

A NEW E-TRANSFORMATION METRIC SYSTEM FOR COUNTRIES: A CASE STUDY - CZECH REPUBLIC

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Abstract

Assessment of e-transformation is essential to shift governments' e-performance to an advanced level. In this context, the major purpose of this paper is to evaluate e-performance of Czech Republic based on a newly developed e-transformation metric system. This new system has been derived from some popular e-transformation assessment methodologies. The results of e-transformation assessment of Czech Republic are demonstrated in two different ways. Initially, e-Performance of Czech Republic is summarized considering results of four assessment methodologies annually published between 2001 and 2008. Summary has included both the scores and rankings of Czech Republic in these years. Secondly, Czech Republic's e-performance is analyzed according to methodology of newly developed e-transformation metric system. That is, Czech Republic's performance in e-transformation aspects is analyzed and its overall e-score card is provided based on the metrics of the new metric system.

1. Introduction

Governments are being enforced to adopt technological advances and innovations of today's information era. e-Transformation has been gaining significance every passing day as knowledge based economy and global competitiveness have become indispensable priorities of governments. Arifoğlu proposed a comprehensive definition for e-transformation as “the use of ICT to change the culture, business model, business processes, product and services in an integrated way for the benefits of employees, citizens, business partners, and all other social shareholders” [1].

e-Transformation provides various advantages to its stakeholders: government, business, and citizens. It is confirmed that e-transforming governments accelerate development and enhance competitiveness [11]. With the use of ICT opportunities in processes of government, modernization and automation of public services are accomplished, so that effectiveness and efficiency of public services are satisfied [10]. Similarly, e-transforming organizations are able to perform their transactions with time and cost efficient manner. e-Transformation supports strength of government relations between businesses and citizens. Governments' transparency regarding their functioning as well as availability of service channels improves communication and interaction, hence, supports democracy. From the perspective of individuals, citizen centered design of e-transformation enables whole country citizens to

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access public services ubiquitously. Quality of citizen life is getting better and better, which provides governments to gain more prestige and trust from society [12].

The process of e-transformation needs to be continuous. In order to achieve e-transformation, governments identify their strategic goals and turn their goals into actions. After these two phases are completed, governments need to be informed about results of their actions. Being unconsciousness about progress of e-transformation prevents governments to continue transformation in a sound way. In other words, during life cycle of e-transformation, measurement phase commits a vital role to expose progress, success and shortcomings, which are precious feedback for upcoming studies. Gupta and Jana (2003) support the idea by stating that “In order to ensure success, it is important to assess the performance of e-government and take necessary actions based on these assessments.” [8]

To date, several methods to evaluate e-transformation have been proposed. Generally, these methods assess e-government achievement level of nations, and compares governments' scores considering results of assessment. Furthermore, some studies include best e-transformation practices of nations. Outcomes of such assessments would be guidance for governments by which they have opportunity to comprehend the best practices, realize the worldwide e-government trends and learn e-government policies of other countries [9].

Each framework developed for assessment of e-transformation does not serve the same specific purpose, hence includes distinct set of measures. Some of the frameworks evaluate only maturity level of e-government services, some assesses degree of society's e-transformation, some focuses on e-government with affecting factors, etc. The purpose of the framework determines which aspects of e-transformation to be covered in methodology. More specifically, e-transformation frameworks evaluate performance of governments through some set of criteria within a variety of aspects such as technology, society, economy, policy and so on. Additionally, even if frameworks share the same purpose, they may produce different e-performance results and rankings for nations. Discrepancy among results prevents governments from identifying their exact e-performance (i.e. achievement level of e-transformation). Furthermore, amount of metrics in e-transformation changes across evaluation studies. That is, total number of e-transformation metrics is ranging from 8 to 100. However, collecting data in national or international level requires great effort during evaluation process.

