GROWTH RATE CATEGORIZATION OF E-GOVERNMENT DEVELOPMENT

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Abstract—**This survey addresses growth rate e-Government development by comparing the corresponding e-Government services benchmarks carried out in European countries. Initiated by the amount of information about e-Government we propose a new methodology to divide countries in clusters with representative behavior according to their growth rate and achieved result. We identify countries with high growing rate and cluster them according to their behavior.**

Index Terms—**e-Government, Benchmark, e-services, growth rate**

I. INTRODUCTION

Authors in [1] provided a similar study in April 2006 analysing the current situation of e-Government in Western Balkan Countries (WBC). The methodology used consists of EU e-Government benchmarks precisely defined by [2]. The benchmark set measures the online sophistication of 20 basic public online services and percentage of fully available online services. Table I presents the benchmarks and maximum sophistication level.

	Citizen	Max Grade
1	Income taxes	5
2	Job search	4
3	Social Security Benefits	5
4	Personal documents	5
5	Car registration	4
6	Building permission	4
7	Declaration to the police	3
8	Public libraries	5
9	Certificates	4
10	Enrollment in higher education	4
11	Announcement of moving	4
12	Health related services	4
	Business	**Max Grade**
1	Social contributions	4
2	Corporate tax	4
3	VAT	4
4	Registration of a new company	4
5	Submission of data to statistical offices	5
6	Customs declaration	4
7	Environment-related permits	5
8	Public procurement	4

TABLE I
THE 20 BASIC SERVICES FOR E-GOVERNMENT BENCHMARKS

The measurement scale is presented in Figure 1 expressing maturity level from 0 to 1. It is often expressed in percentage from 0 to 100% as ratio between the grade and the maximum attainable grade. Each service is evaluated usually with grades 0, 1, 2, 3, 4 or 5 (not for all services), where grade 0 is interpreted as no information available on line; 1 is interpreted as relevant information available; 2 is interpreted as one way interaction (downloadable forms); 3 as two way interaction (electronic forms); 4 as transaction fully available online (full electronic case handling); and 5 as targeted, proactive, automated service delivery.
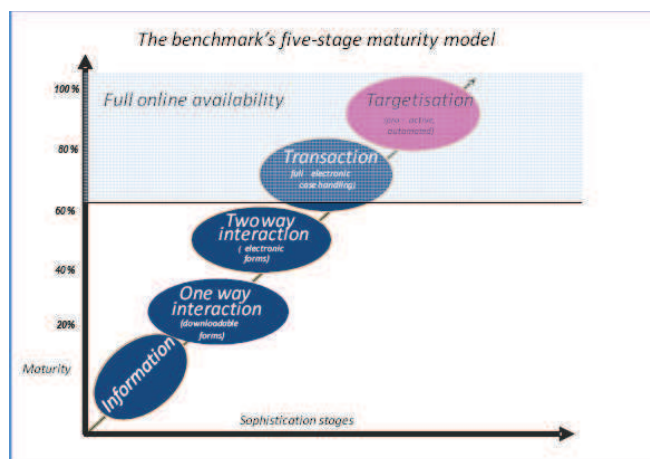

Fig. 1. The benchmark's five-stage maturity model [3]

Most services can achieve maximum grade 5, but some, like Certificates and Job search, can have maximum grade 3. The final overall online sophistication level is the average of the sophistication of the 20 basic services. Each service can fall in one of the two target groups: citizen or business. There are four clusters defined on groups of services identified as income cluster, registration cluster, returns cluster, and permits cluster. In this study we analyze the growth rates of member states and compare it to results of what we measured for achievement of e-Government in Macedonia. The results of measurements in previous years were also published [4], [5], [6] and this study compares it with growth trends achieved in EU member states.

II. E-GOVERNMENT BENCHMARKING RESULTS

Benchmarking of e-Government services has been conducted on a yearly basis in the past decade.

