the State Space Agency.

What are current trends and likely impacts of Digital transformation, Data and AI?

Current trends are:

The Ministry of Digital Transformation of Ukraine tries to make all the data easily accessible and bring it into one portal. Such AI features, as a face recognition and machine learning are used very often for safety measures and to process more data in a short period of time.

References:

The Ministry of Digital Transformation of Ukraine: https://thedigital.gov.ua/
The State Space Agency: https://www.nkau.gov.ua/en/
Some researches in satellite images processing: https://eos.com/uk/products/crop-monitoring/
https://www.researchgate.net/publication/283291665_Retrospective_regional_level_land_cover_map_for_Ukraine_methodology_of_development_and_results_analysis_in_Ukrainian
https://www.researchgate.net/publication/315939269_Deep_Learning_Classification_of_Land_Cover_and_Crop_Types_Using_Remote_Sensing_Data

2.4.2 Digital transformation in Serbia – Geospatial data as a core instrument to transform a country

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- E-governance in spatial data management (Geospatial Governance or gGovernance) leverages the latest advances in geospatial technologies to map and monitor the resources of an entire nation, allowing for the quantitative documentation of policy implementations on the ground.
- In 2020 the government of the Republic of Serbia established two groups to manage the responses to the covid-19 pandemic: dealing with health and social issues, dealing with the economic issues.
- The global covid-19 crisis showed that the policies and laws should go in parallel with the increased use of technologies.
- Serbia is working toward digital transformation of the national economy and public administration by developing a number of technological systems.
- The use of geospatial information and new systems assisted in making better decisions in the covid-19 crises in line with the fast-changing situations.

The use of spatial data is a key element for addressing these challenges. Investments in geospatial technologies can address various activities, including sustainability programs around land, water, food, natural resources as well as other aspects including National Security, Disaster Response and Resiliency, Infrastructure development and was critical in the response to the global covid-19 pandemic. E-governance in spatial data management (Geospatial Governance or gGovernance) leverages the latest advances in geospatial technologies to map and monitor the resources of an entire nation, allowing for the quantitative documentation of policy implementations on the ground.

The global covid-19 crisis showed that the policies and laws should go in parallel with the increased use of technologies, which could provide information when and where most needed and provide evidence for monitoring the effects of the human interventions, providing the opportunities to model the possible risk zones and to help decision makers to take preventive measures, both in the areas of health, social protection and deciding on the possible support to economy, including agriculture, food production and supply of goods for first aid.

The Republic of Serbia is one of the countries supported by the FAO, World Banka and other development partners to improve the use of available geospatial data and technology and to strengthen government capacity to make best use of available data and technology.

In Serbia, the Republic Geodetic Authority (RGA) is a national Spatial Data Infrastructure (SDI) coordinator and the INSPIRE National Contact Point. The RGA is a special governmental organization, which performs state survey, maintenance of real estate cadastre and management of geospatial data at the national level. The RGA plays an important role in making the available geospatial information and services accessible to all by creating various innovative solutions, to support the government and municipal authorities as well as the general public and businesses to make better use of the available data and technologies, including information provision to respond to the covid-19 pandemic in order to plan the necessary social, health and economic measures.

In 2020, when the covid-19 pandemic started, the government of the Republic of Serbia established two groups to manage, coordinate and support the responses to the covid-19 pandemic:

Group 1, dealing with health and social issues, under the Prime Minister supervision;

Group 2, dealing with the economic issues, under the supervision of the President of the Republic of Serbia.

The use of geospatial information and services by both working groups assisted in making better and more informative decisions, to monitor the fast changing situation and decide what measures to be put on place and where most support is needed.

The RGA Immovable Property Registration and Cadastre IT System (ISREC), which is in its third phase of implementation, creates an enabling digital environment, allowing all business activities, irrespective of location, to be performed digitally with minimal or no need for personal contacts/visits to the local offices to submit or collect documentation. Therefore, it is expected to improve the resilience to any future health related disaster event by enabling nationwide processing of transactions and central storing of data in different backup locations.

The economic environment in Serbia will benefit from further development of the Mass Property Valuation System and the development of an Investment Location Mapping System (SIDA supported project). Both systems will support the government and the industry to use relevant, accurate and up to date data for decision making. Final effect of the activities will favour better socio economic environment and national resilience to the poverty spread.

The outbreaks of the pandemic diseases (namely COVID 19), floods, and wildfire risks have been prioritised, as these represent the highest risks for Serbia. Guidelines for management of forest fire risks has been stipulated in the Law on Forestry, mandating that all forests must have their own protection plan with detailed instructions on the best response. In addition, other risks prevention plans have to be prepared by the local authorities in accordance with their priorities.

Experts' operational teams have been established focusing on landslides and erosion, floods and large forest fires to advance the knowledge in the areas of particular risks in specific areas with the purpose of prevention. The staff of these teams comprises of representatives from ministries, scientific institutions, and other relevant organisations.

2.4.3 NSDI development in Croatia from interoperability perspective

Tomislav CICELI, State Geodetic Administration, NSDI Division, Zagreb, Croatia.

- The main purpose of National Spatial Data Infrastructure (NSDI) is to raise the level of data exchange between different data systems.
- Analyses of NSDI development in Croatia is made by segmentation by interoperability levels: legal, organisational, semantic and technical.
- From an organisational level, NSDI structure was created with the State Geodetic Administration having the role of National Contact Point.
- The NSDI geoportal collects the metadata records and focuses on both quality and quantity of the data.
- Through NSDI development, digital transformation is tackled on the level of local and regional governments.

According to EIF interoperability is the ability of organizations to interact towards mutually beneficial goals, involving the sharing of information and knowledge between these organizations, through the business processes they support, by means of the exchange of data between their ICT systems. At the end, looking from that perspective we can say da main purpose of NSDI is to rise level of data exchange between different data systems.

Analyses of NSDI development in Croatia is made by segmentation by interoperability levels: legal, organizational, semantic and technical.

On the level of legal interoperability Law on state survey and cadastre from 2007 (Official Gazette, 2007). Was the first step, which was then adjusted to Directive INSPIRE in 2013 with Act on NSDI (Official Gazette, 2013). From organizational level, NSDI structure was created, with State Geodetic Administration having the role of National Contact Point. If we look on semantic perspective, firstly transposition of implementing rules, and later on, when becoming EU remember states, direct adoption was made. And finally from technical level, all activities related to spatial data itself could be seen from this perspective.

Also very important issue is to make comparison of NSDI development from user perspective. Seeing development from their perspective could help as a lot to see are we going in right direction. It is also important from perspective of quality, which is by definition; fitness for purpose. (Juran, 2010). Firstly it could be seen that firstly focus was on most demanding user from Interoperability perspective, European Commission, while the last was on ordinary citizens.

Through NSDI development, digital transformation is also tackled, especially on the level of local and regional governments.

References

European Commission, 2017: New European Interoperability Framework Promoting seamless services and data flows for European public administrations https://ec.europa.eu/isa2/sites/default/files/eif_brochure_final.pdf
Official Gazette, 2007; https://narodne-novine.nn.hr/clanci/sluzbeni/2007_02_16_651.html
Official Gazette, 2013; https://narodne-novine.nn.hr/clanci/sluzbeni/2013_05_56_1135.html
Joseph M. Juran, Joseph A. DE Feo (2010): Juran's Quality Handbook, 6th Edition, The McGraw-Hill Companies

2.4.4 Data integration & interoperability of public land administration services in Federation of Bosnia and Herzegovina

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- Services that are provided by the Land Administration institutions in FBH are now recognized as an essential component of the infrastructure for the benefit of the general public.
- The demand for better quality services lies in the core of public sector reforms and e-government strategies accompanied by greater accountability and transparency.
- Achievements in integration and interoperability of data enable simplification of already existing services and development of new modern customer oriented services.
- Customer awareness and a need for value for money are ever more recognized as important drivers of change.
- Customers of the land administration do not differ from customers in other areas, and they expect an easily accessible customer service to respond to their needs.
- The provision of accurate and reliable real estate data with a high quality, timely, and easy-to-use customer service is evidence of the sound development of land administration in FBH.

Strengthening of the Land Administration Sector in Bosnia and Herzegovina (BH) is recognized by the World Bank (WB) and donors' countries as a very important goal which can significantly contribute to secured tenure rights, an efficient and transparent property market, the European Union (EU) accession and consequently to the overall economic and social development and growth.

Joint efforts of geodetic authorities in BH with the support of various carefully coordinated projects are leading to the fulfilment of ultimate goals, improvement of entire land administration system and facilitation of public service provision. The dedicated and successful work on the establishment of accurate and up to date property registers (real estate cadastre, land cadastre and land registry), address registers and sales price registers has attracted many stakeholders enabling continuous activities on data integration and interoperability.

Exchange of data via web services with other governmental authorities and local governments raising efficiency of work in entire land administration system for user benefits. This prevents duplication of data, issuance of incorrect data from unauthorized sources, help in clear definition of roles and jurisdictions among public institutions. The achievements in integration and interoperability of data among different institutions enables simplification of already existing services and development of new modern customer oriented services.

Federation of Bosnia and Herzegovina recognizes the activities of the Land administration sector as an important goal that can significantly contribute to the digital transformation goals, the European Union accession and consequently to overall economic and social development and growth. Joint efforts of geodetic authority and other spatial data holders, with the support of various carefully coordinated projects is leading to the fulfilment of ultimate goals and facilitation of public service provision. The dedicated work on the establishment of accurate and up to date spatial data registers has attracted many stakeholders enabling continuous activities on data integration and interoperability. Data and metadata standards, procedures, and policies are used to promote coordination among data in the Federation of Bosnia and Herzegovina. By the end of 2021, more than 2 million land registry folios had been incorporated in the electronic land registry thanks to the systematic harmonization of real estate data between the land registry and the cadastre. As a result of the project, funded by the World Bank, more than 55% of these folios are now based on the new cadastral survey as opposed to 30% at the start.

Following the establishment of IT system used by local tax authorities and municipal staff, the Sales Price Register (SPR) data was published for public and other users and close to 30.000 individual transactions have been displayed publicly on the FGA geoportal.

Establishment of an up to date official database of Address data is also well under way, since FGA now distributes data via services for 27 municipalities of 79 in total, and full coverage is expected by the end of 2023.

Continued evidence of the digital transformation in the Federation of Bosnia and Herzegovina is the increased exchange of data via web services with different authorities and local governments that raises the efficiency of work in land administration and laying the foundations for e-government for user benefits. This consequentially prevents data duplication, issuance of incorrect data from unauthorized sources, helps in clear definition of roles and jurisdictions among public institutions.

2.5 Start-ups & companies in Artificial Intelligence and geospatial software

2.5.1 Monitoring policy effectiveness with agent-based model approach

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- The components of an agent-based model (ABM) are a collection of agents and their states, the rules governing the interactions of the agents and the environment within which they live.
- ABM is well suited for providing necessary insights for policy analysis, since it allows for rich representation of individuals or groups of individuals.
- Croatian Parliament adopted the Proposal of the multi-year program of cadastral surveys of construction areas for the period 2021-2030.
- The Croatian land administration environment was modelled based on agents and tools provided by complex system approach used to involve various stakeholders' perspectives.
- State geodetic administration recognized the proposed ABM approach and supports the research of modelling cadastral surveys' impact on quality and accuracy of cadastral system.

Every society can be seen as a system in which heterogeneous social groups interact and make decisions based on their motives. These groups are either formal (professional associations, civil society organizations, public institutions, etc.) or informal (landowners, protesters, etc.) that can sometimes exist inside formal group (moderate vs conservative groups inside right political party).

The motives of these groups i.e., reasons why the entities are grouped together, can be publicly declared in a form of a statute, but many times are only generally known (owners of private companies aim for profit) or hidden (corrupted politicians).

The society is governed by various policies prepared by public authorities that representatives of people that constitute society (elected politicians) adopt in parliament.

Although a policy is a top-down instrument, its impact is aggregation of behavioural changes of many low-level entities. And some of them are very often not even considered during a policy development.

Land governance is about the policies, processes and institutions by which land, property and natural resources are managed. Each state establishes its land governance system depending on cultural heritage, social system, economic development and technological availability. As such, it has direct impact on competitiveness of national economy while is indirectly influencing functioning of whole society. Main components that support functioning of land governance are land administration systems which are based on registers of which cadastre is among most important one.

To be able to observe a society more thoroughly and analytically, one approach is using complex systems approach. A complex system is defined as a system composed of many components which may interact with each other. This approach includes application of diverse mathematical, statistical and computational techniques, to generate insight into how some of the most complicated physical and natural systems in the world function. One type of complex system is a complex adaptive system. It is also dynamic network of interactions, but the behaviour of the whole may not be predictable according to the behaviour of the components. It is adaptive in that the individual and collective behaviour mutate and self-organize corresponding to the change-initiating micro-event or collection of events.

A computational model that is often used for simulating the actions and interactions of autonomous components of the system in order to understand the behaviour of a system and what governs its outcomes is the agent-based model (ABM). By conducting computer-based experiments, ABM is applicable to complex systems embedded in natural, social, and engineered contexts, across domains that range from engineering to ecology. It combines elements of game theory, complex systems, emergence, computational sociology, multi-agent systems, and evolutionary programming.

Given that ABM allows for rich representation of individuals or groups of individuals, it is well suited for providing necessary insights for policy analysis.

An Agent is a persistent thing which has a state worth representing, and which interacts with other agents, mutually modifying each other's states. The components of an agent-based model are a collection of agents and their states, the rules governing the interactions of the agents and the environment within which they live.

Previous works on the topic of evaluation of cadastral and land administration systems very often suffer from profession blindness syndrome – a view that cadastre is cornerstone of every society, not questioning what the impacts of cadastral development or lack of it have on a society that should serve. Another issue of these evaluations is that they focus only on certain aspect of cadastral system; mostly technical, organizational, or legal.

The key problem with evaluation of cadastre systems is that they cannot be compared. Each cadastre is the result of various historical, societal and economic factors that made it the way it is. Hence, possible indicators that could be used for evaluation of certain cadastre should be thoroughly examined.

For a society to thrive, policy makers should get as complete picture of the social systems at the entity level and should consider complexity of entities' interactions to propose effective policy. Croatian Parliament adopted the Proposal of the multi-year program of cadastral surveys of construction areas for the period 2021-2030. State geodetic administration recognized the proposed ABM approach and supports the research of modelling cadastral surveys' impact on quality and accuracy of cadastral system. They provided access to data on previous cadastral surveys that were conducted in last three decades - and how they affected the Joint information system of cadastre and land book.

Through this research, State Geodetic Administration took an active role in facilitating new approaches in analysing past programs in order to better steer upcoming ones.

In this presentation we intend to demonstrate steps in the process of modelling Croatian land administration environment based on agents and tools provided by complex system approach that we used to involve various stakeholders' perspectives.

The simulation of the modelled environment was carried out in Netlogo. Since the simulation is ran on combination of real and estimated data, we'll present plans to apply machine learning algorithms for solving data "holes" that we need to better define the model and gain more insights from the simulations.

References

Bigagli, E., 2017. Is it possible to implement a complex adaptive systems approach for marine systems? The experience of Italy and the Adriatic Sea. Ocean and Coastal Management, 149, 81–95. https://doi.org/10.1016/j.ocecoaman.2017.09.019

Çağdaş, V., & Stubkjær, E., 2009. Doctoral research on cadastral development. Land Use Policy, 26(4), 869–889. https://doi.org/10.1016/j.landusepol.2008.10.012

Holland, J. H., 2006. Studying complex adaptive systems. Journal of Systems Science and Complexity, 19(1), 1–8. https://doi.org/10.1007/s11424-006-0001-z

Nikolic, I., & Ghorbani, A., 2011. A method for developing agent-based models of socio-technical systems. 2011 International Conference on Networking, Sensing and Control, ICNSC 2011, 44–49. https://doi.org/10.1109/ICNSC.2011.5874914

Rajabifard, A., Williamson, I., Steudler, D., Binns, A., & King, M., 2007. Assessing the worldwide comparison of cadastral systems. Land Use Policy, 24(1), 275–288. https://doi.org/10.1016/J.LANDUSEPOL.2005.11.005

Shalizi, C. R., 2007. Methods and Techniques of Complex Systems Science: An Overview. Complex Systems Science in Biomedicine, 33–114. https://doi.org/10.1007/978-0-387-33532-2_2

Steudler, D., Rajabifard, A., & Williamson, I. P., 2004. Evaluation of land administration systems. Land Use Policy, 21(4), 371–380. https://doi.org/10.1016/J.LANDUSEPOL.2003.05.001

Zevenbergen, J., 2004. A Systems Approach to Land Registration and Cadastre. In Nordic Journal of Surveying and Real Estate Research (Vol. 1, Issue 1). www.unece.org/env/hs/wpla.