While developing new e-transformation metric system, we searched for widely recognized measures of e-transformation assessment studies previously developed to offer a new system consisting key metrics of methodologies. In this way, reasonable amount of metrics are included under common e-transformation aspects: technological infrastructure, e-society, human capital, political and regulatory environment, economy environment, and online services and applications. In this study, our purpose is to evaluate e-performance of Czech Republic by applying our e-transformation metric system. For this purpose, we have obtained essential data from databases of prestigious research institutions. Additionally, in this study, we focused on findings of e-transformation methodologies towards evaluation of world countries. We extract e-performance of Czech Republic among these findings. The methodology for analysis is based on quantitative findings of four different e-transformation evaluation studies developed by prestigious research institutes.

The content of the paper is as follows. Following the introduction, 2nd section presents four different studies' quantitative findings regarding e-performance of Czech Republic from 2001

to 2008. 3rd section of the paper explains methodology of the study. Then, 4th section reveals e-performance scores of Czech Republic based on our e-transformation metric system. The paper’s final section is allocated for conclusion of the study.

2. e-Performance of Czech Republic According to Existing Methodologies

Existing e-transformation assessment methodologies of prestigious institutions were consulted to observe their findings towards e-performance of Czech Republic. In order to gather data regarding e-performance of Czech Republic, totally four methodologies were considered; UN’s e-Government Survey, EIU’s e-Readiness Rankings, WEF’s Network Readiness Rankings, and Global e-Government Survey of Brown University. All data produced by each methodology beginning from the initial year to the recent year have been collected. The resulted years for whole data range between 2001 and 2008.

After data collection, historical e-performance progress of Czech Republic from the year when initial findings of the existing methodologies have been published to the year when recent findings are issued by same methodologies. Then, Czech Republic’s e-performance in major aspects of e-transformation has been explored. Comparison of e-performance of Czech Republic with world regions was also performed to observe the place of Czech Republic in the world.

2.1. Overall e-Performance of Czech Republic

Czech Republic’s scores and rankings according to four previously developed methodologies are demonstrated in the *Table 1* below.

Table 1 Czech Republic’s e-Performance

Year	UN’s e-Government Survey		EIU’s e-Readiness Rankings		WEF’s Network Readiness Rankings		Global e-Government Survey of Brown University	
	Ranking / # of Countries	Score / Out of	Ranking/ # of Countries	Score / Out of	Ranking / # of Countries	Score / Out of	Ranking / # of Countries	Score / Out of
2001					28 / 75	4.38 / 7		
2002			27 / 60	6.45 / 10	28 / 82	4.43 / 7	59 / 198	45 / 100
2003	36 / 191	0.542 / 1	27 / 60	6.52 / 10	33 / 102	3.8 / 7	27 / 198	33.8 / 100
2004	28 / 191	0.6211 / 1	27 / 64	6.47 / 10	40 / 104	4.4 / 7	28 / 198	30.9 / 100
2005	29 / 191	0.6396 / 1	29 / 65	6.09 / 10	32 / 115	4.5 / 7		
2006			32 / 68	6.14 / 10	34 / 122	4.28 / 7	46 / 198	31.7 / 100
2007			31 / 69	6.32 / 10	36 / 127	4.33 / 7	27 / 198	36.7 / 100
2008	25 / 192	0.6696 / 1	31 / 70	6.68 / 10				

In terms of UN’s findings it can be interpreted that e-performance of Czech Republic has advanced from the value of 0.542 (2003) to 0.6696 (2008). Increase in the scores is also reflected to ranking place of Czech Republic, which is recently in the 25th place among 192 countries [13-16].

EIU’s framework reveals that Czech Republic experienced fall in its score in 2005, then has increased its performance and has achieved the highest score, 6.68 in recent year of the study.

The ranking degree of Czech Republic has not changed considerably from 2002 to 2008. Places of Czech Republic have lied between 27 and 31 in those years [2-7].