Through the measurement process and result analyses we can track e-Government services improvement in most of European countries, and we can see trends showing improving in

C	2001	2002	2003	2004	2006	2007	2009	2010
IE	68%	85%	86%	84%	84%	78%	94%	100%
PT	51%	58%	65%	68%	83%	90%	100%	100%
AT	40%	56%	83%	87%	95%	99%	99%	100%
MT				67%	92%	96%	100%	100%
DE	40%	48%	52%	66%	74%	84%	89%	99%
IT	39%	57%	59%	72%	80%	79%	80%	99%
SE	61%	87%	87%	89%	90%	87%	99%	99%
ES	50%	64%	64%	73%	79%	84%	89%	98%
NL	37%	54%	65%	70%	79%	83%	87%	97%
UK	50%	62%	71%	84%	87%	90%	94%	97%
EE				78%	90%	87%	95%	97%
SI				68%	87%	96%	97%	97%
FI	66%	76%	80%	83%	85%	82%	94%	96%
DK	59%	82%	86%	81%	85%	80%	93%	95%
FR	49%	63%	73%	74%	85%	87%	90%	94%
LV				33%	47%	54%	78%	94%
BE	23%	47%	58%	67%	74%	80%	89%	92%
NO	63%	66%	75%	82%	89%	86%	87%	92%
TR						69%	69%	91%
LU	15%	32%	47%	53%	55%	67%	81%	87%
PL				36%	53%	53%	74%	87%
CH		49%	55%	60%	62%	60%	67%	85%
CZ				57%	61%	71%	78%	85%
LT				59%	68%	64%	77%	84%
SK				40%	50%	57%	72%	81%
HU				50%	81%	70%	76%	80%
IS	38%	53%	56%	76%	74%	68%	76%	79%
HR						51%	60%	78%
BG						51%	65%	77%

TABLE II
ONLINE SOPHISTICATION BENCHMARKS FOR 33 EUROPEAN COUNTRIES
(2001-2010)

all services. This improvement is never sudden, and although there are leaps between certain benchmarks, we can see that improvement process take the shape of a discrete stairway function.

In this section, we will give graphical representation of this derived conclusion for all countries included in last benchmarks. In our continuous work we provide benchmarking results for Macedonia's e-Government services, and we compare these results with other European countries, and we will continue to do so. Thus, in this paper we will turn our attention not only to score achieved, but we provide more insight into pace with which different countries are developing and implementing e-Government services. We will give our view on what is most important for certain countries, and which periods between consecutive benchmarks have proven of greatest importance for various services. We provide results for e-Government services' Online Sophistication as well as Full Online Availability.

Since benchmark results have been provided for 33 European countries, we will divide them into five groups that will give better representation of how certain countries improve their e-Government services. These groups have been formed on basis of the year benchmarking has first taken place, and on benchmark results. First two groups consist of 18 countries measured for e-Government benchmark since 2001.

Our intent is to group the countries by score relative to all other countries. An identification bar is set to 80% for Full Online Availability for all e-Government services and to 100% for Business Services' Online Sophistication. Next two groups consist of countries measured by this benchmark staring 2003. There are 10 countries satisfying this requirement, and similarly to first 18 countries, we use the same scoring to form these two groups. The last group consist of countries with benchmarking results provided starting 2007. Although benchmarking is carried out since 2004, we included Macedonia in this group, since it's behavior and achieved benchmark results and annual progress is very similar to the other four countries (this group also includes the newest EU members or candidate states, similar to Macedonia).

III. ONLINE SOPHISTICATION FOR 20 E-GOVERNMENT SERVICES

Online Sophistication benchmarking is presented on Table II. It is full of unstructured information and therefore we try to analyze it by presenting a bar graph in Figure 2. It also looks messy and we present a methodology to realize clusters and present average representative behavior of the cluster. The idea to divide countries in clusters with similar behavior is realized according to the growth rate and achieved score.

In this paper we introduce a categorization for online sophistication according to the growth rate and achieved score to enable meaningful information presentation. Table III summarizes countries in identified clusters and Figure 3 shows typical behavior of each cluster.

Cluster	Countries	First benchmark	2010 Score
A	Belgium, Denmark, Germany, Spain, France, Italy, Ireland, Austria, Netherlands, Portugal, Finland, Sweden, United Kingdom, Norway	2001	> 90%
B	Greece, Luxembourg, Iceland, Switzerland	2001	< 90%
C	Estonia, Latvia, Malta, Slovenia	2003	> 90%
D	Czech Republic, Cyprus, Lithuania, Hungary, Poland, Slovakia	2003	< 90%
E	Bulgaria, Romania, Croatia, Turkey, Macedonia	2006	

TABLE III
CLUSTERS IN CATEGORIZATION OF ONLINE SOPHISTICATION
BENCHMARKS (2001-2010)

A limit of 90% on the 2010 benchmark is determined in this categorization to allow division into different clusters. Five clusters are identified by this categorization and presented in Table III. The growth rate from a typical representative from each cluster is presented in Figure 3, results for Online Sophistication in each cluster are shown in Figures 4-refose.