2.5.2 Horizontally scalable lambda architecture for processing and analysing multivariate time-series data

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- Digital transformation is the crucial transformation of business and internal organisational processes to fully address the changes and the new opportunities.
- A horizontally scalable lambda platform architecture for processing and analysing multivariate time-series data was developed.
- The analytics platform processes historical sensory data and real-time data streams, and autonomously selects the optimal forecasting model based on customer specific criteria.
- Forecasts are automatically evaluated and updated to continuously improve and to reduce the forecast error.
- The proposed solution is used by solar and wind energy producers, energy traders, and distribution companies, delivering forecasts of substantial outputs in minutes.

Today, we are living in a world of ubiquitous connectivity. Things around us continue to get faster, smarter, more connected, and even more digital, and a significant role in this evolution, altering both consumer and developer behaviours has been played by the digital transformation. Digital transformation is the crucial transformation of business and internal organizational processes to fully address the changes and the new opportunities.

Here, we describe a horizontally scalable lambda architecture for processing and analysing multivariate time-series data that is successfully applied in:

1. Energy and utility industries to forecast the asset's behaviour and to optimize integrated supply-demand models, and
2. Telecommunication industry to allow faster and more accurate root-cause analysis, anomaly detection, smart alarming, and alert noise reduction of the next-generation IT infrastructure.

The proposed solution processes historical and real-time data, combines them with inputs from external sources, and autonomously selects the optimal forecasting models based on specific criteria. Forecasts are automatically evaluated and updated to continuously improve and to reduce the forecast error.

The proposed solution is used by solar and wind energy producers, energy traders, and distribution companies. It delivers forecasts in minutes, helping agents in the energy sector generate electricity demand or production forecasts, reducing oversupply or undersupply of electricity, avoiding regulatory penalties, and balancing costs.

Using the stream processing component, the proposed solution provides latency bounded streaming analytics over heterogeneous data. For solving the problem of intelligent IT infrastructure management, a two-level approach is used (that includes Physical Infrastructure monitoring and Service monitoring on the first level, and the System condition monitoring on the second level):

1. Physical Infrastructure monitoring - Metrics monitoring that include monitoring of the current utilization and status of the infrastructure typically as cross-layer information regarding throughput, CPU, memory, disk, and latency.
2. Service based monitoring by integrating Component/Protocol monitoring - identification of component/protocol communication failure or performance decreasing based on the protocol messages collected from the physical nodes, and
3. High level System condition monitoring that involves cross correlation analysis between the physical Infrastructure monitoring and the service-based monitoring. Drill down to the probable root problem or the probable troublemaker.

2.5.3 Collaboration platform as a driver of the digital transformation

Luka JOVICIC, GDi, Skopje, North Macedonia.

- GIS Digital transformation in North Macedonia is in early adoption phase, where the core spatial data among the large number of stakeholders has already undergone digitalization.
- Collaboration platforms can foster and secure digital transformation region wide, and two such platforms were developed.
- NSDI Geoportal focuses on data producers and their needs, gathering interoperable services from various subjects and imposing their wider production and usage.
- LiDAR distribution portal offers raw and processed LiDAR data interactive extraction, giving possibility to acquire sensor data for users' business services.
- Further steps in accomplishing digital transformation are envisioned as implementation of analytic web services which utilise data integrated from various sources and spatial analysis in 3D.

In the domain of the Geographic Information Services (GIS) digital transformation is a process navigating organizations and communities towards services-based workflows (Bundock 2018). In such manner, added value is brought to the traditional operational- and decision-making workflows. Focus point of such approach is building smart communities. Experience from communities already mature in digital transformation imply IoT exploitation as well as AI being integral part of the smart communities.

Digital transformation in North Macedonia regarding GIS can be discussed in terms of early adoption phase, where the core spatial data among the large number of stakeholders has already undergone digitalization. Furthermore, at least spatial web map viewing services are considered regular in common usage. Advanced services usage, as regarding data exchange, or querying, extraction and analysis is present in the best cases examples and at organizations which continuously invest in GIS technology.

Experience from the project implementation within the GDi Skopje, as the ESRI distributor, custom solutions developer and spatial data and services Enablement Company, shows successful examples of spatial data infrastructures (SDI) and wider approach – collaboration platform as a concept that can foster and secure digital transformation regionwide.

This paper focuses on two implemented national level projects to support practical digital transformation process: National spatial data infrastructure (NSDI) geoportal and LiDAR distribution portal. The first is the example for gathering interoperable services from various subjects and imposing their wider production and usage. While NSDI geoportal focuses mainly on data producers and their needs, LiDAR distribution portal represents geoportal which offers number of raw and processed LiDAR data interactive extraction, introducing users from various domains with the possibility to acquire sensor data for their business services, emphasizing wider state of art data source usage.

NSDI Geoportal

NSDI Geoportal of the Republic of North Macedonia acts as INSPIRE and national standards compliant services node between NSDI subjects, being open towards citizens and other interested parties. Governed by the Agency for Real Estate Cadastre, it brings to users an enhanced experience in searching resources compliant either with national or INSPIRE recommended standards. Map viewer enables all resources to be previewed and gives insight in available features, while allowing adding external OGC compliant services for overlay. Further, it permits selecting referent service subset for download using intuitive tools like importing area of interest, selecting from predefined map tiles or drawing the area of interest.

The platform NSDI Geoportal represents (Kotsev et al. 2018) enabled tighter institutional collaboration, providing publication of secured and limited access services. This is accomplished through the Geoportal's user and services administration capabilities which can differ who access and uses which resources under which conditions. Throughout the implementation, working on better data accessibility and wider data usage, this approach enabled institutions with limited capabilities to take part, open up data access as much as the legal framework allows and enhance their data management for creating more integral institutional collaboration and market opportunities.

The whole platform is structured as the Esri ArcGIS Enterprise solution, focusing on the back-end capabilities offered by the ArcGIS for INSPIRE Extension, exposing the geoportal to end users with the Esri opensource component the Esri Geoportal Server catalog and the Esri WebAppbuilder for ArcGIS map viewer application. In

regards to client requirements, custom user management and integration of e-payment system has been integrated, satisfying national legislative in regards to data access and distribution.

LiDAR Distribution portal

LiDAR distribution portal provides functionalities and services in order to enable LiDAR and DTM/DSM data sharing and distribution to all interested users of the Agency for Real Estate Cadaster. Portal consists of web applications – map viewer, metadata catalogue, administration and statistics module, e-payment module; as well as components dedicated to data processing (conversion, loading, validation) as well as service development and publication). Developed web application supports multiple coordinate systems, is browser independent, dominantly supporting work with LiDAR LAZ/LAS formats, as well as DTM/DSM grids. Web application has the main focus on navigating and visualizing LiDAR datasets on national level, different means of selection (by objects, imported area or by interactive drawing), ordering and downloading point cloud and raster datasets. Web solution provides module for creation and serving metadata and web map services in secured and standardized (OGC) manner.

The LiDAR Portal is built on top of the branded Esri COTS solution. The ArcGIS Enterprise base deployment is set up with addition of another, federated, ArcGIS Image Server. Additionally, database server is set up and equipped with the Oracle instance, storing data that serves as the input for the Image Server and ArcGIS Server.

Presented projects are seen as a form of collaboration platforms. From one aspect platform acts as enabler (PaaS, SaaS) of integrating services for and among the stakeholders which are represented by at least 20 state organizations in North Macedonia (Dimova et al. 2021). On the other side, platform is a provider of state of the art acquired, processed and available for further utilization LiDAR datasets and derived products.

Implemented portals as a best practice case examples represent digital transformation in practice and differ in the focus on data providers and data users. Although being developed by the COTS solution, the development approach considered creating interoperable environments and support of major open and standard distribution formats.

Further steps in accomplishing digital transformation are envisioned as implementation of analytic web services which utilize data integrated from various sources (as for example within the NSDI geoportal) and spatial analysis in 3D as available with utilization of LiDAR data.

Wider usage of such services as well as inclusion of other subjects with capabilities for advanced spatial analysis utilization like universities, research centers, etc. would better support the efforts of different providers of digital transformation processes.

References

Bundock, B., 2018. GIS for Digital Transformation Is the Start of Smart. ArcUser, p.25.

Dimova, S., Ivanovska Kirandziska, S. & Jovičić, L., 2021. ANALYSIS OF DATA SETS AND SERVICES ON THE NSDI GEOPORTAL. Scientific Journal of Civil Engineering, 10(1), pp.11–16.

Kotsev, A. et al., 2018. The private sector perspective on SDI and open data developments in the former Yugoslav Republic of Macedonia. Data-driven Economies in Central and Eastern Europe.

2.5.4 Emotional Artificial Intelligence using Face mounted Mask

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- An engine for Emotional AI – EmteqPRO, was developed to recognize and better understand the user's emotional and affective states.
- The engine employs a face-mounted multi-sensor mask that measures facial physiological responses, facial muscle activations, and motions from the user.
- Advanced bibliometric sensors built into facial wearable enable measurements of affective state of the user in real time.
- The emteqPRO system can work by itself, as an open-face mask, or can be combined with a commercial Virtual Reality head mounted display.
- This newly developed technology has the potential to significantly improve the way we collect data, design experiences, and interact within Virtual, Mixed and Augmented Realities.

We are presenting an engine for Emotional Artificial Intelligence (AI) that we are developing for the emteqPRO system – which uses a face-mounted multi-sensor mask that measures facial physiological responses, facial muscle activations, and motions from the user. These measurements are then analysed by our Emotion AI engine to recognize and better understand the user's affective states and context, i.e., arousal, valence, stress, physical activities, etc. The emteqPRO system can work by itself, as an open-face mask, or can be combined with a commercial Virtual Reality head mounted display. It comprises of 3 sensor modalities: a 7-contact f-EMG sensor, a PPG sensor, and a 3-axis IMU, enabling measurements of affective state of the user in real time. We will demonstrate how the system is used in practice in a Virtual Reality environment. This newly developed technology has the potential to significantly improve the way we collect data, design experiences, and interact within Virtual, Mixed and Augmented Realities. Emotions are subjective states of mind that are triggered by internal stimuli or events and usually are expressed by our body, so other people can recognize them. However, if not strong enough, they are difficult to detect and recognize because the body is not expressing symptoms visually. Emotion recognition is one of the areas where computer systems are trying to recognize the human emotions. The most traditional way of recognizing emotions is by using cameras. However, this approach cannot recognize subtle responses. On the other hand, facial EMG is a scientifically valid method of evaluating affective states and has been proved in the past. We present a novel multimodal AI-based approach that uses machine learning and advanced multi-sensor data fusion algorithms to:

- Recognize user's arousal state (low, medium and high);
- Recognize user's valence (negative, neutral and positive);
- Recognize user's facial expressions (smile, frown, surprise, etc.);
- Estimate heart rate variability features, including the actual heart rate;
- Estimate user's breathing rate.

Our approach uses the data provided by the emteqPRO system (shown in Figure 1). The emteqPRO system measures various physiological and behavioural parameters using sensors such as: a 7-contact f- EMG sensor, a PPG sensor, and a 3-axis IMU. This data is analysed by our Emotion AI module in order to recognize and provide more comprehensive information about the person's emotional and affective state.

Figure 1. Left: The emteqPRO multi-sensor mask, showing the EMG channels: frontalis (in red), orbicularis (in green), zygomaticus (in blue) and corrugator (in purple). Right: The locations of the sensors mapped on the face.

2.5.5 4 INFO

Viktor MISOVSKI, 4 INFO, Skopje, North Macedonia.

- 4Info is a mobile application for monitoring, control and analytical functions of the marketing mix subject to the supply records of companies in the FMCG and the service sector.
- It is used for tracking commercial data, purchasing experiences and customers' behaviours.
- A proven benefit is the instant distribution of promotional content to all registered customers by digital channel.
- It encourages sales through an increased visiting bystander, fully indoors, (in house) and through its mobile devices.
- The companies benefit from precise reports and analytical information of the marketing activities, in a format suited for the scope of the advertiser.
- The application is already functionally useful in Macedonian, English and Albanian language.

The company 4Info was established in 2018, with a primary goal and strategy for the market in the Republic of Northern Macedonia, to develop, present and put in commercial use one brand new, revolutionary and innovative digital concept for monitoring, control and analytical functions aimed at all elements of marketing mix subject to the supply records of companies in the FMCG and the service sector, through a unique and innovative mobile device application. Under the working name "On The Spot" marketing system, this digital application builds its capacities on the basis of the growing trend of modern needs for market information and industry in general, through a fully digitized system of tracking commercial data, purchasing experiences and Consumers' and customers' behaviours in a specific market segment, directly from the point of sale, using only digital tools and systems that today are already owned by every modern consumer: a smart mobile phone, a wireless connection and an appropriately adapted mobile application.

In the past 2 years, the 4-Info team has taken a series of investment activities necessary for confirmation of the market interest for such a platform and for the development of the basic components of the application, which accordingly were put it in usable function for several company clients (user contracts attached).

However, the crisis with Covid19, and the mandatory closing of the catering facilities through restrictions on population movement, presented a brand-new challenge for the applicant company to redefine the strategy of development of the basic idea. Accordingly, in the direction of its long-term sustainability, the range and functionality, fully redefined phases and development components from the aspect of functionality and market application were applied to the original concept.

These changes, at this point, are the main basis of the new concept, which above all, are directed towards major chains of markets and shops, generating a completely new commercial portfolio for different categories of clients.

Equally important for the process are the insights of the current application of the platform, as well as the direct feedback obtained through direct talks with existing, and new potential customers. Based on this, a full assortment of new, additional market needs was generated, on which the 4Inform team is ready to respond.

The company "4Info" is managed by Nikola Ribaroski, MSc in Technical Sciences and with notable Work Experience of 11 years, who together with a team of external associates and experts, each in the separate areas that this concept covers, continuously works on perfecting and developing the digital operating platform/application and the benefits that it would generate for its users.

Despite the fact that the business idea uses the existing digital tools that have wide application in the general population, (applications and smart devices), the platform design, the tools and portfolio of services arising from it, represent a unique and completely new digital solution. The key level of innovation of the 4Inform platform is compared with regard to traditional media and social networks, and implies the time, place, speed and relevance of placing promotional data and information, adapted to the needs, behaviour and expectations of consumers at the point of sale.

Existing market trends and buyers' habits are moving in a diametrically opposite direction from propositions generated by marketing activities at the place of sale, which unfortunately in our country are still led by traditional methods of dissemination of printed content and visual messages with universal character. With this, more often the needs of the "modern" buyer and the transmitted message through the "traditional" marketing channel or promotion, lose common touch points and do not create any added value on both sides of supply

and demand. In response to this misbalance on the market, the applicant company creates and crafts a concept through which it offers modern solutions that apply or basically represents the start of one full process of transforming market experiences and concepts for product promotion, and of course, customer satisfaction. Summarized, this platform develops and unites the following processes:

- Digitizes, increases and guarantees the range and speed of distribution of promotional content towards customers at the place of sale - provides instant distribution of information to all registered users by digital channel;
- Encourages sales through an increased visiting bystander, fully indoors, (in house) and through its mobile devices.
- Provides precise reports on the success of marketing activities, according to an absolutely accelerated, precise and digital service in a format suited for the needs of the SCOPE of the advertiser or a useful analytical information generated through this unique digital system.

At this point, all these activities do not exist in classical advertising with printed leaflets and billboards, or with television and radio ads.

According to the above mentioned, the company applicant with the finalization of the investment cycle and the launch of the digital platform on the market in the North Macedonia, offers an effective commercial solution for a wide range of users through its application and will be able to transform or enhance all key elements of marketing The singer's mix and value chain in general.

Up to this moment, the development of this platform in a significant part is aggravated by the effects of the Covid19 crisis, which prevented the applicant company to fully commercialize its initial finished product, despite the fact that on an operational level, several contracts with users of the This concept are in the phase of full implementation. Nevertheless, and regardless of the current circumstances and obstacles, the "4Inform" team from the period of establishment of the company, to date, manages to set, test and put into use the basic concept model of the digital platform containing the following components:

- Mobile application called "4Inform", available for Android and IOS operating systems of mobile phones/devices, which displays promotional content at the moment when the application user is registered in the network of the point of sales,
- Functional infrastructure network of wireless emitters (antennas) that emit to phones or other portable devices in a certain radius of the antenna itself, which can be "read" from the appropriate application developed and administered by the applicant company, i.e. client user.
- Back-Office content management platform, fully integrated with mobile devices.

None of the activities of the project does not affect the quality of air and the environment, as it implies the development of a digital commercial solution that has no contact points with the environment. The project does not involve with the compliance of the legal environmental regulations that convey to air emissions, use of water or wastewater and solid waste management.

None of the activities of the project, are subject to a procedure for estimate and reckoning of additional environmental fees, penalties, penalties or other environmental obligations (for example: legal procedure ongoing which includes environmental issues.

With the widespread commercial offer of the application generated by this project, it will indirectly engender environmental benefits, starting from reducing or completely eliminating the generation of solid waste from printed promotional materials and paper leaflets, as well as the need for their distribution which suggests the use of motor vehicles, and of course, emissions from harmful gases that would be generated as a result of research activities of agencies when market analyses would implement through the organization of field physical visits to sales facilities.

In one sentence, it is a complete "green" project when it comes to environmental protection.