According to WEF's study, Czech Republic has experienced fall in its NRI scores from 4.43 (2002) to 3.8 (2003). Then, a significant jump was detected in 2004. Following this progress, scores of Czech Republic are nearly flattened and becomes 4.33 in 2007. Total number of countries analyzed has increased from 75 (2001) to 127 (2001). Because of this increase as well as Czech Republic's decrease in its score lead to worsen place of Czech Republic [22-28].

With regards to survey of Brown University, Czech Republic has achieved the maximum performance with the score 45% in the first year of the survey. However, after that year Czech Republic has experienced fall in its overall score. Then, Czech Republic has experienced an increase from 30.9% (2004) to 36.7% (2007). According to ranking results of the study, Czech Republic's place changes between 27 and 59 in those years [17-21].

2.2. Yearly e-Performance of Czech Republic

Considering all findings we aim to provide e-performance of Czech Republic through one aggregated score in each year. However, each study includes different measurement scale in their assessments. To be more specific, discrepancy between measurement scales prevents direct integration of findings regarding e-performance of Czech Republic. Hence, raw scores are standardized to their representative scores, which are finally out of 10. After this standardization process, aggregate performance scores of Czech Republic between years 2001 and 2008 are obtained. (See *Figure 1*)

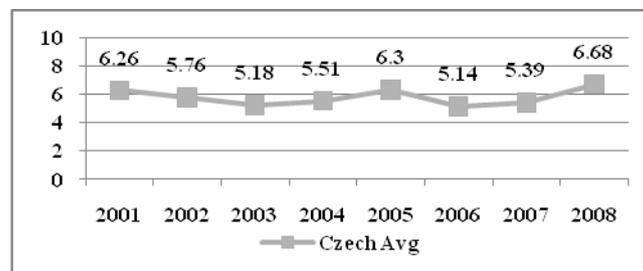


Figure 1 Yearly e-Performance of Czech Republic

According to historical e-performance of Czech Republic, some conclusions can be drawn. In general, e-scores of Czech Republic are fluctuating. From year 2001 to 2003, Czech Republic's e-performance decreased from 6.26 to 5.18. Following this drop, an increase was experienced from 5.18 (2003) to 6.3 (2005). Then, a sharp decline has again occurred; Czech Republic's e-performance score was 5.14 in 2006. However, in recent years, Czech Republic has been advancing its level of e-transformation. The highest e-performance score is 6.68 (2008), which has been obtained in recent year of the study.

2.3. Czech Republic vs. Continents

The procedure of calculating aggregate e-performance score for Czech Republic is also repeated for six world regions: Africa, North America, Latin America, Western Europe, Central & Eastern Europe, and Asia Pacific. Then, aggregate regional scores are compared with Czech Republic's aggregate score. The comparisons are given in *Figure 2*.