A. Leaders

Leaders is the name of the cluster that scored approx. 50% in 2002 and reached e-Government online sophistication > 90% in 2010. These countries show constant growth and lead

C	2001	2002	2003	2004	2006	2007	2009	2010
IE	22%	54%	60%	52%	52%	52%	80%	100%
IT	15%	35%	47%	54%	61%	69%	68%	100%
MT				40%	78%	91%	100%	100%
AT	15%	20%	70%	76%	83%	100%	100%	100%
PT	32%	34%	39%	43%	62%	81%	100%	100%
SE	28%	69%	69%	76%	76%	75%	95%	100%
UK	24%	36%	50%	59%	68%	78%	93%	98%
DK	32%	61%	72%	61%	66%	61%	84%	95%
DE	20%	35%	40%	47%	49%	72%	74%	95%
ES	30%	40%	40%	55%	57%	69%	80%	95%
NL	5%	21%	26%	33%	56%	63%	71%	95%
SI				45%	69%	91%	95%	95%
FI	33%	50%	61%	69%	64%	65%	86%	95%
EE				66%	82%	73%	93%	94%
LV				6%	10%	28%	66%	93%
NO	35%	35%	51%	62%	69%	72%	80%	90%
TR						58%	58%	89%
FR	25%	37%	51%	50%	65%	73%	78%	85%
BE	0%	25%	35%	35%	47%	63%	69%	79%
PL				10%	20%	21%	55%	79%
CZ				31%	33%	58%	63%	74%
LT				40%	43%	37%	62%	72%
LU	5%	5%	16%	21%	21%	41%	64%	72%
BG						14%	40%	70%
CH	0%	0%	0%	6%	11%	26%	32%	70%
HU				15%	50%	43%	53%	66%
HR						5%	38%	65%
SK				15%	20%	30%	56%	63%
RO						38%	48%	60%
IS	11%	28%	28%	50%	47%	44%	53%	58%
CY				25%	38%	46%	51%	55%
EL	11%	32%	32%	32%	30%	45%	45%	48%
MK				0%	0%	10%	15%	20%

TABLE IV
FULL ONLINE AVAILABILITY OF eGOVERNMENT SERVICES FOR 33 EUROPEAN COUNTRIES IN THE PERIOD 2001-2010.

Cluster	Countries	First benchmark	2010 Score
A	Denmark, Germany, Spain, Italy, Netherlands, Portugal, Finland, Sweden, United Kingdom, Norway, Ireland, Austria	2001	> 80%
B	Belgium, Greece, France, Luxembourg, Iceland, Switzerland	2001	<= 80%
C	Estonia, Malta, Slovenia	2003	> 80%
D	Czech Republic, Cyprus, Lithuania, Latvia, Hungary, Poland, Slovakia	2003	<= 80%
E	Bulgaria, Romania, Croatia, Turkey, Macedonia	2006	

TABLE V
CLUSTERS IN CATEGORIZATION OF FULL ONLINE AVAILABILITY BENCHMARKS (2001-2010)

D. Late adopters

Figure 13 presents the cluster **late adopters**. There are 7 countries in this cluster with first benchmark in 2004 and reaching overall value of full online availability less then 80% with slow growth rate.

Typical representative of this cluster is Slovakia starting with full online availability of 25% in 2004 and reaching 50%
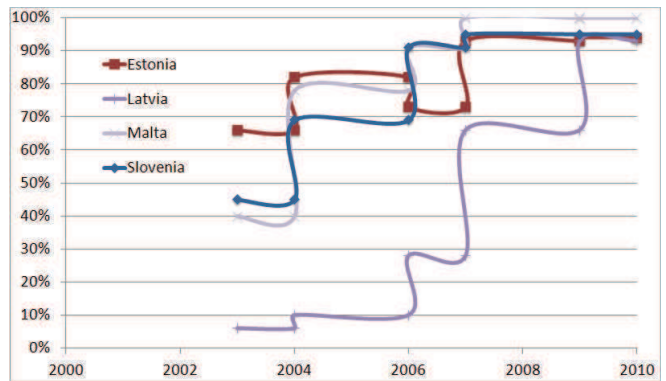

Fig. 12. Full Online Availability of eGovernment services for cluster C (2001-2010).