Unlike all existing solutions that emerged or are already functioning on the market in the Republic of North Macedonia and the region and whose basic business idea is to promote the product or customer service to the users' location that is outside the scope of the selling place, (point of sale, i.e. The user is at home, at work or at a distance location) and is using a standard Internet protocol, our application aims to place the message to the user of the application while the application user is adjacent to the location of the client / selling place.

In addition, the application does not use a standard 3G / 4G internet connection, but "communicates" with its technical infrastructure via a special protocol that has been developed the applicant company and any without additional expense for the consumer itself.

This emphasizes the efficiency of the concept and by this, substitutes a full system of direct promotion at the place of sale that is currently executed in a traditional and cost-ineffective form.

In the context of the mentioned arguments regarding competition and the market, we conclude that it is a completely new market with a huge technological barrier of entry, which through the development of the operating platform / application is completely exceeded by the 4Info proposal, and is with user potential in the target Groups from 16 to 70 years of old age and geographical range in all Southeast European countries. We emphasize that the application is already functionally useful in Macedonian, English and Albanian language. By adding a Serbian-Croatian language to the platform it would open a market of another 15 million potential users.

References

http://www.stat.gov.mk/publikacii/2.4.11.14.pdf

http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__Naselenie__ProcenkiNaselenie/124_Popis_Ops80_NasPolStar3006_mk.px/table/tableViewLayout2/?rxid=38d1872b-8230- 4ae2-b9fb-d4fee0d499a3

http://www.stat.gov.mk/PrikaziSoopstenie.aspx?rbrtxt=77

http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__InfOpstestvo__Domakinstva Poedinci/375_InfOpst_Mk_051_IntRedovLica_mk.px/table/tableViewLayout2/?rxid=52a3ada4- 2558-4f23-8c7d-b2e39f67836e

http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__DelovniSubj__AktDelovniSubjekti/225_DelSub_Mk_02DeSSeV_mk.px/table/tableViewLayout2/?rxid=4411cd7f-f4b1-409a-aa09-3b503c38d593

http://www.stat.gov.mk/PrikaziSoopstenie.aspx?rbrtxt=69

2.6 Blockchain, Economy and Society

2.6.1 Towards a technical architecture for societal Trust: developing the main building blocks

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- Citizens' trust relies heavily on transparency, requiring information platforms that make the data easy to access, use, manipulate, visualise, and share.
- Trust between Data Providers, platforms' operators and Data Consumers is essential for the long-term availability of data as a service, which in turn is a key enabler of a smart environment.
- Architectural solutions are emerging for data platforms and digital identity management aimed at serving smart cities and creating online Trust in digital environments while empowering the citizens with the control over their data.
- Three building blocks that are recently gaining ground in Europe to support data governance and identity management in smart cities are the Digital Identity Wallet, Personal Online Data Spaces (PODS), and the Data Mesh.
- The three proposed building blocks offer the basis to design a sound blueprint for a secure and trustable platform for a Smart City environment.

The maturity of smart socio-technical systems, such as smart cities, depends heavily upon connectivity, pervasive devices, and the data shared among various stakeholders, such as citizens, government actors and service providers.

Over the last few years, the availability of 5th generation wireless networks and the diffusion of the Internet of Things (IoT) is pushing forward the technical implementation of smart environments, especially in the sector of utilities, mobility, and digital government and services. Moreover, the development of platforms for big data analytics and the progressive availability of open data both from the public and private sector show that the technical feasibility of smart cities can be considered at a turning point.

However, data is not sourced out of the blue, but must be provided by citizens, businesses, and devices under the control of people or organizations. Therefore, Trust between Data Providers, platforms' operators and Data Consumers is of paramount importance for the long-term availability of data as a service, which is one of the key enablers for a smart environment.

What can be inferred from some recent consultations and assessments made by the European Commission to launch the ongoing EU data strategy, is that people want a larger control over personal data, which is still out of reach today especially since the online identity is usually managed by a handful of large players and every time a digital service "forces" us to create a digital identity in order to log in we have no idea of what will happens to our data.

The recent experiences of Covid-19 pandemic have highlighted that the willingness of people and organizations to share data does not depend on the technical instruments and on the promise of data-driven politics. Instead, it is rooted in the societal imaginary and values and on a number of social and institutional factors that can affect the feeling that people have of being in control of their own way of living and data.

The perception that data and information are a source of power is strongly rooted in organizations, whilst people are more concerned about their privacy and freedom. In both cases, the willingness to share data depends on material and immaterial benefits that can derive, like prestige, respect, goods or services that can be traded in exchange for the data themselves.

One thing that emerges from recent research is that people and organizations are more reluctant to share data with government than with other people or organizations. Perhaps the local and socially cohesive nature of smart cities can counterbalance some of the barriers which affect data crowdsourcing in large societies.

Anyway, some questions emerge on data governance and call for disruptive solutions to create online societal Trust by design and by default. They should offer a high level of transparency about data openness, manipulation, and ownership, since these three aspects play a major role in the future development of data powered services, which are a characteristic of the smart environments. On the other hand, citizens' trust relies heavily on transparency, requiring information platforms that make the data easy to access, use, manipulate, visualize, and share.

Based on these considerations, some architectural solutions are emerging for data platforms and digital identity management aimed at serving smart cities and creating online Trust in digital environments while empowering the citizens with the control over their data.

In the following sections, we will present three building blocks that recently are gaining ground in Europe to support data governance and identity management in smart cities, namely the Digital Identity Wallet, Personal Online Data Spaces and the Data and Service Mesh.

Digital wallets for e-Identity

A Digital Identity Wallet is a digital solution that enables people to choose which aspects of their identity, data and certificates they want to share with third parties, and to keep track of such sharing. Keeping the users in control of their data ensures that only information that needs to be shared will be shared.

The European Commission, through an initiative connected to the revision of the eIDAS regulation, has recently proposed a new schema of digital wallets for e-Identity. Through such wallets citizens will be informed about the attributes required for the provision of a specific service. Moreover, they will be able to control the amount of data provided to relying parties.

Service providers across the EU shall inform Member States of their intention to rely on a European Digital Identity Wallet, which would allow Member States to control that sensitive data sets, for example, related to health are only requested by service providers in accordance with national law.

A number of different usage scenarios can be envisaged in which self-managed identity Wallet can disrupt the current centralised approach. For instance,

- Management of sanitary data, such as those related to Covid-19 vaccines as discussed and implemented at the EU level by the eHealth initiative. Interoperability and scalability of any given solution must be ensured as well as a high degree of security.
- Voting rights for e-voting initiatives. In such a case, the hardest constraints (both governance- and implementation-wise) are implied by the requirements of the voting itself (e.g., secrecy, anonymity, freedom to vote and so on).

Personal Online Data Spaces

Personal data spaces, or PODSs, are emerging intermediary services that give users control over the sharing and use of their own data. They are also mentioned as Personal Information Management Systems and provide technical means to empower data owners and producers. PODS are the data sources and storage facilities in digital wallets and in the Data Mesh.

Data Mesh

Data mesh is a data governance approach more than a technical platform solution. The Data Mesh approach relies on four principles:

1. domain-oriented decentralized data ownership and architecture
2. data as a product
3. self-service data infrastructure as a platform
4. federated computational governance.

Each principle drives a new logical view of the technical architecture and organizational structure. The adoption of a Data Mesh architecture in a Smart City is aimed at giving citizens control over their data, since access and visibility policies can be enforced by the data owners over any data asset in the mesh. These policies can be comprised of pay-for-use, targeted authorizations, or anonymization measures

The three proposed building blocks offer the basis to design a sound blueprint for a secure and trustful platform for a Smart City environment.

We conclude arguing that the problem we are dealing with is a complex one and the technical solutions alone are not enough. It is a societal problem and people should change their approach with the world and environment where they live. This is not an easy task, since the gaps are rooted in some interweaving cultural and societal imaginary aspect, related with our self-perception and our positioning in society. Given this complex nature, the ultimate "building block" for change is education.

REFERENCES

P. Brockman, I. K. Khurana, and R. I. Zhong, “Societal trust and open innovation”, Research Policy, vol. 47, no. 10, pp. 2048–2065, 2018.
Available: https://www.sciencedirect.com/science/article/pii/S0048733318301756
“Commission proposes a trusted and secure digital identity for all Europeans,” European Commission, Tech. Rep., Jun2021.
Available: https://ec.europa.eu/commission/presscorner/detail/en/IP212663
Z. Dehghani (2020), Data mesh principles and logical architecture
Available: https://martinfowler.com/articles/data-mesh-principles.html

2.6.2 Most exciting disruptive technologies for accounting researchers and professionals

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- A biometric analysis was conducted on published articles to identify the research preferences of selected technologies between academia, professional development associations and experts.
- Results showed that the academia is working and researching in the same direction as practitioners and that it is providing support for adapting and aligning accounting with technological innovation.
- The technologies that disrupt most the accounting profession are big data, data analytics, cloud, artificial intelligence and blockchain.
- Results showed that accounting firms and professional accounting associations focused on artificial intelligence, while academic journals on blockchain.
- AI is the third most researched technology in terms of the absolute number of published articles.

Disruptive technologies such as big data, data analytics, cloud, artificial intelligence, and blockchain, are challenging both accounting academia and professionals to exploit their potential for advancement of quality and efficiency in offering professional accounting services.

The purpose of our research was to identify a potential gap in research preferences related to selected technologies between academia, professional development associations and experts through extensive analysis of published articles. The research was conducted using bibliometric analysis, more precisely co-word and co-occurrences analysis to examine the level of coverage of each of the selected technologies by the Big Four accounting firms, professional accounting associations and institutions and high-ranking academic journals in the period from 2016 to 2020.

The findings, which are early quantitative research data on publishing trends related to the most disruptive technologies for accounting, show that there are no significant gaps or divergences between the views and research preferences of academics and practitioners. Although there are some concessions that are worth discussing, the results indicate that the research efforts by accounting academics supports practitioners and their endeavours to increase automation, efficiency and quality of accounting services.

Digital disruption is happening at an accelerated pace and is a kind of industrial upheaval (Karimi and Voltaire, 2015). It transforms businesses that are part of the global supply chain by changing the methods of organizing, creating and extracting values. Many of the emerging technologies, like big data and data analytics already have a major impact on accounting processes and professional practice. Disruptive technology will permanently transform the way accounting is done, as well as the people who perform it (AICPA, 2021). According to Marrona and Hazelton (2019) it is not enough to develop new accounting software or computer tools based on advanced technologies unless there is a parallel development of new paradigms that provide an essential understanding of the new ways of generating, archiving, collecting, and analysing data. Thus, academic researchers and tech leaders need to explore and investigate and provide the appropriate theoretical foundations to help practitioners better adapt to technology, increase their awareness and confidence in it. The significance of the results of such research is very important for all parties involved, as well as regulatory bodies, in order to be able to establish the right strategy and coordinated activities to respond to the challenges of the most exciting disruptive technologies for accounting of the future.

Our initial qualitative research helped us identifying the most exciting technologies that disrupt the accounting profession: big data, data analytics, cloud, artificial intelligence and blockchain. We conducted bibliometric analysis to identify how many articles, i.e. papers were published by (1) Big Four accounting firms: Deloitte, KPMG, EY and PWC , (2) professional accounting associations and institutes: IFAC, AICPA, ACCA, ICAEW and CIMA and (3) Eight high ranking academic journals. The journals were selected based on the qualitative results of literature review and populated reference list of most frequently cited academic papers for the period from 2016 to 2020. The article database was created through a two-step verification process, where the articles were first selected using advanced search tools according to the following keywords: "Big Data" OR "Data Analytics" OR "Cloud" OR "Artificial Intelligence" OR “Blockchain” AND “Accounting”. In few cases each technology term was searched separately where databases and web pages offered fewer options for advanced search. After the article was identified by the search, the author reviewed the article manually to ensure that relevant technology was conceptually and sufficiently covered, not merely mentioned. We continued our investigation of relevant publication database with descriptive, trend and comparative analysis.

We have identified a total of 8,206 articles, most of which were published by Big 4 accounting firms. In general, the largest number of articles/papers refer to data analytics (31%), followed by Big data (30%), AI (18%), cloud (13%) and blockchain (8%).

Our trend analysis on annual percentage growth of published articles for selected technologies, 2016 being the base year, shows domination of artificial intelligence in Big Four and professional accounting associations focus, while blockchain in academic journals. These results show the intensity and increased interest in technologies by the analysed platforms.

However, our findings differ for the absolute number of published articles elaborating on each of analysed technologies. Big data and data analytics undoubtedly predominate in published articles in the last 5 years. Big 4 firms discuss mostly about Big data, while academic papers mostly cover data analytics. AI has seen significant growth in research by both academia and practitioners and it is the third most researched technology in terms of the absolute number of published articles. Our research of published articles identified notable difference in research preference for blockchain technology among investigated groups. Professional accounting associations prefer to explore this technology the most, followed by relative preference shown by academia and Big 4 firms which lag in interest more than twice on comparative terms then academia. Cloud accounting is technology more researched by accounting practitioners and provokes less interest in research and investigation by academia.

The disruption in accounting caused by emerging technologies such as big data and data analytics, cloud, AI and blockchain, will affect the processes and future operations of companies. The academia must navigate research focus and offer relevant input to practitioners who strive to adapt to the changes that are already coming. It is not a question of whether, but when routine accounting processes and services will become fully automated and enabled through technology without human intervention for many businesses.

Based on our research, the findings show moderate differences in research focus and preferences on relative basis among academia, accounting associations and practitioners. These are positive indications that the academia is working and researching in the same direction as practitioners and that it is providing support for adapting and aligning accounting with technological innovation.

We intend to expand our database of high-profile journals covering relevant topics and to conduct additional in-depth investigation on segregated professional publications such as journal articles, white papers, short online articles, discussions and transcripts. Our expectations are that the number of articles/papers will increase in the future due to the attractiveness and popularity of certain technologies that will gain even greater importance.

References:

AICPA. (2021), "Go Beyond Disrtuption". Available at: https://www.aicpa-cima.com/disruption.html

Cong, Y., Du, H. and Vasarhelyi, M.A. (2018). "Technological Disruption in Accounting and Auditing". *Journal of Emerging Technologies in Accounting,* 15, 1–10. https://doi.org/10.2308/jeta-10640

Coyne, J.G. and McMickle, P.L. (2017). "Can Blockchains Serve an Accounting Purpose?" *Journal of Emerging Technologies in Accounting,* 14, 101–111. https://doi.org/10.2308/jeta-51910

Du, H. and Cong, Y. (2015). "Going Cloud for Agility: Beyond Financial, System, and Control Motives". *Journal of Emerging Technologies in Accounting*, 12, 153–167. https://doi.org/10.2308/jeta-51255

Karimi, J. and Walter, Z. (2015), "The role of dynamic capabilities in responding to digital disruption: a factor-based study of the newspaper industry", *Journal of Management Information Systems*, 32(1), 39-81.

Kokina, J. and Davenport, T.H. (2017). "The Emergence of Artificial Intelligence: How Automation is Changing Auditing". *Journal of Emerging Technologies in Accounting,* 14, 115–122. https://doi.org/10.2308/jeta-51730

KPMG. (2017), "The disruptors are the disrupted - Disruptive technologies barometer: Technology sector". Available at: https://assets.kpmg/content/dam/kpmg/xx/pdf/2016/11/disruptive-technologies-barometer-tech-report.pdf

Marrone, M. and Hazelton, J. (2019). "The disruptive and transformative potential of new technologies for accounting, accountants and accountability". *Meditari Accountancy Research,* 27(5), 677–694. https://doi.org/10.1108/MEDAR-06-2019-0508

Richins, G; Stapleton, A; Stratopoulos, T and Wong, C. (2017), "Big Data Analytics: Opportunity or Threat for the Accounting Profession?", Journal of Information Systems, 31 (3), 63–79.

Vasarhelyi, M.A., Kogan, A. and Tuttle, B.M. (2015). "Big Data in Accounting: An Overview". *Accounting Horizons*, 29, 381–396. https://doi.org/10.2308/acch-51071

2.6.3 Towards a Real-Time Economy: Theoretical and Empirical Insights

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- Switching from physical and paper-based to contactless interactions, machine-to-machine communication, and automation of key business processes are growing preferences.
- Real-Time Economy (RTE) supports free movement of structured data inside and across RTE ecosystems and highlights machine-to-machine communication as a new standard.
- First methodological review of RTE literature is presented, using the meta-synthesis method for qualitative research.
- A conceptual RTE model is presented that illustrates technological, management, and e-service enablers, needed to build an interconnected economy that functions in or close to real-time.
- RTE solutions should be studied in the context of environmental opportunities and risks they represent (i.e., reducing paper use, tracking carbon footprints, energy consumption, etc.).

Over the past decades, we have witnessed an expanding interest among businesses and governments to digitize services, automate administrative processes, minimize physical interactions and adopt emerging technologies to innovative core business and government functions (Brynjolfsson et al., 2002; Greve 2015; Lindgren et al., 2019). In this evolving situation, especially after the first restrictions Covid-19 lock-downs and restrictions, we have witnessed a growing preference for switching from physical and paper-based to contactless interactions, machine-to-machine communication, and automation of key business processes and services.