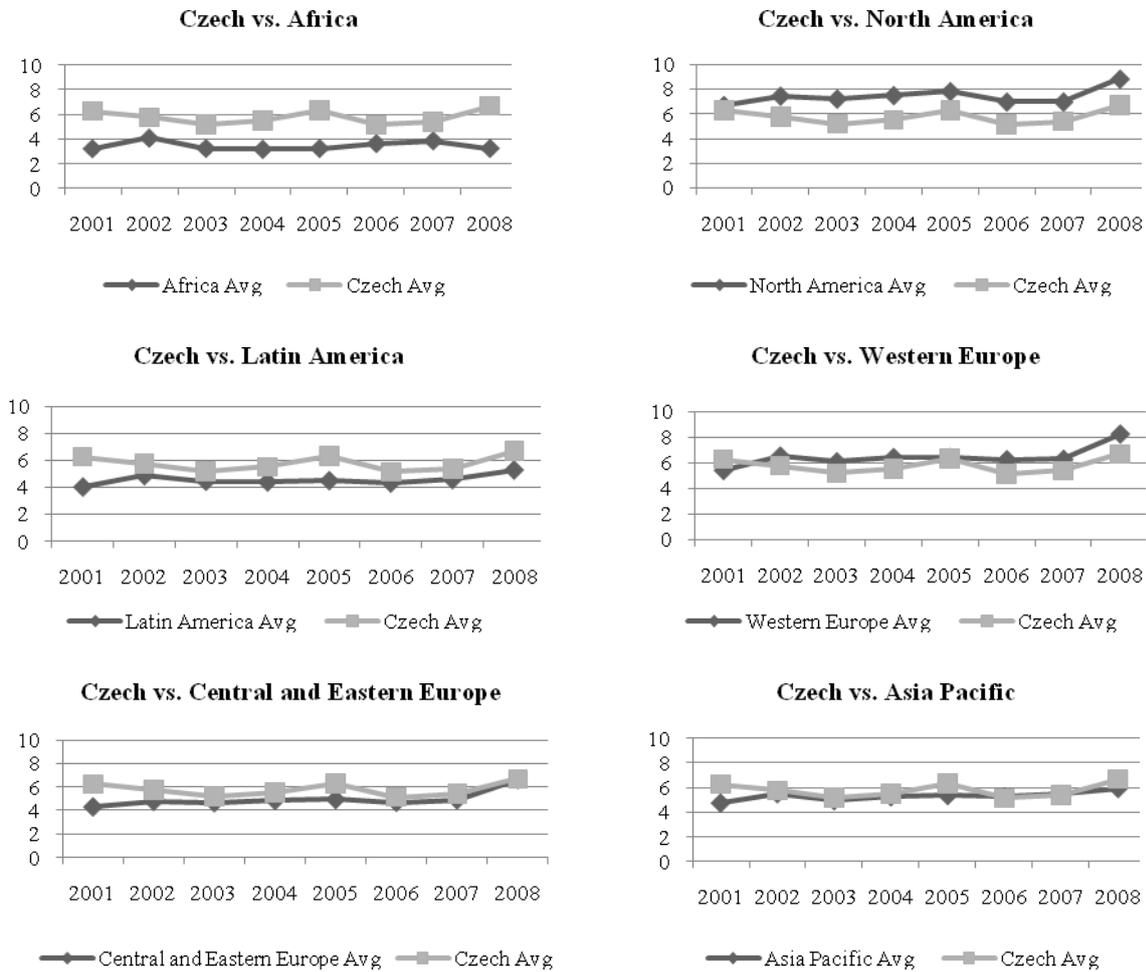


Figure 2 Czech Republic vs. World Regions

Czech Republic is located in Central and Eastern Europe region. In nearly all years of e-transformation evaluations, Czech Republic has been observed as good or average performer among countries in same regions. The remaining comparisons have revealed that there are some similarities and differences regarding e-scores of regions and Czech Republic. While Czech Republic has performed better than Africa and Latin America, its scores always have lied below the North America. The remaining two regions, Asia Pacific and Western Europe, have obtained nearly parallel scores with Czech Republic.

3. e-Transformation Metric System

e-Transformation metric system has been mainly developed to evaluate e-transformation maturity level of governments. Specifically, the system enables governments to (1) evaluate strengths and weaknesses in their e-transformation process, (2) identify e-performance ranking in world, and (3) help them to identify essential actions to be taken for further e-transformation.

The system integrates widely utilized measures of e-transformation evaluation studies. Eighteen studies have been deeply investigated to find out metrics widely considered as necessary factors to determine governments' performance in digital transformation. The

system includes set of metrics under six common measurement factors which are technological infrastructure, e-society, human capital, political and regulatory environment, economy environment, and online services and applications. (See *Table 2*)