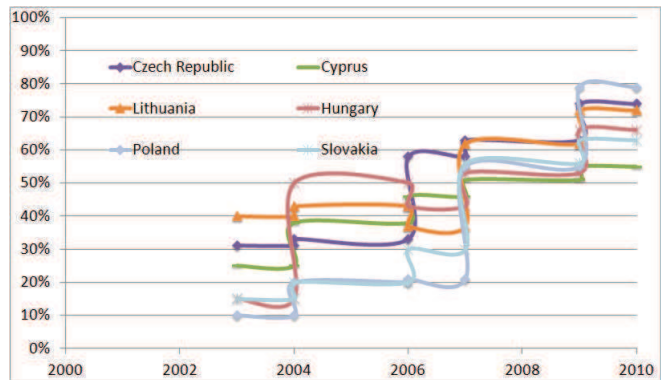in 2010 with approx. annual growth rate of 4.2%.

Fig. 13. Full Online Availability of eGovernment services for cluster D (2001-2010).
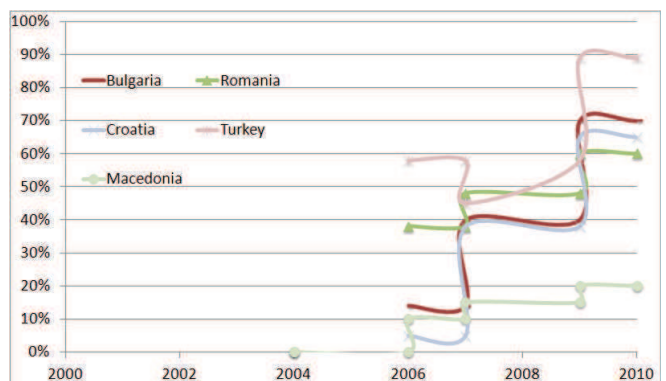
E. Followers

Fig. 14. Full Online Availability of eGovernment services for cluster E (2001-2010).

The last group of 5 countries belong to cluster **followers**. Full online availability results are presented in Figure 13.
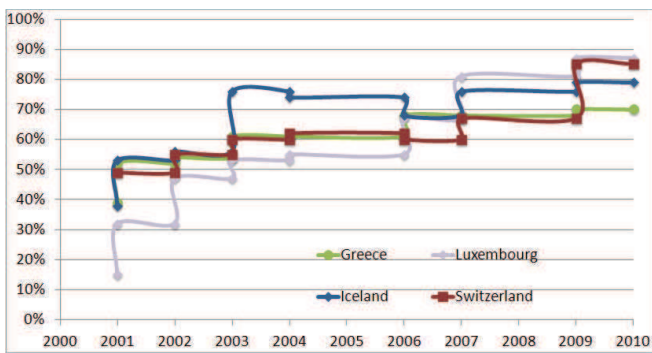
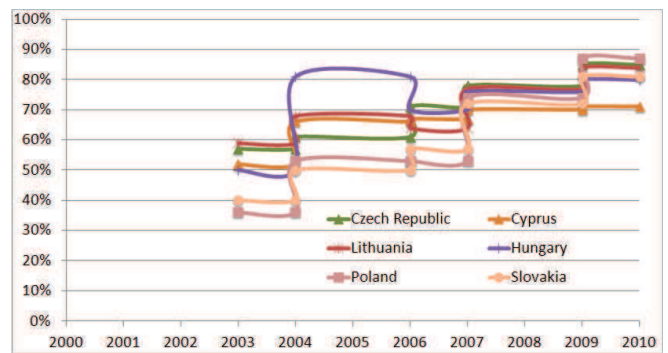Fig. 5.   Online Sophistication benchmarks for cluster B (2001-2010).

Fig. 7.   Online Sophistication benchmarks for cluster D (2001-2010).

with 67.6% in 2004 and reached 97.25% in 2010 with approx. annual growth rate of 5%. Latvia is the fastest growing representative for this cluster, it started with 32.66% in 2004 and reached 93.9% in 2010 with approx. annual growth rate of 10%.
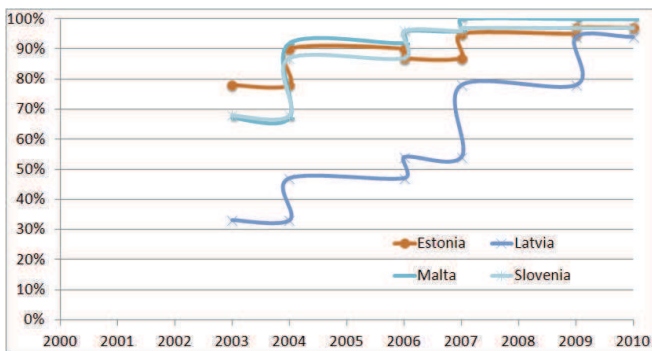
Online sophistication benchmarks for countries in cluster E by measurement of e-Government is presented in Figure 8 for period of 2001 to 2010.
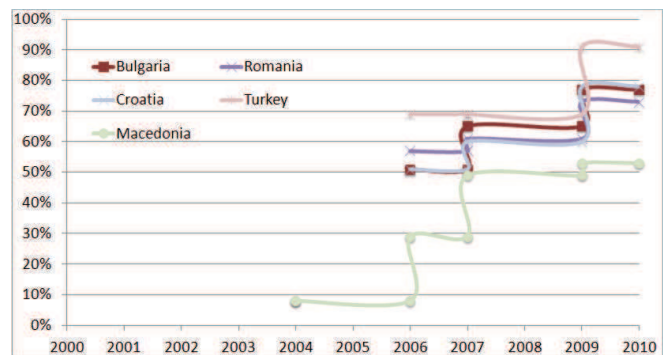