To inform and support the transformation from the analog to a digital economy, I am co-author of a study that explores the literature on Real-Time Economy (RTE), which provides a comprehensive understanding of issues related to digital ecosystems, exchange of data, and automation of key business and administrative processes. Broadly defined, RTE represents a new type of digital ecosystem. All stakeholders (government, businesses, and citizens) can interact remotely and perform business and administrative transactions in or close to real-time. This concept also provides a new approach to address old and pressing issues including bureaucracy, administrative burden, fragmented digital government solutions, and eliminate the need for human-to-human interventions at different G2G, B2G and, G2C levels. Also, RTE points out new ways of supporting the free movement of structured data inside and across RTE ecosystems and highlights machine-to-machine communication as a new standard.

For the first time, the concept of RTE appeared in The Economist article "How about now?" by Ludwig Siegele (2002). In this article, the author makes a critical distinction between the type of economy where distance and physical are no longer relevant as in the traditional economy (Siegele, 2002). Later on, the Real-Time Economic Competence Center adopted the concept in Finland, where the scope was expanded towards the public sector. Now RTE concept covers a more significant number of applications and e-services, including e-ID, e-signatures, e-address, e-invoicing, real-time reporting, risk-monitoring, automated taxation, etc.

To date, projects that lead to RTE ecosystems development remain limited and isolated in some instances. Also, other names are synonymously used in different geographic locations to represent the same concept as RTE. To fill this gap, the present study attempts to develop a comprehensive RTE definition, develop a theoretical understanding of the topic, structure existing literature, and develop a conceptual model to guide the implementation of RTE ecosystems in practice.

This study uses the meta-synthesis method for qualitative research to review RTE literature and address the research objectives. This method provides a standardized protocol of seven steps to extract concepts, meaning, understandings, interpretations, metaphors, etc. from individual qualitative studies and synthesize the results in one place to provide a deeper and broader understanding of the study subjects (Siau and Long, 2005; Walsh and Downe, 2005). This study also conducts a qualitative empirical investigation in one of the few countries working to develop a RTE program, Estonia. To collect data, group and individual semi-structured were conducted. On the whole, 23 national and European experts participated in interviews.

To date, this article presents findings from the first methodological review of RTE literature. Results from this study advance the foundations to develop further a new type of economy, where transactions between stakeholders within the ecosystem are contactless, take place in or close to real-time, and machine-to-machine communication and free movement becomes the new normal. This paper also provides a comprehensive definition of RTE, addressing the widespread confusion about its meaning that mainly results from the field's interdisciplinary nature.

This study also proposes an integrated RTE model that illustrates the necessary technological, management, and e-service enablers (building blocks) needed to build an interconnected economy that functions in or close to real-time. The model also shows the benefits that government/s, businesses, and citizens can capture through RTE solutions and applications. While describing RTE's great potential to become a future priority in the European digital transformation agenda, this study also identifies many barriers that require further attention and brings forth risks that need to be addressed while developing fully-fledged RTE ecosystems.

The results of this study provide a model and guidance to implement the vision of RTE in practice. This primarily happens by illustrating the necessary layers of enablers (technological, management, and e-service) and building blocks required to build such an ecosystem. Also, this study introduces the real-time-by-default principle, which suggests that new e-services and applications should aim to reduce process latencies to a minimum level possible.

Yet, RTE is not an easy mission. There are many barriers that this study identifies, which require further research and testing in practice. Additional attention is further needed to address different interoperability layers, reduce process latencies among public and private organizations, build trust between network participants, establish rules and standards for governing large-scale and complex digital ecosystems, previous path dependencies, legacy ICT systems, etc. Findings from this study also reveal a large gap between RTE research and theories. For this reason, it is essential to establish a more vital link between the two and empirically investigate the value that RTE solutions add for different stakeholders and the privacy and security implications in similar digital ecosystems. Also, RTE solutions should be studied in the context of environmental opportunities and risks they represent (i.e., reducing paper use, tracking carbon footprints, energy consumption, etc.).

References

Brynjolfsson, E. and Kahin, B. eds., 2002. Understanding the digital economy: data, tools, and research. MIT press.

Greve, C., 2015. Ideas in public management reform for the 2010s. Digitalization, value creation and involvement. Public organization review, 15(1), pp.49-65.

Lindgren, I., Madsen, C.Ø., Hofmann, S. and Melin, U., 2019. Close encounters of the digital kind: A research agenda for the digitalization of public services. Government Information Quarterly, 36(3), pp.427-436.

Siau, K. and Long, Y., 2005. Synthesizing e-government stage models–a meta-synthesis based on meta-ethnography approach. Industrial Management & Data Systems.

Siegele, L., 2002. How about now?. Economist, 362(8258), pp.3-6.

Walsh, D. and Downe, S., 2005. Meta-synthesis method for qualitative research: a literature review. Journal of advanced nursing, 50(2), pp.204-211.

2.6.4 What drives the digital transformation in the Western Balkan banking sector? – The case of North Macedonia

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- Banks are the key technological enablers of digital transformation in the finance sector in North Macedonia.
- Digitalization contributes to easier and faster access to a wide range of products and services, which in turn stimulates the growth of non-cash payments.
- In 2020 there is a significant increase in the usage of e-banking by customers and a 121% increase in paying online with a card.
- Quantitative analysis will be based on secondary data resources, involving available databases, research papers, books, and national and international economic organisations' reports.

The purpose of this paper is to examine the determinants of current trends in the digital transformation, data, fintech, and AI in the banking sector of the Republic of North Macedonia as a representative of small and open economies in the Western Balkans. Furthermore, the paper will make attempt to identify key drivers, practices, and barriers in digital transformation through the collection and analysis of primary data. Finally, the results of the paper will enable the creation of sound recommendations for the improvement of the processes of digital transformation in the Western Balkans.

The digital transformation brings fundamental changes in numerous industries at fast pace. In particular, digital innovation is leading to fundamental changes in the financial services industry (Barberis & Christi, 2016). Although the financial services industry is key to almost every economy (McKinnon, 1973; Shaw, 1973; Odedokun, 1996,) the research has lagged behind in comprehensively analysing the phenomenon of digitalisation in the financial services industry (Schweizer, 2019).

The Macedonian financial sector consists of banks, savings banks, exchange offices, and other financial institutions, where the banks play the most significant role and are the key providers. At the same time banks are the key technological enablers of digital transformation in the finance sector in North Macedonia. In that context, our analysis will be focused on the banks in the country.

The modern global payment models, inspired by the changes introduced by the processes of digitalisation, influence the local and regional paying habits. Digitalisation contributes to easier and faster access to a wide range of products and services, which in turn stimulates the growth of non-cash payments. (National Bank of the Republic of North Macedonia, 2019).

There is a significant increase of the demand for digital services offered by banks in the country, according to the Annual information on payments in the Republic of North Macedonia in 2020 (National Bank of the Republic of North Macedonia, 2021). The online payments in 2020 in North Macedonia increased by 10,2%, and in the same period, the electronic credit transfers increased by 6,5%. Companies have been the main beneficiaries of the digitalisation in the banking sector, receiving 56,1% of the total credit transfers. According to the Report, in 2020 there is a significant increase in the usage of e-banking by customers and a 121% increase in paying online with a card.

The data used in this paper will be conducted with primary, as well as with a review of available secondary data. Quantitative analysis will be based on secondary data resources, involving available databases, research papers, books, and national and international economic organisations' reports. This data will provide insight in the digital transformation trends in the financial sector. The quantitative analysis will be based on macro indicators and provides significant information, necessary to forecast the future trends and likely impacts of the digital transformation in the banking sector of North Macedonia.

For collecting primary data, we will conduct survey analysis with representatives from the banking sector in Republic of North Macedonia, regarding the process of digitalisation, AI, fintech and other new technologies in their organisations. The central part of the research is conducted through three rounds of survey questionnaires using the method of qualitative forecasting – Delphi. The questionnaires will be distributed to employees – part of the managerial team in the 13 banks operating in the North Macedonia.

The questions from the first-round aim to inform about digitalisation, artificial intelligence, fintech, and other new technologies in their banks, discovering digital performance, implementation of artificial intelligence

solutions and the problems they face in the implementation of these technologies. The second-round of questions consists of the questions formulated based on the first round of questions-The third-round of questions is based on the last received answers (Cvetkoska & Dimovska, 2019; Dimitrievski & Cvetkoska, 2020). The questionnaire includes 5 open end questions in the first round and 5 closed ended questions in the second and third round. According to Guest, et al., (2006), number of respondents to reach "saturation" in a qualitative study is at least 12. Respondents will be selected based on their responsibilities and role in the bank, as well as access to relevant information about the digital transformation in the bank they represent. The findings from this analysis will provide better understanding of the background process of the digital transformation in the banking sector and showcase their views of the management regarding new technologies such as artificial intelligence, fintech, etc. Furthermore, the websites of all 13 banks in the country will be comparatively analysed in relation to the digital performances and implementation of AI solutions in their operations.

The paper presents how banks embraced the benefits and overcame the challenges from the current tech trends in the industry and respond to the increasing demand of digital services by their customers. This particular research design and the collection and analysis of primary and secondary data, has added value to the research credibility.

The results of this paper will allow us to determine the key drivers of the digital transformation in the banking sector in North Macedonia. The expected results will cover IT infrastructure, security, automation of financial services, AI customer interaction, etc. The findings will enable us to measure the intensity of all of these factors and detect the barriers to the digital transformation in the banking sector. As a final point, the findings will lead to comprehensive recommendations of how to strength the national policies and open new paths to accelerate the digital transformation, data, fintech, and AI in the banking sector of the Republic of North Macedonia.

This paper provides in-depth analysis of the current state of the digitalisation in the banking sector and its future prospects and challenges.

In this paper, we address the research gap about the digital transformation in the banking sector in Western Balkans trough the case of North Macedonia, by applying a multi-methodological approach with quantitative and qualitative analysis.

This paper contributes to the field by offering support and new findings regarding the IT infrastructure, security, automation of financial services, and AI customer interaction in the banking sector. This paper adds to the body of literature in what is considered a relatively new and innovative topic. The recommendations from this paper will have broader scope than the digital transformation in North Macedonia and its recommendation are relevant for the whole region of Western Balkan.

References

Abbasov, A., Mamedov, Z. & Aliev, S., 2019. Digitalization of the Banking Sector: New Challenges and Prospects. *Economics and Management,* Volume 6, pp. 81-89.

Barberis, J. & Christi, S., 2016. *The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries.* Chichester, West Sussex, United Kingdom: John Wiley & SOns Ltd..

Cvetkoska, V. & Dimovska, M., 2019. Analysis of the Possibility of Introducing Seven-Hour Working Time in Correlation with Achieving Maximum Productivity: Delphi Method. *Annual of the Faculty of Economics - Skopje,* Volume 54, pp. 343-359.

Dimitrievski, D. & Cvetkoska, V., 2020. *Delphi Method Application to Find a More Efficient Model for Evaluating the Performance of Administrative Servants.* s.l., University of Belgrade, Technical Faculty in Bor, Management Department.

Guest, G., Bunce, A. & Johnson, L., 2006. How Many Interviews are Enough? An Experiment with Data Saturation and Variability. *Field Methods,* 18(1), pp. 59-82.

Kazakova, S. et al., 2020. European enterprise survey on the use of technologies based on artificial intelligence, Luxembourg: Publication Office of the European Union.

McKinnon, R. I., 1973. *Money and Capital in Economic Development.* Washington DC: Brookings Institution.

National Bank of the Republic of North Macedonia, 2019. Annual Information on Payments in the Republic of North Macedonia in 2019, Skopje: s.n.

National Bank of the Republic of North Macedonia, 2021. Annual Information on payments in the Republic of North Macedonia in 2020, Skopje: s.n.

NBRM, 2019. Annual information on payments in the Republic of North Macedonia in 2019, Skopje: NBRM.

NBRM, 2020. Annual information on payments in the Republic of Northern Macedonia in 2020, Skopje: NBRM.

Odedokun, M. O., 1996. Alternative Econometric Approaches for Analysing the Role of the Financial Sector in Economic Growth: Time Series Evidence from LDCs. *Journal of Development Economics,* 50(1), pp. 119-146.

Schwab, K., 2019. *The Global Competitiveness Report 2019,* Cologny/Geneva, Switzerland: World Economic Forum.

Schweizer, A., 2019. Digitalization in the Financial Services Industry: Fostering Innovation Through Fintechs and Blockchain Technology. Germany: Universitaet Bayreuth.

Shaw, E. S., 1973. *Financial Deepening in Economic Development.* New York: Oxford University Press.

Shearer, E., Stirling, R. & Pasquarelli, W., 2020. *Government AI Readiness Index 2020,* England: Oxford Insights.

2.6.5 Digital transformation for participatory urban planning

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- A Virtual Platform that enables active participation of the citizens in urban planning was developed.
- On the platform the citizens can comment on the current situation with their urban habitat as well as on suggested changes.
- The citizens can suggest ideas and start initiatives that they want to see in their habitats.
- It enables authorities to make smart decisions and bring urban plans according to the needs of the local population.
- The success of this virtual platform accompanied with other measures could spark changes in legislation and practices toward participatory urban planning.

When we talk about urban planning and urban art interventions in the public spaces, in the Republic of North Macedonia they are usually realized by architects with the license for an urban planner. Our experience and conducted research (elaborated in the report: Analysis of the current situation with the involvement of the citizens in the urban planning, GAUSS Institute – Bitola, December 2015) shows that in the Republic of North Macedonia, regarding urban planning

- Citizens are inadequately and untimely informed.
- Citizens are being consulted only pro forma and in the final phase of the preparation of urban planning documents.
- Citizens hardly understand the planned development and its' consequences.
- There are no user-friendly IT tools for citizens' participation in urban planning.

Why citizens' participation in urban planning? Elaboration of this question we will start with the elaboration of the knowledge transfer. Traditionally the processes of knowledge transfer are based on the principle of ONE (or few) to MANY (or all). Similar is the situation in the area of urban planning and urban development. When developing an urban plan, a proposal to rebuild or beautify parts of the city is relying on the ideas and knowledge of a limited number of experts (urban planners). Regardless of the amount of knowledge and ideas that they possess, still, a limited number of input parameters affect the knowledge and creativity of the experts.

Contrary to the processes in which we have a limited number of sources is crowdsourcing. Crowdsourcing is the process of getting work, usually online, from a crowd of people. The word is a combination of the words 'crowd' and 'outsourcing'. The idea is to take work and outsource it to a crowd of workers. Famous example: Wikipedia. In Wikipedia, explicit knowledge is shared. Explicit knowledge is what is documented or codified and can be transferred easily to others. The processes, procedures, journals, manuals, drawings, or any such artefacts come under explicit knowledge.

But in urban development in order to capture the spirit of the specific area besides the explicit knowledge, it is important to capture the tacit knowledge of the citizens living in the area. This knowledge cannot be learned from the books; it is accumulated in the citizens living in the area on the basis of their everyday life experience. Tacit knowledge is what people carry in their minds and we find it difficult to access. There are times we are not ourselves aware of the knowledge we possess and also how valuable it can turn out to be if shared with others. The transfer of tacit knowledge mainly happens through personal contact and trust but this is considered to be very valuable. Many times, this is not shared, primarily because we are unable to communicate all we know.

Thus, we developed a Virtual Platform that enables active participation of the citizens in urban planning. Through this platform, the citizens through the internet can comment (give positive and negative comments) on the current situation with their urban habitat as well as on the suggested changes with new or amendment urban plans. But not just that. They can suggest ideas and start initiatives that they want to see in their habitats. With this approach of giving voice to the citizens in the whole process of urban planning, the authorities can make SMART decisions and bring urban plans according to the needs of the local population (citizens).

Virtual platform for civil activism in urban planning. In order to demonstrate good practice for citizens' involvement in urban planning, we created a web-based software –operational and accessible through www and social media. It can be used by citizens to submit and share ideas for better urban living. They can criticize certain locations and projects. They may applause good urban solutions and initiated projects. They may suggest

solutions for improving their urban communities. Thus, this tool will create an environment for urban development crowdsourcing. It is a good example of how should function existing governmental e-urbanizam.mk portal if we want real participatory urban planning.

The platform is accessible through the web and is integrated with Facebook (users can be registered, view proposals and comment through Facebook. It supports publishing: text, 2D images, videos and 3D models in .kml/.kmz format. The platform is organized in layers.

The users of the platform can post their ideas in several layers based on their experience in urban planning, experience from living in the affected area, etc.

When posting on the platform the users can declare themselves as:

- Expert for architecture/ urban planning.
- Citizen directly affected by location about which submits an idea.
- Citizen who wants to contribute to a more functional/beautiful city (not living in the affected area).
- Visitor with a positive attitude who wishes to share his/her ideas, experiences.

The users can post three types of posts

- Reports of non-functional locations, buildings, urban installations, objects, etc.
- Suggestions for improvement/beautification.
- Praise for good practices: resolved locations, buildings, urban installations, objects, etc.