Table 2 Measures of e-Transformation Metric System

Technology Infrastructure	e-Society
Proportion of households with computer	PC users per 100 inhabitants
Proportion of households with Internet	Internet users per 100 inhabitants
Mobile cellular subscriptions per 100 inhabitants	Mobile phone users per 100 inhabitants
Fixed telephone lines per 100 inhabitants	Fixed phone users per 100 inhabitants
Broadband per 100 inhabitants	Broadband users per 100 inhabitants
Secure Internet servers per 1 million inhabitants	Firm level Technology Absorption
International Internet bandwidth per Internet user (bit/s)	Extent of Business Internet Use
Mobile cellular prices (% of GNI per capita)	Government Success in ICT Promotion
Broadband Internet prices (% of GNI per capita)	ICT Use and Government Efficiency
	Presence of ICT in Government Offices
Human Capital	Political and Regulatory Environment
Professional and Technical Workers as % of the Labor Force	Government prioritization of ICT
Adult Literacy Rate	Importance of ICT to government vision of the future
Digital Literacy Rate	Laws relating to ICT
Tertiary enrollment ratio	Quality of competition in the ISP sector
Secondary enrollment ratio	Effectiveness of law-making bodies
Schools having Internet access	Judicial independence
Quality of Educational System	Intellectual property protection
Patents granted by USPTO per million people	Efficiency of legal framework for disputes
Total royalty payments and receipts (US\$/pop.)	Property rights
University-Company Research Collaboration	
Economy Environment	Online Services and Applications
Annual GDP Growth (%)	Information Dissemination/Outreach
GDP (current US\$ bill)	Service Delivery Capability
The level of taxes	Access/Usability
Financial market sophistication	Citizen participation / Interconnectedness
Intensity of local competition	
Time required to start a business	

The system produces an overall index to reveal governments' e-performance. Besides, country performances in measurement categories are observed. The calculation procedure is composed of five sequential steps:

1. Nations' data essential for evaluation are collected from major research institutions such as ITU, UN, WEF, and WB.
2. Based on data obtained in Step-1, nations are sorted from highest scorer to least scorer, which resulted in diverse country rankings for each metric.
3. Each metric has unique rankings for countries; hence scores of measurement categories need to be normalized to be in same scale of measurement. The normalization is performed according to formula of Knowledge Assessment Methodology of World Bank. The formula is summarized as follows (World Bank, 2008):

$$\text{Normalized score} = 10 * (1 - \text{Highers} / \text{All})$$

Highers: Number of countries scoring higher than country being assessed

All: Total number of countries assessed

Nations' normalized scores range from 0 (lowest score) to 10 (highest score).

4. Score of a measurement category is calculated by taking average of the normalized scores of the metrics included in that category. In this step, six groups of score are resulted.
5. Similar to the task in Step-4, e-transformation index is estimated by averaging measurement category scores. The resulted e-transformation index ranges between 0 and 10.

4. Evaluation of Czech Republic with e-Transformation Metric System

4.1. The Countries Evaluated

e-Transformation metric system has been applied to thirty one countries in total. We have evaluated Czech Republic within 30 countries, which were previously assessed through the metric system. All the countries assessed as well as Czech Republic are listed in *Table 3*. These countries were selected according to two major criteria. First is that availability of statistical performance of countries on metrics of the system is considered. The other criterion is that countries from all regions were considered to be assessed through the system. Number of countries evaluated in a region is parallel with total number of countries located in that region.

Table 3 Countries Assessed

Region	Countries Assessed	Total # of Countries
Africa	Algeria, Botswana, Egypt, Ethiopia, Kenya, Mauritius, Mozambique, Nigeria	53
America	Argentina, Brazil, Canada, Mexico, United States, Venezuela	35
Asia	China, India, Indonesia, Japan, Malaysia, Singapore, Sri Lanka, Turkey	47
Europe	Austria, Finland, Italy, Spain, Sweden, Russia, Czech Republic	43
Oceania	Australia, New Zealand	14