Fig. 6.   Online Sophistication benchmarks for cluster C (2001-2010).

Fig. 8.   Online Sophistication benchmarks for cluster E (2001-2010).

IV. FULL ONLINE AVAILABILITY FOR 20 e-GOVERNMENT SERVICES

D. Late adopters

Figure 7 presents online sophistication benchmarks for countries in cluster D by measurement of e-Government in period of 2001 to 2010. These countries are called **late adopters** since their start and achievement of 50% of e-Government online sophistication was in period 2005-2006 and have achieved high level of 70%-90% by 2010.

Slovakia is typical representative of this cluster. It started with 39.9% in 2004 and reached 80.6% in 2010 with approx. annual growth rate of 4.5%.

E. Followers

Followers is the name for countries in cluster E. These countries have started very late and reached the 50% level of e-Government online sophistication by 2007. Their growth rate is slow and reached values of less then 70% by 2010. Romania is typical representative of this cluster that reached 57% in 2007 and 73.3% in 2010 with approx. annual growth rate of 5.4%.

In this section, we compare Full Online Availability for all eGovernment services. Table IV and Figure 9 provide an insight into Full Online Availability from 2001 through 2010 for all services.

In order to have better classification for Full Online Availability we have set target value of 80% on the 2010 benchmark and obtained the clusters identified in Table V.

Results for Full Online Availability for each cluster are shown in Figures 10-14.

A. Leaders

Leaders for full online availability are presented in Figure 10. 12 countries in this cluster have reached full online availability > 80%.

Germany as typical representative started with 30% full online availability in 2001 and reached 85% in 2010 with approx. annual growth rate of 6%.
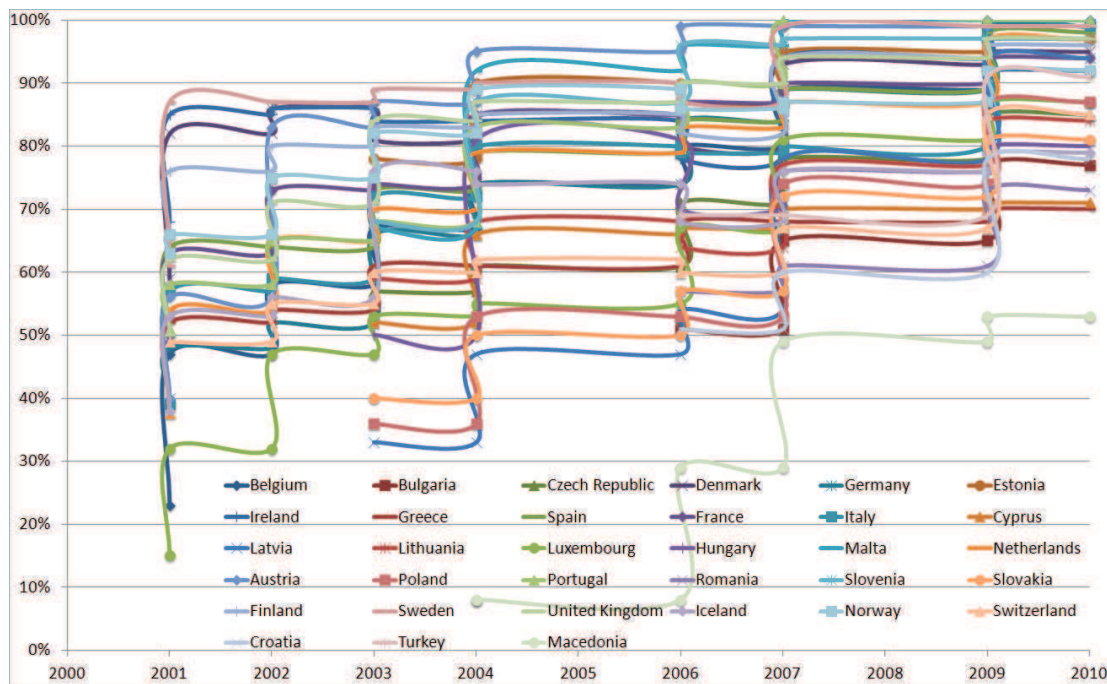
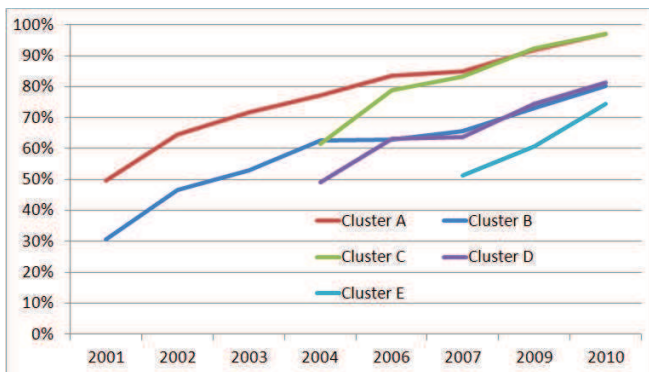Fig. 2.   Online sophistication benchmarks for 33 European countries (2001-2010)