Furthermore, the users can post their posts as

- 2D proposals: images and text, and video (optional)
- 3D proposals: kml/kmz format currently is supported

Every post on the web platform is synchronized with the Facebook page and vice versa.

Synchronization with social media (Facebook) is very important for the success of the project because our experience shows that it is much easier to attract visitors to interfere through Facebook rather than to attract to visit a specific web page.

The platform enables iterations in the process of urban art and planning.

Conclusion. We believe that through the operation of this platform the authorities will recognize that their decisions for SMART urban development should be based on the voices and ideas of the crowd (regardless of how naïve or professional they can be). There are no bad and good ideas, only ideas and a lack of ideas. We also believe that a developed virtual platform enables hearing the voices of the crowd. The success of this virtual platform accompanied with other measures could spark changes in legislation and practices toward participatory urban planning.

Acknowledgments. This work was supported by the European Union under Creative Europe Large Scale Cooperation Grant 2014–2330/ 001-001; Civica Mobilitas (a programme of the Swiss Agency for Development and Cooperation) under Grant CM-AKT-01, and Swedish Institute under Grant 05874/2015.

References

Koplin M., Siegert S., Neuvonen S., Salo K., Kerney K., Skelton C., Leora Culén A., Nedelkovski I., The Smart City as Shared Design Space. Chapter in the book Smart Cities in the Mediterranean. Spinger Verlag, April 2017 DOI10.1007/978-3-319-54558-5_7.

Koplin M., Vistica O., Johansson M., Nedelkovski I., Salo K., Eirund H., Schrank C., Blau L. Social Art in European Spaces – An Approach to Participation Methodologies Within PS2. Proceedings of INTED2016 Conference 7th-9th March 2016, Valencia, Spain ISBN: 978-84-608-5617-7, 1690 – 1699

Koplin M., Nedelkovski I., Salo K., The People´s Smart Sculpture. Proceedings of the 22nd International Symposium on Electronic Art ISEA2016 Hong Kong. Pages 414-419.

Dimova, M, 2015, Analysis of the current situation with involvement of the citizens in the urban planning. GAUSS Institute – Bitola.

Caragliu, A., Del Bo, C., Nijkamp, P. (2009). Smart Cities in Europe. Proceedings of the 3rd Central European Conference in Regional Science, Ko———————————————ice, Slovak Republic 7-9 October 2009, 45-59.

McLoughlin, C. Lee, M. (2008). Future learning landscapes: Transforming pedagogy through social software. Innovate 4(5), p.3.

United Nations, Department of Economic and Social Affairs, Population Division (2015). World Urbanization Prospects: The 2014 Revision, (ST/ESA/SER.A/366).

2.7 Digital transformation and Artificial intelligence in Education

2.7.1 Goce Delcev University–Stip drives seamless transition to remote learning during pandemic

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- This overview covers a success story with transition to online working at the Goce Delcev University (UGD), due to proper university development.
- 67% of the students believe that online teaching should continue after the emergency COVID19 measures, as a supplement to regular teaching.
- Timely addressing digitalisation in higher education institutions is key for success in the long run.
- Universities should review their structures to be less bureaucratic and more adaptable, flexible, and enabling each learner to progress at their own pace.

Goce Delcev University - Stip (UGD) has been one of the first educational institutions in N. Macedonia that has implemented information and communication technology (ICT) in its education processes. ICT significant changes in the learning and teaching processes in higher education institutions around the world. The importance of those changes came to place when the world was challenged by the pandemic. UGD was the first university in North Macedonia to seamless transitioned to remote learning and its success was recognized by Microsoft and shared worldwide as a good example. This extended abstract highlights practices and activities that took place at the university in the face of the global crisis caused by Covid-19.

UGD was formed almost 15 years (27 March 2007) ago and since than the university has managed to become second top-ranked public university in N. Macedonia. The university is education hub in the East part of the county and is being recognized internationally over special approach and emphasis on quality teaching and improvement in student life throughout new modern study programs and e-systems and established quality systems at the highest institutional level. The university now functions in 15 units - 12 faculties and three Academies on 4 campuses, with more than 9,000 active students on three cycles of studies.

Universities around the world have a long history of operating in environments that are unstable, disruptive, and unpredictable. They have always managed to give answer to political changes, financial crises, and disruptive trends. The pandemic is one of them and it is the biggest one since Second World War. COVID-19 has created severe operational challenge and universities struggled with transition to online working. This was mainly due to:

- Inadequate information technology infrastructure. In the implementation of teaching and learning process, administration, and all academic activities within the university, good IT infrastructure is required. The quality and quantity of infrastructure need to be considered for improvements in productivity and efficiency".
- Limited expertise for online teaching and learning methods. Teachers need to receive training in how to apply what they have learnt in a variety of situations (transfer) and over an unlimited time span (lifelong learning)".

These uncertain times, guessing "what is next" for the higher education sector needs some calculated speculation and some risk-taking and this was mitigated at UGD due to proper university development. Since the beginning the university had a clear vision that included development of platforms for online education. The university had adequate information technology infrastructure including fully functional platform for student's administrative work (e-index), platform for online learning (e-learning, Moodle) and platform for published study materials (e-library) when the pandemic started. Experience knowledge developed over the period of usage of the platforms was key of having ready employees that can easily use the platforms and have some expertise for online teaching.

Three days after the official lock down of the country, on 15 March 2020 the first online class was delivered, and after that all classes were offered online. By the end of March 2020, more than 4,400 students and 360 lecturers were actively using Microsoft 365 and all classes were online using Microsoft Teams. Over the course of three months, students and teachers benefited from more than 100,000 hours of audio lectures and 50,000 hours of live video. They participated in more than 11,000 live meetings (Microsoft case, 2020).

Knowing the infrastructure and experience that we had, the university main goal was no to stop in any way the education process. Swiftly the teachers and students adopted Teams and, in some cases, even enhanced teacher student interactions.

UGD is integrated university and agile decision-making processes gave the flexibility to response fast in real-time to the constantly shifting demands of the pandemic. This change has come suddenly, and it demanded immediate responses in relation to safety, communication, and education continuity.

All classes on first, second and third cycles of studies were offered online from all 15 different faculties plus educational centers that the university has. The learning methods were challenged, and creative approaches were used so that each study programme can be delivered online. All examinations (tests and exams) were delivered online over Teams or Moodle platform in regulated planed academic calendar and not a single activity was postponed. Thesis defending on all cycles of studies was delivered and all administrative work was organized online. Wide area of activities were organized online, from online meetings for Professors Councils, to study program reaccreditations activities and online conferences.

Student satisfaction was important and we organised (25-31 May 2020) a survey with participation of 1237 students from all faculties (Djidrov, 2020). Of the 1,237 surveyed students, only 19 (2%) stated that they did not have access to a computer or other IT device, and 83 (7%) students stated that they did not have easy access to the Internet. Most of the students (67%) said that they believe that online teaching should continue after the emergency measures, as a supplement to regular teaching. Less than 10% of students had difficulty following online lectures, using IT tools and using UGD's e-services and more than 50% of students are satisfied with the timely introduction and organization of online lectures, as well as the support that UGD has provided during the lock down. Here we should also mention those about 30% of the students who declared themselves neutral on these issues (Zdravev, 2020).

The process of implementing ICT in everyday work in teaching is not easy, especially in times of crisis and emergency measures. Timely addressing digitalisation in higher education institution is key for success in a long run.

This momentum is an opportunity for higher education to develop online education further, where we might need to reconsider not only our technology strategy, but also education strategy. Now is the time for higher education institutions to reconsider their value propositions and operating models for successfully and sustainably delivering universities missions in the years to come. Universities should review their structures to be less bureaucratic and more adaptable, flexible, and enabling to academics, researchers, and students.

After what all higher education institutions have faced around the world with the pandemic, we need to embrace online teaching beyond the emergency remote mode that the pandemic has forced us to adopt. We need to re-envision the spaces where learning takes place with using multiple physical and virtual spaces both in and outside of universities. We need to rethink and reimagine the traditional modes of teaching and learning in ways that have appropriate peer to peer contact, in-person services that is necessary to develop skills like emotional intelligence, engagement and collaboration. We need to embrace personalized and self-paced learning systems that offers alternative pathways where diverse individual needs of each learner will be addressed that will be flexible enough to enable each learner to progress at their own pace. This will allow lifelong and student-driven learning to continuously improve existing skills and acquires new ones based on students' individual needs. This will help us expand our student pool, another challenge that is pressuring the universities in N. Macedonia and around the world.

At UGD we see our post-Covid expectations as a way to leverage our new potential with our existing capacity. We will have to optimize multiple delivery modes and embrace more creativity and innovation in teaching and learning in the upcoming years, with blending teaching and learning methods that will improve learning outcomes.

References

Hetty Primasari, Clara & Setyohadi, Djoko. (2018). Improvement of Information Technology Infrastructure in Higher Education using IT Balanced Scorecard. Proceeding of the Electrical Engineering Computer Science and Informatics. 5. 10.11591/eecsi.v5i5.1590.

Tawana Kupe. (2020) COVID-19: A time to reimagine and reposition universities, site: www.universityworldnews.com (accessed 14.11.2021)

Dzidrov, M. (2020). Survey for students' experience - online education during the Covid 19 crisys. Shtip:
University Goce Delchev.

Zdravev, Zoran and Boev, Blazo and Dzidrov, Misko (2020) Implementation of e-learning and ICT in the educational process of UGD in the situation of Covid-19 emergency. Истражувачки активности на МАНУ за справување со пандемијата од Ковид-19.

Microsoft Customer stories – Case example: Leading university in North Macedonia drives seamless transition to remote learning with Microsoft 365 (14.08.2020) link https://customers.microsoft.com/en-us/story/836725-goce-delcev-university-of-stip-higher-education-microsoft-365-en-macedonia

2.7.2 Fostering digital transformation by building capacities for open education

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- An innovative online mentoring program Open Education for a Better World (OE4BW) has been developed to support and implement Open Education Resources (OER) with social impact according to Sustainable Development Goals (SDGs).
- Access to quality professional development resources and integration of OE4BW can improve effective and equitable schooling and help educators to strengthen their digital skills.
- In the academic year 2020/21, a new master's degree program Leadership in Open Education (LOE) was launched at the University of Nova Gorica, Slovenia.
- Next steps include higher promotion and raising interest among Western Balkan countries in order to attract more OER developers, mentors and future IE leaders.

When the coronavirus pandemic erupted, schools had to change and adopt a new way of digital transformation. Education processes had to increase the use of digital technology and unlock potential for open education for ensuring more flexibility, accessibility and sustainability. An innovative model of online mentoring program Open Education for a Better World (OE4BW) has been developed to support and implement Open Education Resources (OER) with social impact according to Sustainable Development Goals (SDGs). Access to quality professional development resources and integration of OE4BW can improve effective and equitable schooling and help educators to strengthen their digital skills. Being global while respecting local specifics, OE4BW provides opportunities also to Western Balkan (WB) countries Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia. Moreover, empowering next-generation of WB open education leaders could be strategically planned and implemented with their inclusion into the existing international online master program Leadership in Open Education (LOE), offered by the University of Nova Gorica and designed together with the UNESCO chair on Open Technologies for Open Educational Resources and Open Learning at the Jožef Stefan Institute as an upgrade of OE4BW.

COVID-19 epidemics amplified needs for digital transformation in education and brought new challenges in achieving quality education for all. Consequently, activities towards sustainable and affordable education got new momentum and increased the importance of Open Education. Open Education embraces Open Pedagogy - the educational process designing architectures and creating and reusing tools for learning that enable both students and teachers to shape public knowledge commons in an open way, lowering the barriers of all kinds. For this pedagogy, digital technology and literacy are a prerequisite, requiring from all stakeholders to develop digital skills. This spans from e-learning for digital society (Bregar et al., 2020), sustainable and affordable education (Urbančič and Orlič, 2016) to advanced human resource management in companies (Florjančič, 2021). International studies have identified a lack of digital competencies among various stakeholders as one of the main limiting factors and also emphasize digital capacity building as one of the main enablers for open education (Open Educational Resources: Global Report, 2017).

The OE4BW Model of an Open Online Mentoring Program

The program is open to all, regardless of their professional background, education, background, or other specifics. Proposals for OER development projects are selected on a global call based on their social impact, the maturity of the idea, and potential for implementation. Selected applicants are supported online by OER experts volunteering as mentors. At the end of the program, participants deliver a presentation at the annual closing event. Their produced educational material must be in the public domain and labelled as such with an appropriate open license. At the end of the program, participants deliver a presentation at the annual closing event. Most of them already report on feedback provided by first users of their materials. Initial model and improvements based on first year feedback are presented by Urbančič et al. (2019). With the second, third and fourth call, additional changes were introduced to better manage scaling-up through hubs. While some hubs were geographically based, more recently topical hubs have shown their additional advantages by connecting developers with similar interests and allowing for more ambitious educational goals to be covered collaboratively.

So far, 185 projects have been developed by 165 developers under the expert guidance of 114 mentors. In 2021, the OE4BW program was running for the 4th year. Whereas in the 1st (2018/19) and 2nd (2019/20) year of the programme, the OER projects were categorised in 3 geographical hubs (Hub Africa& Europe, Hub Asia,

Hub North and South America), in the 3rd year (2019/20), the first topical hub was introduced, related to the SDG7 on Affordable and Clean Energy. In the 4th year, besides geographical hubs there were 5 topical hubs: Hub "Teaching Science, Technology Engineering, Mathematics and Medicine", Hub "Field specific education", Hub "Energy, biodiversity, sustainable living", Hub "Society, peace, justice, gender, equity", Hub "Youth Section". As for SDGs, the majority of the projects addressed Quality of Education, Good health and wellbeing, Affordable and clean energy, Sustainable cities and communities, Climate action, and Peace, justice and strong institutions. The feedback and ideas for improvements of the program were systematically collected from developers, mentors and international Advisory Board, analysed and used in for improvements in subsequent years.

In collaboration with international experts, a new master's degree program Leadership in Open Education (LOE) was launched at the University of Nova Gorica, Slovenia in the academic year 2020/21. It was developed in cooperation with the UNESCO Chair on Open Technologies for Open Educational Resources and Open Learning at the Jožef Stefan Institute. Its unique features include (1) an interdisciplinary approach connecting technological, pedagogical, managerial and societal aspects, (2) global perspective with a truly international teaching team and target audience, (3) big potential impact through the emphasis on future leaders. Currently second generation of students is enrolled. For most of them we succeeded to provide financial support covering their tuition fee completely for both two years of their study. Students have already shown through their assignments and student projects how they can contribute to the development of Open Education strategies, OER design and production. They also reflect on OE4BW and suggest improvements, contributing to further connections of both programs (Fabjan, 2021).

Participation from WB region in presented programs was very low, almost absent. The region is represented at the OE4BW mentoring side and with a professor from the North Macedonia contributing to the LOE program. Although not numerous, this involvement shows great potential for the region to connect more intensively into the growing network of Open Education leaders and practitioners. Our next steps in this direction will include more systematic promotion in WB, aiming at attracting more OER developers, mentors and future OE leaders from WB to the programs OE4BW and LOE. We have also already started activities for providing financial support for students from this region. Next, joint projects with universities and other institutions from this region are also an opportunity, where finding EU support might help a lot to upgrade digital capacity in WB, to enable spread and development of good practices and inclusion of this region into sharing and collaboration in the field of open education. This will inevitably contribute also to the enhancement of WB capacities for digital transformation in education as well as in other sectors of society.

References:

Bregar, L., Zagmajster, M. & Radovan, M., 2020. *E-izobraževanje za digitalno družbo*. Ljubljana: Andragoški center Slovenije.

Fabjan, A., 2021. *Open Policy Roadmap for the "Open Education for a Better World (OE4BW)"* [Online] Available at: https://doi.org/10.5281/zenodo.4730631 [Accessed date 8 November 2021]

Florjančič, V. *Odprto izobraževanje kot izziv usposabljanja zaposlenih v podjetjih*; Available at https://www.fm-kp.si/zalozba/ISBN/978-961-266-189-2/75-88.pdf [Accessed date 10 November 2021]

LOE Leadership in Open Education [online] Available at:http://www.ung.si/en/study/school-of-engineering-and-management/study/2NVOI/ [Accessed date 10 November 2021]

OE4BW. Open Education for a Better World [online] Available at: http://www.oe4bw.org [Accessed date 10 November 2021]

Open Educational Resources: Global Report (2017). Commonwealth of Learning: Burnaby [online] Available at http://oasis.col.org/bitstream/handle/11599/2788/2017_COL_OER-Global-Report.pdf?sequence=1&isAllowed=y [Accessed date 10 July 2019].

Urbančič, T. & Orlič, D., 2016. Opening up Education: Towards affordable and sustainable solutions. In: G. Eby, T. Volkan Yuzer, & S. Atay, ed. Year. *Developing successful strategies for global policies and cyber transparency in E-learning*. Hershey : Information Science Reference, pp.133-144.