For the analysis of e-performance of countries we have followed five major steps. As first, we have gathered country data for system's metrics from International Telecommunications Union (ITU), United Nations (UN), World Economic Forum (WEF), and World Bank (WB). Considering values acquired in previous step, we have sorted countries from higher scorer to lower scorer. After this sort operation, it is observed that each metric has its own country order. Since scale of measurement differs between metrics, we have applied normalization procedure to place all data in same scale. After normalization procedure, all the scores of metrics range between 0 and 10. Countries' performance in a measurement category is calculated by averaging the scores of metrics in that category. All countries' performance in six measurement categories has been calculated. Countries' overall e-performance has been obtained by taking average of their scores in measurement categories. Results based on analysis are summarized as radar graph and e-scorecards for the countries assessed.

4.2. Czech Republic's Radar

For each country evaluated, a radar graph is developed to exhibit country's scores in measurement categories of the metric system. At the same time, average scores in measurement categories are revealed to enable comparison between scores of a country and all countries evaluated. The radar graph of Czech Republic is presented in *Figure 3*.

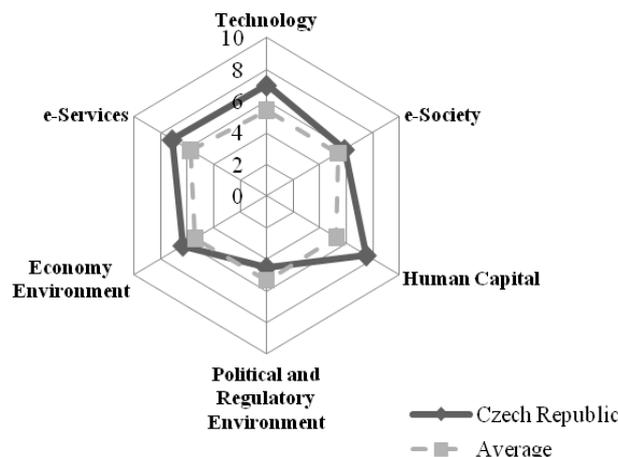


Figure 3 Radar Graph of Czech Republic

Czech Republic has attained higher than average with respect to all categories except the category – political and regulatory environment. Czech Republic has achieved the highest score -7.51- in human capital, which has average score 5.27. According to online public services, Czech Republic obtained the score – 7.10, whereas the average is 5.74. The results show that Czech Republic was well equipped with technology compared with countries evaluated. The score is 6.99, while the average is 5.40 with regards to technology category. With its score 6.29, Czech Republic has taken place above the average – 5.38 in economy environment category. According to e-Society, Czech Republic scores (5.87) slightly above the average (5.38). On the other hand, political and regulatory environment is the lowest achievement of Czech Republic. While its score is 4.52, overall average is 5.32 in that category.

4.3. Czech Republic’s e-Score Card

e-Scorecards reveal e-performance of countries in a detailed way. Specifically e-scorecards demonstrate country performance such as e-transformation index, ranking, score in measurement categories and metrics. The scores in score cards are ranging between 0 and 10. In the *Table 4*, e-Scorecard of Czech Republic can be seen.

e-Transformation index of Czech Republic has been calculated as 6.41 out of 10. With this score, Czech Republic sit in 12th place among 31 countries evaluated. The order of countries can be seen from *Figure 4*.