Fig. 3.   Online Sophistication benchmarks for typical cluster representaives (2001-2010).
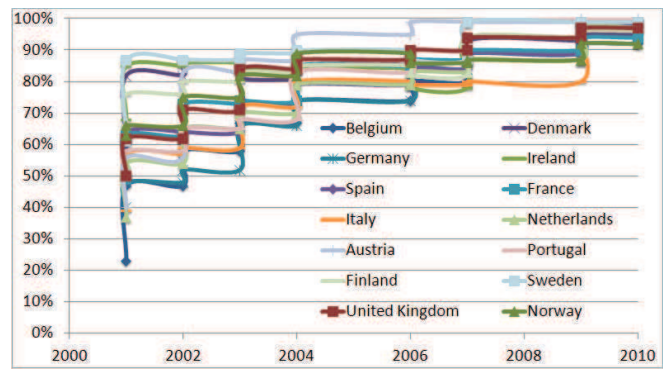

Fig. 4.   Online Sophistication benchmarks for cluster A (2001-2010).

others towards achievement and implementation and usage of new technologies to establish a more successful and efficient government.

Figure 4 presents online sophistication benchmarks for countries in cluster A by measurement of e-Government in period of 2001 to 2010. Typical representative of this cluster is Germany, started with 40% in 2001 and realized 93.75% in 2010 with approx. annual growth of 6%.

B. Early adopters

Cluster B represents the **early adopters**. These countries have reached the starting value of e-Government online sophistication of approx. 50% by 2003 and reached high level of benchmark in region of 70% up to 90% by 2010.

Online sophistication benchmarks for countries in cluster B by measurement of e-Government in period of 2001 to 2010 are presented in Figure 5. Typical representative of this cluster is Island, started with 33.92% in 2001, reached 78.65% in 2010 with approx. annual growth rate of 5%.

C. Fast growers

Fast growers is the cluster C. Figure 6 presents online sophistication benchmarks for countries in cluster C by measurement of e-Government in period of 2001 to 2010. Cluster C represents all countries that have started with lower values of e-Government benchmarks achieved by early adopters (Cluster B) and have scored high level of online sophistication more then 90% by 2010.

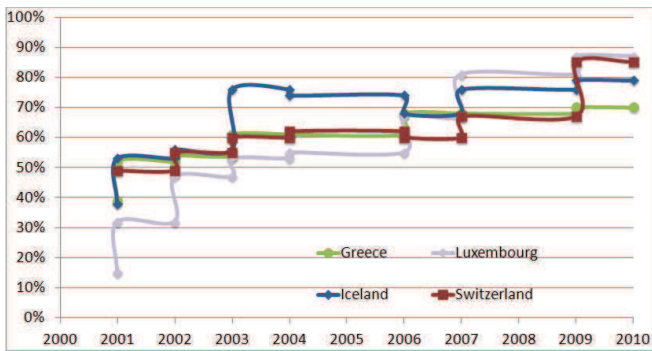Slovenia is typical representative for this cluster starting