Urbančič, T., Polajnar, A. & Jermol, M., 2019. Open education for a better world : a mentoring programme fostering design and reuse of open educational resources for sustainable development goals. In Open praxis. [Online]. 11 (4), pp 1-18. Available at 10.5944/openpraxis.11.4.1026

2.7.3 Implementing the geospatial technology for studying the natural and social subjects in primary schools in North Macedonia

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- This abstract presents results of a pilot project for mapping education with GIS tools in the primary school "Ismail Qemali" in Skopje.
- GIS technology enables the students to perceive materials more easily, seek solutions to local and global problems and work in a modern learning environment.
- A curriculum with nine chapters was designed for pupils in primary school. However not all chapters were implemented due to the COVID19 pandemic.
- Students managed to develop two cartographic products and to update data in Open Street Map in line with the spotted differences.
- Using GIS tools and open data allow teachers and pupils to perform spatial analyses of natural and social data.

Although most primary schools in North Macedonia have computer rooms, geography teachers don't use them for teaching GIS software during theoretical and practical lectures. Geo-SEE Institute, as a promoter of education on GIS and SDI in North Macedonia, have an objective to promote systematic usage of FOSS, Open Data and online applications in the official education process. It needs to be analysed why national responsible institutions don't provide trainings for GIS for older teachers in a systematic and organized process as a lifelong learning programme. There are 8 reasons why GIS technology can enrich the educational process in the school:

- Learning materials will be easier to perceive and understand, and learning much more fun.
- Develop functional literacy of students.
- Stimulate team work in and outside of the classroom.
- Explore variety of scenarios.
- Improve students' skills to ask the right questions and seek solutions to local and even global problems.
- Develop spatial and critical thinking.
- Trends for multidisciplinary education.
- Last but not least, by using constantly developing modern technologies, students will have the opportunity to work in a modern learning environment.

The Geo-SEE Institute from Skopje have held lectures to pupils in the Primary School "Ismail Qemali" in Chair municipality in Skopje for using the digital cartography tools with GIS software. This was the first pilot project in North Macedonia, implemented in primary schools by training teachers and pupils. The training was designed according to the principle "train the trainers". From the teaching staff, two geography teachers and one IT teacher were trained, while from pupils' side in total 16 students (four pupils from each level i.e. from the sixth, seventh, eighth and ninth level) attended the training. Pupils were obliged in coordination with teachers to transfer knowledge to other pupils in all classes in the school, while teachers conducted practical lectures in a computer lab in combination with field activities with geospatial technology.

A team of experts has designed curricula for special purposes for pupils of the primary school. The main objectives of special purpose designed curricula by the Geo-SEE Institute staff for the pilot project are to:

- Understand the map as a model.
- Learn and use the map legend.
- Identify and explain the natural and social features shown in map.
- Familiar with the map orientation and using map for orientation and movement in a field.
- Familiar with vector and raster data formats in digital cartography and GIS.
- Use GIS tools of FOSS for map making and performing spatial analyses.

- Learn to downloading spatial data from open portals, and have to be familiar with the copyrights on open data.
- Share awareness importance of opportunities on contribution as VGI (Voluntary Geographic Information) by online editing and updating spatial data in open geoportals.
- Familiar with the use of GIS applications in computer, tablets and smart phones for learning other subjects.

Based on the above defined objectives and results from analyses of demands and supply, a special purpose curriculum have been developed, with nine chapters:

1. Introduction to maps and map contents
2. Introduction to GIS and map making tools
3. Introduction to FOSS and OD with practical lessons for downloading and usage
4. Field identification and data acquisition with smartphone applications
5. Data editing in GIS software
6. Map compilation process and printing
7. Orientation and movement in a field with paper map and mobile maps on smartphones
8. Contributing to open geodatabases as VGI
9. Introduction to the basics of crowd sourcing and geoportals / Spatial Data Infrastructures (SDI)

During project implementation period, each pupil created an own account for the OpenStreetMap (OSM) portal and was trained for downloading and online data editing in the OSM portal, while by using SRTM and Global Map portals pupils and teachers learned how to download datasets of other countries and regions.

A first group of pupils from the 6th and 7th degrees was focused on compiling a map of North Macedonia with downloaded data from Global Map and SRTM, while the second group compiled a map based on downloaded OSM data and field identification for updating OSM data that covers an area of about 40 hectares (0.4km^2) nearby the location of the primary school.

Since all pupils created their own accounts with rights for editing and adding data in OSM, all identified differences during the field identification process have been used for updating of OSM dataset for the "Topansko Pole" area. With updating of OSM data, the trained pupils have started voluntary contribution to developing open spatial datasets as part of the global trend of VGI (Voluntary Geographic Information).

In the era of globalization and digitalization, the use of digital technology should be one of the priorities in primary school curricula, while the use of geospatial technology must be implemented for practical exercises in geography and other related subjects. The use of electronic devices as smartphones and tablets in the practical part of the lectures for learning spatial phenomena, could motivate pupils to explore more possibilities for using applications in the function of learning and research.

Such a system can enrich the educational process and can improve the skills for critical thinking and multidisciplinary analyses in a contemporary e-learning environment.

References

Sobel, D. (1998). Mapmaking with children. Sense of place education for the elementary years, Heinemann, Portsmouth.

Vanderbei, R. (2005). Diffraction Analysis of Pupil Mapping Systems for Planet Finding. Proc. SPIE 5905, Techniques and Instrumentation for Detection of Exoplanets II, 590517 (31 August 2005), San Diego, California, doi: 10.1117/12.617394

Idrizi , B. Selimi, N. (2021). Mapping the surrounding environment by pupils. Case study: Primary school "Ismail Qemali" in Chair – Skopje. Proceedings of the ICA conference 2021, Volume 4, id 46. Florence. Italy. https://doi.org/10.5194/ica-proc-4-46-2021

Meadows, C. (1979). Teaching map concepts to poor readers. University of North Florida. https://digitalcommons.unf.edu/cgi/viewcontent.cgi?article=1005&context=etd

Kilinc, Y. (2011). A study on the maps skills of primary school students: a case of 7 th and 8 th grades. https://www.researchgate.net/publication/228946334_A_STUDY_ON_THE_MAPS_SKILLS_OF_PRIMARY_SCHOOL_STUDENTS_A_CASE_OF_7_TH_AND_8_TH_GRADES

Thomson, C. (1997). Concept Mapping as a Means of Evaluating Primary School Technology Programmes. International Journal of Technology and Design Education volume 7, pages 97–110. https://link.springer.com/article/10.1023/A:1008817221300

Vanderbei, R. Traub, W. (2005). Pupil Mapping in 2-D for High-Contrast Imaging. The Astrophysical Journal, 626:1079–1090. DOI: 10.1086/429909 https://iopscience.iop.org/article/10.1086/429909/pdf

Sobel, D. (1997). Sense of place education for the elementary years. ERIC – Institute of Education Sciences. ED421312. https://files.eric.ed.gov/fulltext/ED421312.pdf

2.7.4 Programming Logic in Artificial Intelligence: a metamorphosis of M-mode to I-mode

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- The research tends to combine and analyse FAS (Formal Axiomatic Systems) and Agents of Artificial Intelligence to enhance their intelligence, by promoting a transition from mechanical to intelligent mode.
- The developed case study would assist to differentiate between "thinking as a machine: M-mode" and "thinking with intelligence: I-mode", or working within a system or thinking about the system.
- Engineers are able to create algorithms to solve different mathematical or other problems in M-mode, however, there is still a lack of creating agents in fully I-mode.
- Human's intelligence should be used wisely to ease the life of human societies by creating intelligent agents, but also to take care of possible casualties that might be created unintentionally.

The Formal Axiomatic Systems are used in Artificial Intelligence and Mathematics to indicate any set of axioms, from which some or all axioms can be in conjunction to provide theorems. In this paper, we tend to combine and analyse FAS (Formal Axiomatic Systems) and Agents of Artificial Intelligence to enhance their intelligence, by promoting a transition from mechanical to intelligent mode. In addition, we will apply typographic and arithmetic methods to define isomorphism and its importance. It would be very easy to program a computer to generate theorem after theorem of a given system, however, if a machine could transit from the so called mechanical mode and use the intelligence, it would jump out of the formal axiomatic system and think autonomously. The recursive algorithm will be used to specify a model that would use the prior step to find the next one in a case study. The mapping between self-referenced systems and formal axiomatic systems would help researchers differentiate the performances of artificial agents in their perceptions and actions in a certain environment.

We will use the recursive algorithms to solve the Hanoi towers problem through Prolog and also define which mode of self-reference system would be implemented. The Hanoi Tower, sometimes referred to as the mystery of the end of the world was first introduced by French mathematician Eduard Lucas. He was inspired by the Hindu legend regarding the history of a temple. This case study would assist to differ between "thinking as a machine" and "thinking with intelligence", or working within a system or thinking about the system.

There have been developed many algorithms to solve different problems in informatics, but also for other areas of study. A recursive algorithm is an algorithm which calls itself with "smaller" input values, and which obtains the result for the current input by applying simple operations to the returned value for the smaller input.

In the MIU system, the isomorphism takes the typographical system in to an arithmetical one (actually invertible, hence it is always possible to come back to the original FAS). Gödel numbering is one example of useful isomorphism to study FAS by transforming it into TNT.

One of the most significant features of artificial agents and artefacts with good governance is their commitment to maintain a high degree of intelligence that is demonstrated through continuous feedback and thinking about the system is the I-mode. Engineers are able to create algorithms to solve different mathematical or other problems in M-mode; however we still lack in creating agents in fully I-mode.

However, many scientists believe that if we reach to the point where the self-reference systems would implement the I-mode to other systems, and agents would be able to create other agents, or with other words to reproduce themselves, then humanity could be at risk of not having full control to these kind of systems.

We should use our intelligence to ease the life of human societies, by creating intelligent agents and robots, but also taking care of the possible casualties and bugs that we might create unintentionally or even intentionally by irresponsible people.

REFERENCES

Panu Raatikainen, Gödel's Incompleteness Theorems, in the Stanford Encyclopedia of Philosophy, November 11, 2013.
Dov M. Gabbay and John Woods, Handbook of the History of Logic. Volume 5. Logic from Russell to Church, 2008 Elsevier BV.
Theo Johnson-Freyd, Math 105-6: Freshman Seminar: Theories Of Mind And Mathematics, Northwestern University, 2014.
Festim Halili, et.al, Combining AIML, C# and Agent Control 2.0 to produce an Albanian Speaking bot, in International Conference Proceedings ISTI, 2013, Tirana Albania.
Uri Levy, The Magnetic Tower of Hanoi, Atlantium Technologies, Har-Tuv Industrial Park, Israel 2010
E. Dolgin, Devices: Artificial inspiration, Nature. 489 (2012) S12-4.

Brynjolfsson, E. & Mitchell, T. What can machine learning do? Workforce implications. Science 358, 1530–1534 (2017).
Verghese, A., Shah, N. H. & Harrington, R. A. What this computer needs is a physician: humanism and artifcial intelligence. J. Am. Med. Assoc. 319, 19–20 (2018).
Hosny, A., Parmar, C., Quackenbush, J., Schwartz, L. H. & Aerts, H. J. Artifcial intelligence in radiology. Nat. Rev. Cancer 18, 500–510 (2018).
Bonnefon, J.-F., Sharif, A. & Rahwan, I. Te social dilemma of autonomous vehicles. Science 352, 1573–1576 (2016).
Russell, S., Hauert, S., Altman, R. & Veloso, M. Ethics of artifcial intelligence. Nature 521, 415–416 (2015).
Rahwan, I. Society-in-the-loop: programming the algorithmic social contract. Ethics Inf. Technol. 20, 5–14 (2018).
Taddeo, M. & Floridi, L. How AI can be a force for good. Science 361, 751–752 (2018).
Kleinberg, J., Lakkaraju, H., Leskovec, J., Ludwig, J. & Mullainathan, S. Human decisions and machine predictions. Q. J. Econ. 133, 237–293 (2017)
McCorduck, P. Machines Who Tink: A Personal Inquiry into the History and Prospects of Artifcial Intelligence (CRC, Natik, 2009).

2.7.5 Development and implementation of speech-to-text technology using AI in Albanian language

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- A model is presented that conceptualizes speech-to-text recognition technology and AI integration for the Albanian language.
- The ability to quickly review, retrieve and reuse speech documents, makes the transcribing of speech to become crucial in the IT era.
- ASTT is the leader in the production of speech-to-text services for the Albanian language, which converts speeches to text with high accuracy using machine learning algorithms.
- The service can be used in a wide range of tasks: video and audio transcription, academic transcription, podcast transcription, business transcription, and customer care.

In this abstract, we present a model that integrates AI technology in speech-to-text recognition domain in Albanian language. Through in-depth literature review and utilizing an inductive methodology, we have developed theory and presented an AI application of Albanian speech-to-text recognition system. Our work contributes to theory development and offers new pathways to future researchers and practitioners in AI's implementation in speech-to-text technology in the Albanian language.

Speech is the most natural and effective way of communication and of creating connection and meaning between human beings. The ability to quickly review, retrieve and reuse speech documents, makes the transcribing of speech to become crucial in the IT era. The technological ability to recognize spontaneous speech is still very limited. Spontaneous speech is characterized as the transfer of redundant information, such as repetitions, repairs, word fragments, etc. When we add to this the diversity of languages, we may argue that the need for sophisticated technology is required in speech-to-text recognition. Moreover, spontaneous speech is ill-informed and includes information which when transcribed will inevitably include recognition errors. Therefore, an approach that uses technology and AI to document speech recognition patterns is paramount.

The Albanian language is among the oldest languages in the world and is considered as one of the most difficult to learn in the Balkans. The main methodology that will be utilized is reviewing current developments in the literature and the implementation of a qualitative research methodology and instrument. Through in depth literature review, we aim to inform scholars on the importance of AI and its forceful importance in the speech-recognition domain.

REFERENCES

Artificial Intelligence. Stephanie Dick (2019). https://hdsr.mitpress.mit.edu/pub/0aytgrau/release/2

Furui, S., Kikuchi, T., Shinnaka, Y., & Hori, C. (2004). Speech-to-text and speech-to-speech summarization of spontaneous speech. *IEEE Transactions on Speech and Audio Processing*, *12*(4), 401-408.

2.8 Data, digital transformation, and AI in public institutions

2.8.1 Potential challenges of Digital Government Transformation in Serbia

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- The preliminary research identifies the existing challenges related to the interoperability and data exchange in Serbia and presents observations on how to overcome existing challenges.
- National Interoperability Framework in Serbia was adopted in 2014 which relies on the first version of European Interoperability Framework and could be updated.
- The business processes of the public administration are still not aligned in public administration which leads to duplicated data and lower efficiency in service delivery.
- One of the crucial identified barriers is the complexity of data exchange information systems, quality of data and non-aligned business processes
- The existing e-services in Serbia are not fully automatic and mainly communication between administrations is asynchronous with delays in service delivery.
- Developing interoperability and full horizontal integration in the public sector in Serbia and data exchange, is also a prerequisite for potential cross-border e-services.

Digital transformation has been recently considered as a key for improving the public sector services and reducing existing administrative burden that can lead to increased savings in money and time for public administration, businesses, and citizens. In this regard, the COVID-19 pandemic has emphasized the importance of the digital transformation in public sector as it is shown that digitally developed countries have had low impact of COVID-19 on the delivery of their public services (Crahay et al., 2021). Similarly, Serbia has been emphasizing the importance of the digital transformation in government as the main pillar of their public sector reform. The digital transformation of the public sector in Serbia has been supported by many stakeholders. These key technological enablers include the Prime Minister office under which Office for IT and e-government is functioning; international and national development organizations such as EC, UNDP, World Bank; business and private associations such as Chamber of Commerce and Industry of Serbia; and last but not least non-governmental organisations such as NALED.

However, although there is significant support and interest from many stakeholders to enable digital transformation, Serbia still faces challenges with successful development of e-services. One of the key challenges of government implementation of e-services, use of data and data exchange is the lack of interoperability. The lack of interoperability is an issue of many countries working on developing e-government, thus Serbia faces similar challenge. Interoperability is acknowledged as the first action and goal to achieve in "Program for e-government development of Serbia" (Government of Serbia, 2020). Within this program it is acknowledged that there is no existing interoperability among the software solutions and lack of connectivity among public administrations (Government of Serbia, 2020). Furthermore, the exchange of data between administrations is required by the law on administrative procedures, however, the exchange of documents and data has not been successful (Analysis of e-government in Republic of Serbia, 2019).

Thus, the purpose of this research is to identify the existing challenges related to the interoperability and data exchange in Serbia and to present recommendations on how to overcome existing challenges. In this research, methods that are used are desk research, literature review and document analysis.

The definition of interoperability "the ability of organisations to interact towards mutually beneficial goals, involving the sharing of information and knowledge between these organisations, through the business processes they support, by means of the exchange of data between their ICT systems." (European Commission, 2017).