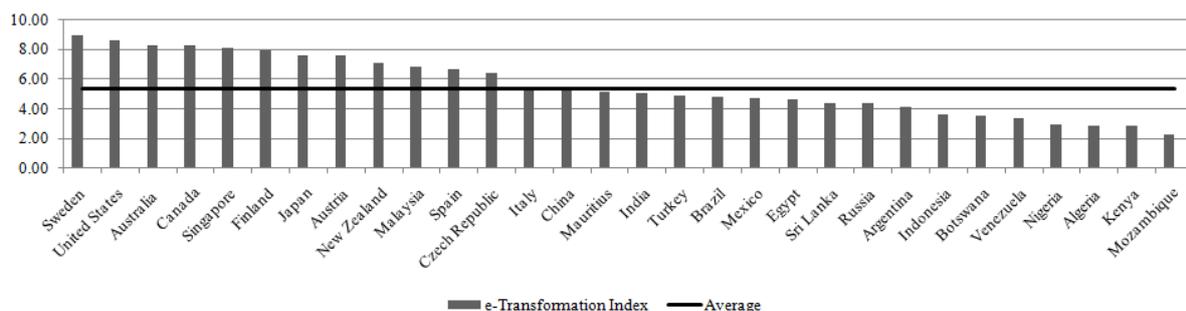


Figure 4 Ranking of the Countries Evaluated

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Countries' average on e-transformation index is resulted as 5.42. Sweden attains the leadership with its score 8.92. The United States scoring 8.61 achieves the second place. The lowest scorer country is Ethiopia with its 2.09 e-transformation index value. Czech Republic scores 6.41, which is above the average and in 12th place.

Table 4 e-Scorecard of Czech Republic

e-Transformation Index	6.41	Ranking	12
Technology Infrastructure	6.99	e-Society	5.97
Proportion of households with computer	6.45	PC users per 100 inhabitants	6.45
Proportion of households with Internet	6.45	Internet users per 100 inhabitants	6.77
Mobile cellular subscriptions per 100 inhabitants	9.35	Mobile phone users per 100 inhabitants	9.35
Fixed telephone lines per 100 inhabitants	4.84	Fixed phone users per 100 inhabitants	4.84
Broadband per 100 inhabitants	6.45	Broadband users per 100 inhabitants	6.45
Secure Internet servers per 1 million inhabitants	7.10	Firm level technology absorption	6.45
International Internet bandwidth per Internet user (bit/s)	7.42	Extent of business Internet use	8.06
Mobile cellular prices (% of GNI per capita)	7.33	Government success in ICT promotion	1.94
Broadband Internet prices (% of GNI per capita)	7.00	ICT use and government efficiency	3.55
		Presence of ICT in government offices	5.81
Human Capital	7.63	Political and Regulatory Environment	4.52
Professional and technical workers as % of the labor force	8.06	Government prioritization of ICT	4.84
Adult literacy rate	10.0	Importance of ICT to government vision of the future	3.23
Digital literacy rate	N.A.	Laws relating to ICT	6.13
Tertiary enrollment ratio	6.13	Quality of competition in the ISP sector	5.81
Secondary enrollment ratio	6.77	Effectiveness of law-making bodies	2.26
Schools having Internet access	7.74	Judicial independence	5.16
Quality of educational system	7.10	Intellectual property protection	5.81
Patents granted by USPTO per million people	6.13	Efficiency of legal framework for disputes	2.90
Total royalty payments and receipts (US\$/pop.)	6.45	Level of property rights protection	4.52
University-Company research collaboration	7.74		
Economy Environment	6.29	e-Services	7.10
Annual GDP Growth (%)	6.77	Web measure index	7.10
GDP (current US\$ bill)	4.19		
The level of taxes	5.81		
Financial market sophistication	5.16		
Intensity of local competition	8.71		
Time required to start a business	7.10		

5. Conclusion

Assessment in e-transformation is a significant phase to analyze success and shortcomings in governments' digital transformation process. In this paper, we introduced new e-transformation metric system to be applied for the evaluation of digital transformation in

country level. Although there exists some assessment methods for e-transformation, there is not like proposed model consisting of both key and reasonable amount of measures. e-Transformation assessment system is derived from available e-transformation evaluation methods by including mutual measures of those studies.

In order to apply the system, we selected 31 countries located in five regions of the world. Required data of the countries are gathered from researches of major research institutions which are UN, WEF, WB, and ITU. Czech Republic's e-performance is revealed to illustrate the application of the system. The system mainly produces e-score card for Czech Republic. The results demonstrate Czech Republic's performance in measurement categories and metrics of the system.

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