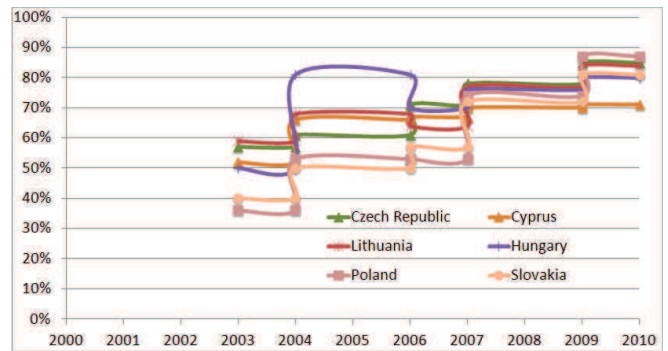Fig. 5.   Online Sophistication benchmarks for cluster B (2001-2010).

Fig. 7.   Online Sophistication benchmarks for cluster D (2001-2010).

with 67.6% in 2004 and reached 97.25% in 2010 with approx. annual growth rate of 5%. Latvia is the fastest growing representative for this cluster, it started with 32.66% in 2004 and reached 93.9% in 2010 with approx. annual growth rate of 10%.
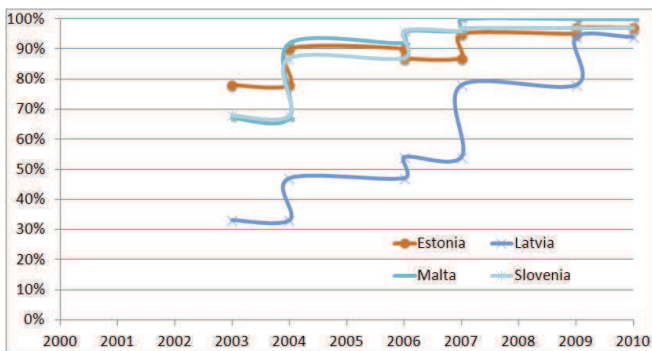

Fig. 6.   Online Sophistication benchmarks for cluster C (2001-2010).

Online sophistication benchmarks for countries in cluster E by measurement of e-Government is presented in Figure 8 for period of 2001 to 2010.
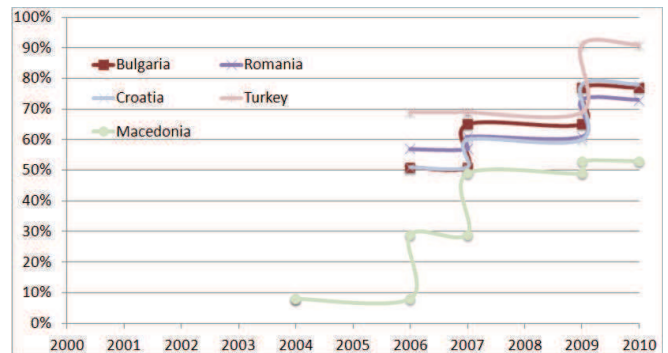

Fig. 8.   Online Sophistication benchmarks for cluster E (2001-2010).

IV. FULL ONLINE AVAILABILITY FOR 20 E-GOVERNMENT SERVICES

In this section, we compare Full Online Availability for all eGovernment services. Table IV and Figure 9 provide an insight into Full Online Availability from 2001 through 2010 for all services.

In order to have better classification for Full Online Availability we have set target value of 80% on the 2010 benchmark and obtained the clusters identified in Table V.

Results for Full Online Availability for each cluster are shown in Figures 10-14.

D. Late adopters

Figure 7 presents online sophistication benchmarks for countries in cluster D by measurement of e-Government in period of 2001 to 2010. These countries are called **late adopters** since their start and achievement of 50% of e-Government online sophistication was in period 2005-2006 and have achieved high level of 70%-90% by 2010.

Slovakia is typical representative of this cluster. It started with 39.9% in 2004 and reached 80.6% in 2010 with approx. annual growth rate of 4.5%.

E. Followers

Followers is the name for countries in cluster E. These countries have started very late and reached the 50% level of e-Government online sophistication by 2007. Their growth rate is slow and reached values of less then 70% by 2010. Romania is typical representative of this cluster that reached 57% in 2007 and 73.3% in 2010 with approx. annual growth rate of 5.4%.

A. Leaders

Leaders for full online availability are presented in Figure 10. 12 countries in this cluster have reached full online availability > 80%.

Germany as typical representative started with 30% full online availability in 2001 and reached 85% in 2010 with approx. annual growth rate of 6%.

These countries achieve full online availability values lower then 50% in 2010.