In the legal aspect, interoperability has been addressed with several initiatives and legal acts which serve as the legal framework for successful implementation of the e-services. Most relevant legal acts relevant to enabling the interoperability in government administration are the Law on e-government, Directive on meta register and access to data exchange infrastructure, Law on central registry of the citizen, Law on basic administrative procedures. These legal acts serve as a framework that should legally enable data procedures and lower efficiency. The databases and evidences are not available to the administrations due to the different data formats and different procedures, which results in higher costs in time and money for businesses and citizens (Naled, 2021). One of the crucial identified barriers for successful and seamless administrative procedure for data and document exchange have been the complexity of the data exchange information system

eZUP (Analysis of e-government in Republic of Serbia, 2019; Ite.gov.rs, 2021a). The eZUP system is not comprehensive and provides only partial data and document exchange and it is used by only trained public servants (Manual for eZUP users in public adminstrations, 2018; Analysis of e-government in Republic of Serbia, 2019). Next to the data exchange information system, one of the key challenges facing Serbia are existing multiple databases that are not interconnected and low technological readiness for cloud services (Naled, 2021). Noticeable initiative within enabling interoperability is the creation of Serbian Data Centre and currently developing metadata registry of administrative procedures (Ite.gov.rs, 2021b).

Finally, there is lack of technical infrastructure in all levels that enables interoperability among public administrations (Government of Serbia, 2020). The connection to the data exchange network, only city of Belgrade is connected and contain necessary infrastructure, however, around 145 local administrations are required to be connected to have fully enabled transfer of data and documents (Government of Serbia, 2020).

The digital transformation of the public sector in Serbia can bring numerous benefits to the citizens, businesses and also to public administrations. Having support on the national level and recognized importance of the e-government, Serbia is surely going in the right direction. Nevertheless, to enable digital society and all benefits that e-government bring such as savings in time, money and reducing red tape and administrative burden, significant planning and coordination is needed. Currently, there is a lack of interoperability in the public sector to enable seamless and automated e-services. E-services that are existing at the moment in Serbia are not fully automatic and mainly communication between administrations is asynchronous. Enabling interoperability and automatic data and document exchange, can be the first step in realizing the full potential of e-government in Serbia.

Enabling nationally seamless data exchange in public sector and developing interoperability in the public sector in Serbia, is an important precondition also for potential cross-border e-services. With the goal of EU accession and creating an Open Balkan initiative, with the Digital Single Market in the EU and Western Balkans integration, the development of the cross-border e-services in Western Balkans is interesting topic for further research.

Consequently, few observations that could help overcoming existing challenges of interoperability and enabling full potential of e-government are following:

- Including principles such as digital by default, interoperability by default, and once-only principle.
- Develop data exchange infrastructure and information systems for automatized data exchange.
- Update National Interoperability Framework according to the updated European Interoperability Framework.
- Update existing business process management of administrative procedures that include digital by default principle.
- Develop Core Public Service Vocabulary which develops the focus on semantic interoperability.

References

(2019) 'Analysis of e-government in Republic of Serbia' [Online]. Available at http://mduls.gov.rs/wp-content/uploads/Analiza-stanja-eUprave-u-Rs-rezultati-konsultativnog-procesa.pdf?script=lat

Crahay, A., Di Giacomo, D., Dussutour, C., Ennadif, G. and Talpo, S. (2021) *Report on Public Administrations' Digital Response to COVID-19 in the EU,* European Commission [Online]. Available at https://joinup.ec.europa.eu/sites/default/files/custom-page/attachment/2021-04/Report_Public_Administrations_Digital_Response_to_COVID19.pdf

European Commission (2017) *New European Interoperability Framework* [Online]. Available at https://ec.europa.eu/isa2/sites/default/files/eif_brochure_final.pdf

Government of Serbia (2020) Програм развоја електронске управе у Републици Србији за период од 2020. до 2022. године са Акционим планом за његово спровођење [Online], Official Gazzete.

Ite.gov.rs (2021a) *eZUP* [Online]. Available at https://www.ite.gov.rs/tekst/sr/80/ezup.php (Accessed 13 November 2021).

Ite.gov.rs (2021b) *Канцеларија за информационе технологије и електронску управу* [Online]. Available at https://www.ite.gov.rs (Accessed 14 November 2021).

(2018) 'Law on basic administrative procedure', in *Official Gazzete*.

(2018) 'Manual for eZUP users in public adminstrations' [Online]. Available at http://mduls.gov.rs/wp-content/uploads/uputstvo-za-korisnike-ezup-verzija4.pdf

Ministry of Trade and Communication (2014) *National Framework of interoperability* [Online].

Ministry of Trade and Communication (2016) *Листа стандарда интероперабилности* [Online]. Available at https://mtt.gov.rs/tekst/954/lista-standarda-interoperabilnosti.php (Accessed 14 November 2021).

Naled (2021) The Grey Book 13: Recommendations for reducing administrative burden in Serbia.

2.8.2 Digital transformation of Turkish public sector; Ontek information system

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- A digital platform “Notified Body and Technical Services Information System (ONTEK)” enhanced digital transformation in the Turkish public sector.
- ONTEK allows citizens to have access to public services, shortening business processes and creating a safer market in Turkey by using digital data.
- With ONTEK, checking the validity of documents became a simple process thanks to a QR code issued by the Conformity Assessment Body (CAB).
- The success of a digital transformation is in involving all relevant parties and system users, even in the design phase.
- Users should be trained to use a digital information system.

The widespread use of the Internet and digital technologies enabled digital transformation in the manufacturing sector and the public sector. Now, we can access and gather massive information more easily often refed as big data. The phenomenon of digitalization of industrial production processes is called Industry 4.0 and has entered the agenda of public bodies in the recent years. The public bodies has stated using digital social media extensively for communication with the citizens. Many countries have taken important steps towards digital transformation, which eliminates bureaucracy and increases efficiency, also reduces the duration of work and transactions in the public services.

The important strategy documents prepared for digital transformation of Turkey are

- National Artificial Intelligence Strategy 2021-2025,
- 2023 Industry and Technology Strategy,
- 2020-2023 Smart Cities Strategy and Action Plan,
- 2023 Education Vision,
- 2023 Industry and Technology Strategy,
- 2020-2023 National Smart Transportation Systems Strategy Document and
- Action Plan and 2020-2023 National Cyber Security Strategy and Action Plan.

The e-government is run by the Digital Transformation Office (DTO) is referred to as the "Digital Turkey Portal". DTO is coordinator in the field of artificial intelligence, which the task to collect data that will be used in creating policies for digital transformation of public administration.

Turkey already provides a wide range of public services over internet platform. The online system called e-government offer many of the public services electronically enabling the citizens access to many public services from their homes.

In this abstract, we are analysing the establishment a digital platform “Notified Body and Technical Services Information System (ONTEK)”, which is an important step in the ongoing digital transformation of the Turkish public sector to shorten business processes and creates a safer market in Turkey by using digital data.

The European Union and Turkey formed a customs union which entered into force on 31 December 1995. According to the Customs Union Agreement, industrial products produced in EU and Turkey can be placed on the market of the other parties without any customs restrictions. Implementation of the EU agreement is another important aspect of the customs union and Turkey has harmonized EU technical legislation and implements them without any exemption. To ensure safety, European Union publish a very comprehensive technical legislation and this technical legislation requires very strict testing and certification requirements which Ministry of Industry and Technology (MoIT) implements in Turkish market.

Conformity Assessment Bodies (CABs) verifies products' compliance with the requirements of applicable standards and technical regulations. MoIT harmonizes the EU legislation and appoints CABs to conduct tests and certifications. The appointment and inspection of the CABs was carried out physically by the Ministry before the “Notified Bodies and Technical Service Information System” (ONTEK) was established. In addition, the test reports and certifications prepared by CABs were kept as physical documents.

While ONTEK was being designed and established, MoIT held meetings with relevant stakeholders and took feedbacks from them. Ministry collaborated with other public institutions and CABs on the system design of ONTEK. Plan-Do-Check-Act methodology is used to improve the system continuously.

With the establishment of ONTEK, the implementation of the entire process was transferred to the digital platform. Application, inspection and appointment of all CABs and the compliance assessments, test reports and certifications issued by CABs are carried out digitally by using this platform, thus preventing illegal activities including using invalid certifications.

After the establishment of ONTEK, MoIT experts reach all data and carry out their inspections from their offices. The entire process is significantly shortened, and efficiency is increased. All relevant documents are uploaded to the system once by CABs and are not required for other applications. Documents from other public institutions (accreditation certificate, university diplomas of the CABs experts, etc.) are uploaded directly to the system.

Activities related to all testing and certification carried out according to the procedures and principles specified in the ONTEK Information System. In this context, MoIT monitors all reports and documentation digitally. Regulations, flowcharts, procedures have been revised in line with ONTEK Information System.

The validity of reports and certifications can be monitored on the system via QR Code. In this way, market surveillance activities can be carried out efficiently. Application, evaluation, assignment, inspection processes of CABs are carried out through the ONTEK system. MoIT and CABs monitor all steps online and CAB can make its objections against the actions taken by Ministry through the system. In case of end of the accreditation, personnel changes, unconformity of appointment conditions, etc., the system warns the Ministry expert and the CAB.

One of the most important factors of being successful in digital transformation is to take the opinions of all relevant parties and system users. Taking feedbacks from them will continuously improve the functionality of the information system. The involvement of system users in the design phase will enable the designers to understand what is needed in the system and how the problems could be overcome.

ONTEK has accumulated an enormous information in a very short time. But the bottleneck of accumulating information in a digital system is the security of this information. The designers of digital platforms are having responsibility of designing a secure system because the users of the system are entering their confidential information to the system. In the case of ONTEK, the authorized representative of the CAB can upload the company information by entering to the system with a digital sign and a password. Only the responsible Ministry expert can see the company information and a confidentiality agreement was signed by the experts of MoIT to enter ONTEK.

Digital platforms and digital technologies can play an important role in eliminating gaps in the system. Before ONTEK was established, all test reports and certifications were kept physically. There were a lot of invalid certifications on the market and checking them was taking too much time and need expertise. After ONTEK, checking the validity of documents became a very simple process. Thanks to the QR code in the certificate issued by the CAB, the validity of the document can be checked by entering the ONTEK website. With the control mechanism provided by ONTEK, the security gap in the system has been eliminated.

ONTEK information system is a platform only used by CABs and include technical processes. ONTEK system users are having a certain technical knowledge. This may not be the case in all digital transformations. For this reason, technical knowledge of the users should be considered on digital platforms, and they should be trained to gain competence. It may be necessary to provide training to people who use digital information system and unfamiliar with digital technologies.

The data collected in the digital platform must be analysed so that it can be used in policy options and designs. In addition, being able to analyse the information uploaded to the system using artificial intelligence can improve the efficiency of the digital transformation.

ONTEK was established within the scope of digital transformation in the public sector. It is a very important step taken by Turkey to conform to the EU system and a successful digitalization platform which contribute to the efficiency of the public sector and enable a safer environment for citizens.

References

T.R. Ministry of Industry and Technology (2021), National Artificial Intelligence Strategy, 2021-2025 (Ankara).
T.R. Ministry of Industry and Technology (2019), 2023 Industry and Technology Strategy, (Ankara).
T.R. Presidency Strategy and Budget Department (2019), Eleventh Development Plan, 2019-2023 (Ankara).

2.8.3 Digitalization of Crisis Management System

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- Financed by NATO SPS programme, in 2016 North Macedonia has started developing Next Generation Incident Command System (NICS) digital tool for Incident management.
- The NICS tool allows to cooperate, coordinate and react in crisis situation.
- The NICS tool enables monitoring of the engaged resources, inter-ministerial coordination, real-time data exchange, decision support system (DSS), spatial display of the situation and the engaged resources on a map.
- NICS contains module for Augmented and Virtual Reality for making 3D models for training.
- With governmental decree from 2019, NICS is the official tool for Digitalization of Crisis Management System and all institutions must implement and use it.

Digitalization of Crisis Management System in North Macedonia is a very important step in using digital data and AI in case of crisis situation. In 2012 Crisis Management Center started with the first step of digitalization and implementation of the project supported by JICS, Macedonian Forest Fire Information System (MKFFIS). MJFFIS made initial digitalization of forest data for fire prevention and protection. This system is upgraded in 2nd phase with ECO-DRR. This system was shared and adopted among Montenegro, Kosovo and Albania.

This tool is good for collection data, prevention and assessment. Later we found out that we need a tool for direct reaction for Incident Management which will use digital data provided by MKFFIS.

That is why in 2016, JICS started with project implementation, financed by NATO SPS program, to develop Next Generation Incident Command System (NICS), together with other 3 western Balkan Countries: Croatia, Montenegro and Bosnia and Hercegovina. Here the main goal is to have digital tool for Incident management. This tool will allow to cooperate, coordinate and react in crisis situation, not only in North Macedonia, but wider cross border or regional with other NICS countries.

The Crisis Management Center is responsible for the implementation of the NICS project - Next Generation Incident Command System - NATO SPS Project (Next Generation Incident Management System) in the Republic of North Macedonia. The project was developed by the Massachusetts Institute of Technology Lincoln Laboratory and supported by the Department of Homeland Security and DARPA (Defence advance research program agency) of the United States. The NICS application is a digitization of the Crisis Management System and it enables the following:

- Commanding the engaged resources (units, teams and MTS) within each institution of the Crisis Management System.
- Inter-ministerial coordination, cooperation and communication between the institutions engaged in dealing with incidents, crises and crisis situations.
- Exchange of data and information (text, image and video content) in real time.
- Spatial display of the situation on the ground and the engaged resources on a map in all phases of management and at all levels (institutional, local, (regional), national and international).
- Monitor engaged resources in real time through global positioning systems using the NICS mobile application.
- Involvement of social media of importance for crisis management with analyses using artificial intelligence
- Decision support system (DSS)
- Generate situational reports supported by maps in accordance with Standard Operating Procedures.

Also, in NICS, young researchers are developing a module for Augmented Reality and Virtual Reality to make 3D models for training.

With governmental decree in 2019, NICS is official toll for Digitalization of Crisis Management System and all institution must implement and use it.

2.8.4 National Population Register and Digital Identity

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- The National Population Register provides personal data on each individual who lives on the territory of the Republic of North Macedonia and citizens that live abroad.
- National Population Register is the first AI Government solution that works without human interaction.
- The register is the basis for digital identity, used for identification and verification when implementing electronic services through the National Portal for Electronic Services.
- The system has the ability to recognize similar texts written as Address information for each person and decide which text should be used based on learned experience.

The National Population Register was established with the support of the European Union. The projects founded by the European Union like IPA 2010, 2012 and 2013 provided some of the key technological enablers and facilitators for digital transformation of the public administration, such as the Interoperability platform, National portal for e-services and the National Population Register. In addition, the Ministry of Information Society and Administration is implementing a number of activities dealing with the improvement of the quality of public services and their transparency.

The National Population Register was established and provides personal data on each individual who lives on the territory of the Republic of North Macedonia and citizens that live abroad. Each institution or business company in accordance with its legal competencies can use the data entered in the Central Population Register, and every citizen through the national service portal knows which institution or company, at what time and according to which law / act personal data have been used that is according the GDPR requirements. The register is the basis for the digital identity, and citizen's personal data are used for the identification and verification when implementing electronic services through the National Portal for Electronic Services.

The National Population Register is the first Artificial Intelligence Government solution that works without human interaction. Using the special algorithm, created by experts engaged during the implementation of the EU project, this solution process all changes that persons made in the previous day. According to the rules from the Law, the system creates master data for all personal data fields. These master data are available to other institutions, using the Interoperability platform, based on Law rules.

As a special upgrade, this system has the ability to recognize similar texts written as Address information for each person. Using different statistical algorithms, the system decides which text should be used based on learned experience before. This is how the system generates better quality on the Address data.

2.8.5 The role of Artificial Intelligence to improve the urban living

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- The demographic pressure of citizens moving to urban areas along with the global warming issues and significant reduction of non-renewable natural resources, led to the search for alternative solutions.
- AI offers possibilities to replace humans in complex and dangerous activities, thus many AI applications have started to become an integral part of many urban activities.
- The future of the transport system is electric, but more infrastructure is needed.
- AI as an emerging area of research needs further investigations from various angles and across disciplines, to build a knowledge base for urban policymakers, managers, planners and citizens.
- The city of AI is not a sustainable city, thus development of AI and development of cities need to be refined and better aligned towards sustainability.

Artificial intelligence (AI) is one of the most unsettling technologies of our time. In simple terms AI can be defined as machines or computers that mimic cognitive functions that humans associate with the human mind, such as learning and problem-solving. AI applications are being used in areas ranging from marketing to banking and finance, from agriculture to healthcare and security, from space exploration to robotics and transport, and from chatbots to artificial creativity and manufacturing.

In recent years, AI applications have been also started to become an integral part of the city. AIs manage the transport systems of cities in the shape of autonomous cars. Robots run restaurants and shops where core aspects of urban life are everyday played out, and repair urban infrastructure.

Higher urbanization rates and "mega-cities" with 10 million inhabitants or more make difficult to create a sustainable and cost-effective environment and a high quality of life for the citizens. To overcome this shortcoming, the latest Artificial Intelligence (AI) techniques are needed to increase ICTs solutions and indirectly, to increase the cities competitiveness.

Smart cities are urban regions very advanced in terms of technology, where people and organizations are ultra-connected. The smart cities dimensions have evolved from industry, education, participation, and technical infrastructure to smart economy, smart people, smart governance, smart mobility, smart living and smart environment (Giffinger & Gudrun, 2010). All these components have to support the sustainable development of human society. It is estimated that by 2050 about 70% of the world's population will live in the urban area (Gupta et al., 2015). This demographic pressure along with global warming issues and the significant reduction of certain categories of non-renewable natural resources led to the search for alternative solutions.

AI offers possibilities to replace the human being in complex and dangerous activities. But smart cities start from smart human capital (Shapiro, 2006; Holland, 2008), because only smart people can create smart ICTs equipped with AI.

The concept of urban artificial intelligence and the main manifestations of AI in cities.

Technological innovation is constantly reshaping the materiality and mechanics of smart-city initiatives. A smart city normally includes smart grids, smart sensors and Internet of Things (IoT) technologies, deployed to produce large volumes of data on the metabolism of cities regarding, for instance, energy consumption and mobility.

More recently, AI applications have also started to become an integral part of many urban services.

AI as urban artificial intelligences are embodied in urban spaces, urban infrastructures, and urban technologies, which together are turning cities into autonomous entities operating in an unsupervised manner.

Examples of urban artificial intelligence are represented by autonomous cars. Recently, innovation in artificial intelligence (AI) in the shape of self-driving cars, robots and city brains, has been pushing the so-called smart city to convert into an autonomous urban creature which is largely unknown. In this emerging strand of smart urbanism, artificially intelligent entities are taking the management of urban services as well as urban governance out of the hands of humans, operating the city in an autonomous manner. The artificial intelligence is capable of sensing the surrounding urban environment by means of cameras, radars and lidar systems. The artificial intelligence employs this information to drive the car to a given location and, at the highest level of autonomy (level 5), no human input or supervision is required, with the AI theoretically capable of handling uncertain situations autonomously. The transition to an autonomous urban transport would cause a number of

large urban changes. If enabled by sharing services, it could decrease the number of cars on the road and so the quantity of energy and, above all, urban space that they need to operate, thereby favouring a less car-centric redesign of the built environment.

The prospects and constraints of developing and deploying AI technology to make present and future cities more sustainable.

The analysis has shown that, while AI technology is evolving and becoming an integral part of urban services, spaces, and operations, we still need to find ways to integrate AI in our cities in a sustainable manner, and also to minimize the negative social, environmental, economic, and political externalities that the increasingly global adoption of AI is causing. In essence, the city of AI is not a sustainable city. Both the development of AI and the development of cities need to be refined and better aligned towards sustainability as the main goal. With this in mind, the viewpoint has generated the following insights, in the attempt to improve the sustainability of AI and that of those cities that are adopting it.

First of all, AI as part of urban informatics significantly advances our knowledge of computational urban science. In the age of uncertainty and complexity, urban problems are being diagnosed and addressed by numerous AI technologies. However, from a sustainability perspective, the quality of our decisions about the future of cities heavily depends on this computational power (technology), and on the inclusivity of decision-making and policy processes. The greater computational powered by AI, therefore, is not enough to achieve sustainability, unless it is coupled with systems of democratic governance and participatory planning.

Second, AI is being exponentially used to improve the efficiency of several urban domains such as business, data analytics, health, education, energy, environmental monitoring, land use, transport, governance, and security. This has a direct implication for our cities' planning, design, development, and management. We cannot and should not expect a hypothetical future artificial general intelligence to fill this gap. Human initiative and coordination are needed now.

Third, the autonomous problem-solving capacity of AI can be useful in some urban decision-making processes. Still, the utmost care is needed to check and monitor the accuracy of any autonomous decisions made by an AI. AI can help us optimize various urban processes and can actually make cities smarter. We can move faster towards the goal of smart urbanism, but if we want to create smart and sustainable cities, then human intelligence must not be dominated by AI.

Fourth, AI can drive positive changes in cities and societies, and contribute to several Sustainable Development Goals. Nonetheless, despite these positive prospects, we still need to be careful about selecting the right AI technology for the right place and ensuring its affordability and alignment with sustainability policies, while also considering issues of community acceptance.

Fifth, we need to be prepared for the upcoming and inevitable disruptions that AI will create in our cities and societies. The diffusion of AI will not be a black and white phenomenon. Many shades of grey will characterize the deployment of heterogeneous AIs in different parts of the world. Even in an optimistic scenario in which a 'benign AI' is promoting sustainability, somewhere someone/something will still be suffering. It is thus imperative to develop appropriate policies and regulations, and to allocate adequate funds, in order to mitigate the disruption that AI will cause to the most disadvantaged cities and social groups, and nature.

Lastly, in the context of smart and sustainable cities, AI is an emerging area of research. Further investigations, both theoretical and empirical, from various angles of the phenomenon and across disciplines, are required to build the knowledge base that is necessary for urban policymakers, managers, planners, and citizens to make informed decisions about the uptake of AI in cities and mitigate the inevitable disruptions that will follow. This will not be an easy task because AI is a technology while the city is not. Cities are primarily made of humans and are the product of human intelligence. The merging of artificial and human intelligences in cities is the world's next big sustainability challenge.

References

Kassens-Noor, E.; Hintze, A. Cities of the future? The potential impact of artificial intelligence. Artif. Intell. 2020
Faisal, A.; Yigitcanlar, T.; Kamruzzaman, M.; Paz, A. Mapping two decades of autonomous vehicle research:
A systematic scient metric analysis. J. Urban. Technol. 2020
Mikhaylov, S.J.; Esteve, M.; Campion, A. Artificial intelligence for the public sector: Opportunities and
challenges of cross-sector collaboration. Philos. Trans. R. Soc. A 2018
Voda, A.I.; Radu, L.D. Artificial intelligence and the future of smart cities. Broad Res. Artif. Intell. Neurosci. 2018
Quan, S.J.; Park, J.; Economou, A.; Lee, S. Artificial intelligence-aided design: Smart design for sustainable city development. Environ. Plan. B 2019
AI for Europe, COM/2018/237 White Paper on Artificial Intelligence A European approach to excellence and trust

3 Provision of guiding principles for digital transformation and AI in Western Balkans

The workshop had 47 excellent presentations of digital transformation (DT), data and AI in the Western Balkan (WB) countries. Additionally, the workshop brought in light ideas for future directions of digital transformation in the WB. As in the rest of the world, because of COVID-19 pandemic, many sectors were forced into accelerated digital transformation achieving valuable benefits. One example is education where there was a rapid adoption of distance learning platforms. The distance learning platforms will modernise education in the WB region and the idea is not only to keep the present development but to go further and offer advanced digital tools that will be of benefit for students, and the interested citizens and society as a whole. These ideas are supported by the initiatives of open science, open publishing, open access of the scientific results and open research infrastructure. Implementing these changes in WB education and research activities will bring it closer to the European educational area.

Digital and green transition are clearly European priorities nowadays. It is emphasized through the Berlin declaration on Digital Society and Value based Digital Government in 2020 and in the European Green Deal in 2019. Many resources will be available in the next few years to support achievement of these ambitious goals. WB countries should build their capacities for these opportunities and foster their development and deployment.

Both goals, digital and green, bring many challenges and opportunities. EC and EU Member States are already doing a lot in this direction. However, examples and good practices presented in the last 3 days clearly show that WB but also Ukraine, Moldova and Turkey are not lagging behind.

The workshop presented DT, data and AI applications in many areas such as: government and public administration including public services, agriculture, geospatial sector, urban planning, education, banking sector, crisis management and start-ups. However it was noted that additional activities are needed to spread DT to other fields of society, governmental services and to improve access of the citizens to data, information and services. Exchange of the experience and good practices between the EU and WB countries and other countries that participated in the workshop will bring further development of DT, data and AI.

The result of the workshop are the guiding principle for DT, data and AI in the WB:

- DT, data and AI will be important factors to boost economic recovery and resilience in the future. The DT can bring a number of benefits for WB countries and their citizens. Transforming the governmental and/or local administration services into digital services is an important direction determined during these 3 days.
- Promoting and supporting the young and innovative entrepreneurs, supporting the development of technological parks and increasing the capacities of the existing ones is direction that will help establishment of the new start-ups and small companies in the dynamic markets with high opportunity for quick growth.
- A number of WB researchers and research groups are active in the field of DT, data and AI. Regional cooperation, internationalisation and open science principles can further boost these activities and make WB an important part of the European Research Area.
- The movement from open data to free data was not presented at the workshop. Data accessibility remains the problem in some countries. The quick opening of the data sources by the public data owners is essential for better and faster implementation of AI in a number of sectors. Free data can boost the interest for data science among young students to develop AI solutions.
- WB countries are on different levels of development and implementation of the DT, data and AI. The promotion of regional cooperation and establishment of the international institutes that will be centres for promoting excellence in these fields and will operate regionally is one of the possible solutions to improve the level of development in all WB countries.
- The Berlin process should consider the existing potentials in DT, data and AI in various fields and support on-going process on country level, and hopefully number of further initiatives on regional level.
- Geospatial information and location data are becoming part of activities of many sectors. Therefore intensification of cooperation, communication and coordination and further work on geospatial data

information is required to make data available for all interested parties. United Nations Global Geospatial Information Management (UN GGIM) can be a good platform for this.

The WB countries DT, data and AI initiatives should be based on open data access, (preferably free data), regional cooperation, cooperation with EU member states, participation in the existing and future EU programmes, instruments and opportunities and promote national and regional policies. Therefore, the WB national policies and development of specific action plans should be alighted toward EU initiatives.

3.1 Identification of good practices in WB countries

The six Western Balkan (WB) countries participants presented 28 papers in the workshop. More specifically, 20 presentations from North Macedonia, 4 presentations from Serbia and one from Albania, Bosnia and Herzegovina and Kosovo and none from Montenegro. Therefore, the distribution of the papers and participants from WB was not in favour of assessing the situation in each of the countries equally. The COVID-19 pandemic had influenced the workshop participation.

During the workshop number of AI use cases were presented, starting from languages translation, speech to text, image processing, urban living, crop yield forecasting, monitoring, control and analytical functions of the marketing sector, measuring the facial physiological responses, facial muscle activations, and motions from the user to recognize emotions, protection of the vulnerable Internet users at Human-Computer Interaction level and others. The workshop demonstrated that AI in WB countries have already moved from research to the implementation within various sectors, such as agriculture, urban living, internet use, marketing, languages etc.

The authors from North Macedonia made presentations addressing the digitization and digital transformation process in a number of sectors such education including the higher education, but also the primary education by implementing the geospatial technology for studying the natural and social subjects in primary schools. Some papers from this group address the digital transformation in public administration, banking sector, participatory urban planning, crisis management system and national population register and digital identity. Moreover, many governmental services are already transformed to digital. There was a presentation on collaboration platform as a driver of the digital transformation in geospatial data and two already completed projects: National spatial data infrastructure (NSDI) geoportal and LiDAR distribution portal. Moreover, two presentations were discussing digital transformation of the geospatial data and development of the digital landslide susceptibility map of North Macedonia and creation of the national cadastres of degraded areas in Serbia and North Macedonia. Two presentations have addressed digital transformation by implementing the machine learning for early season crop yield forecasting and use of remote sensing in Google Earth Engine for assessing the effects of rapid urbanization on land surface temperature.

The authors from North Macedonia made presentations in theoretical background for Applications of Deep Learning Based Semantic Segmentation of Images, Horizontally scalable lambda architecture for processing and analysing multivariate time-series data, Programming Logic in Artificial Intelligence: a metamorphosis of M-mode to I-mode, or discuss on state with the most exciting disruptive technologies for accounting researchers and professionals at the global level (big data, data analytics, cloud, artificial intelligence and blockchain). Three papers addressed companies and products developed using digital services, artificial intelligence and machine learning. First one is based on AI for direct and personalized marketing of the products in real time during the shopping. Second one is AI that can analyse facial movements and associate data collected from sensors to predict emotional status. The third one is AI image recognition software that detects fashion items in images and enables fashion retailers to delight shoppers by saving their time and effort in search for the desired products.

The authors from Serbia had 4 presentations at the workshop. First one was about the establishment of national cadastres of degraded areas. Second one about geospatial data as a core instrument to transform the country. Geospatial data is considered as a key element to map and monitor the resources of an entire nation, allowing for the quantitative documentation of policy implementations on the ground. Serbia is supported by the FAO, World Bank and other development partners to improve the use of available geospatial data and technology and to strengthen government capacity to make best use of available data and technology. Republic Geodetic Authority (RGA) is a national Spatial Data Infrastructure (SDI) coordinator and the INSPIRE National Contact Point. The RGA is a special governmental organization, which performs state survey, maintenance of real estate cadastre and management of geospatial data at the national level. The RGA plays an important role in making the geospatial information available, to support the government and municipal authorities as well as the general public and businesses. One presentation was addressing the challenges of Digital Government Transformation, as a tool for improving the public sector services and reducing existing administrative burden that can lead to increased savings in money and time for public administration, businesses, and citizens. Although, there is

significant support and interest from many stakeholders (EC, UNDP, World Bank; Chamber of Commerce and Industry of Serbia, NGO's as NALED) to enable digital transformation, Serbia still faces challenges with successful development of e-services. Interoperability is one of the key challenges and it is acknowledged as the first action and goal to achieve in "Program for e-government development of Serbia". The fourth presentation presented the results from the project CASPER on the use of AI to filter the content displayed to the user and the content sent by the user via the Internet. The experimental use of pilot software confirmed that AI can be successfully used to protect vulnerable categories of users from inappropriate content and malicious activities on the Internet.

The author from the Federation of Bosnia and Herzegovina presented the process of data integration and interoperability of public land administration services as instruments for providing better and easily accessible services to the end users of the public land administration.

The author from Albania presented a use case of AI as a tool for improvement of urban living.

The author from Kosovo presented an implementation of AI in speech-to-text technology in Albanian language.

4 Conclusions

Digital technologies, data and AI have changed our societies. Europe's ambition is to become the world-leading region for developing and deploying cutting edge, ethical and secure AI, as well as to promote a human-centric approach in the global context. Therefore, it is important for the WB (WB) region to follow, adopt and benefit from these emerging technologies.

The WB countries are candidates and potential candidates for accession in the EU. These countries are at different stages in the EU accession process. The collaboration and exchange on the good practices between experts from WB and EU can positively influence the process. Therefore, the Directorate Growth and Innovation of the Joint Research Centre of the European Commission based in Seville (Spain) and Ispra (Italy) and The Digital Economy Unit (JRC B6) of the Directorate Growth and Innovation JRC B6 together with the UN Food and Agriculture Organisation, World Bank, UN-GGIM-Europe, UN Economic Commission for Europe, and the Ss. Cyril and Methodius University in Skopje jointly organised a workshop: Digital Transformation, Data and AI in the Western Balkans that took place in Skopje from December 9 to December 11, 2021 in Skopje, Republic of North Macedonia.

The Workshop brought together a variety of stakeholders, representing the public sector, civil society, academia and business. The workshop successfully enabled:

- Presentation of WB AI solutions in education, research, services offered by governments and companies and development of new and innovative businesses.
- Exchange of ideas and good practices between EU and WB experts in the topics related to digital transformation, data, AI and innovative services and applications based on above mentioned technologies.

The workshop was organised as a hybrid event, with 53 participants being with physical presence and 102 participants online.

The workshop hosted participants from 12 countries, EU member states: Bulgaria, Croatia, Slovenia and Italy; candidate and potential candidate countries Albania, Bosnia and Herzegovina, Kosovo (This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence), North Macedonia, Serbia and Turkey; European neighbourhood policy countries associated to Horizon 2020: Moldova and Ukraine. The participants during these three days discussed the state of play in digital transformation in the respective countries, implementation of AI in education, society, public services, business, etc.

This report was prepared by 88 different authors, from governmental bodies, non-governmental organisations, higher education institutions, research institutes, public bodies, private companies, emerging business and start-up's. The workshop have successfully:

- Updated participants on the EU's policy on digital transformation, data and artificial Intelligence.
- Discuss about main factors that can help or hinder the adoption of digital transformation in WB.
- Present the state-of-play, opportunities, trends and impacts of Digital transformation, Data and AI in WB.
- Discuss on the added value of the adoption of the digital technologies and AI including drivers, enablers, barriers and risks in the WB.
- Discuss regional differences in the attitudes towards digital technologies and AI.

The participants expressed interest for future development of the initiated topics and activities. Moreover, there is readiness for undertaking the steps toward development of the national and multilateral projects that will boost the process of digital transformation in the region.

The opportunities offered by different programmes (Horizon Europe), various components of the Instrument for Pre-Accession Assistance (IPA) and some other EU programmes and instruments are considered as good opportunities for upgrading the regional cooperation and cooperation of the region with the EU member states.

Moreover, the participants pointed out that Berlin process and Open Balkan initiative can be very good instruments for boosting the activities on national and regional level.

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KJ-08-22-190-EN-N

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doi:10.2760/863985

ISBN 978-92-76-53599-7