Romania as typical representative of this cluster starts with 10% full online availability of e-Government services in 2001 and reaches 45% in 2010 with annual growth rate of approx. 4%.

V. DISCUSSION

A. Online sophistication

The main characteristics of e-Government Online Sophistication growth rate behavior are summarized in Table VI. Due to the fact that e-government benchmarking process started at different period for different countries[2], some results are missing. We can conclude that the average growth rate in the named period seems similar, with the exception that the achieved level of online sophistication differs by 15% - 25%, depending on the cluster. Countries from cluster E are primarily Balkan countries, lagging behind other European countries in their adoption of Internet and electronic services[7], but benchmarks show noticeable improvement in the last 3 years.

Cluster	eGov2001 score	eGov2004 score	eGov2007 score	eGov2010 score	Avg growth rate
A	50%	72%	84%	97%	5%
B	31%	53%	63%	80%	5%
C		62%	83%	97%	5%
D		49%	64%	81%	5%
E			51%	74%	6%

TABLE VI
E-GOVERNMENT ONLINE SOPHISTICATION BENCHMARK AND GROWTH RATE OF TYPICAL REPRESENTATIVES IN CLUSTERS.

Table VII presents a summary of typical representative for given cluster. Although Table VI shows similar growth rate for all clusters, the inclusion of the achieved level of online sophistication enables us to assign different categories for growth rate. Thus, clusters A and C have normal and fast growth rate, respectively, while clusters B, D, and E have slow growth rate.

Cluster	name	50% reached	level in 2010	growth rate
A	leaders	2001	95% - 100%	normal
B	early adopters	2003	70%-90%	slow
C	fast growers	2004	95%-100%	fast
D	late adopters	2005	70%-90%	slow
E	followers	2007	< 75%	slow

TABLE VII
CHARACTERISTICS OF CLUSTERS FOR E-GOVERNMENT ONLINE SOPHISTICATION BENCHMARKS.

B. Full online availability

The main characteristics of Full Online Availability for e-Government benchmark are summarized in Table VIII.

Cluster	eGov2001 score	eGov2004 score	eGov2007 score	eGov2010 score	Avg growth rate
A	23%	55%	71%	95%	7%
B	7%	27%	39%	62%	6%
C		39%	71%	96%	8%
D		23%	39%	68%	7%
E			25%	61%	9%

TABLE VIII
FULL ONLINE AVAILABILITY OF E-GOVERNMENT SERVICES AND GROWTH RATE OF TYPICAL REPRESENTATIVES IN CLUSTERS.

Cluster	name	50% reached	level in 2010	growth rate
A	leaders	2001	85% - 100%	normal
B	early adopters	2003	50%-80%	slow
C	fast growers	2004	90%-100%	fast
D	late adopters	2005	55%-80%	slow
E	followers	2006	< 70%	normal

TABLE IX
CHARACTERISTICS OF CLUSTERS FOR FULL ONLINE AVAILABILITY OF E-GOVERNMENT SERVICES.

Table IX presents a summary of typical representative for given cluster, regarding full online availability. Similar as the level of online sophistication, clusters A and E have normal growth rate, cluster C has fast growth rate, while clusters B and D have slow growth rate. As it is presented through benchmarks, online sophistication and full online availability for e-government services has reached highest levels, and future benchmarks will be more dedicated to use of eSkills, green ICT, and trust and security [9].

VI. CONCLUSION

In this paper we introduce categorization according to the growth rate and final score reached for two e-Government benchmarks: online sophistication and full online availability. This process resulted with identification of 5 different clusters: leaders, early adopters, fast growers, late adopters and followers. We have presented their characteristics for both benchmarks.

We can conclude that all countries have steady improvement between consecutive benchmarks. Countries identified as early adopters, late adopters and followers have slow growth rate and have late start according to the others and reach slow growth for both e-Government online sophistication and full online availability. These countries are still behind the overall leave to be reached with this e-Government benchmark.

Note that due to the change in benchmarking process in the period of 2006-2007 and inclusion of pro-active and targeted services in the scale the scores obtained as e-Government online sophistication is lower then in previous years. Clustering of countries has shown slight differences for both

e-Government benchmarks although most of the countries have shown same behavior for both benchmarks. Interestingly, Ireland and Austria belong to early adopters cluster for online sophistication and to leaders cluster for full online availability, meaning they have improved overall impression. On contrary, Latvia belongs to cluster of fast growers for online sophistication and to late adopter for full online availability, decreasing the overall impression. Similar to this slight degradation are Belgium and France which belong to leaders cluster for online availability and to early adopters for full online availability.

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