

Assessment of Croatia's Readiness for Using the ICT Potentials

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Abstract. ICT is one of the key factors of modern development. However, the researches show that the amount of investments in this sector is not a warranty of business effects. Therefore, the relevant studies have been done also at the aggregated level. This paper presents that kind of studies, as well as metrics that could be used for positioning some country's efficiency in using ICT potential. Whereas Croatia is not most often included in that kind of researches, through this paper we have tried determine its position in that context, recognize its strong and weak characteristics, make a comparison with similar countries, note the biggest blockades in ICT penetration, and point out necessity of further researches.

Key words. ICT investments, ICT metrics, National Readiness Index, e-Readiness, ICT development index, Friedman's, Pearson's, Spearman's testing.

1. Introduction

There is no doubt that ICT play a key role of enablers of economic change and progress and development enhancing economic growth and improving living standard in many ways. ICT have an impact on government efficiency, transparency and better communication and services with and to the citizens. ICT is a driver of productivity and improved services quality in the public sector. Also, the effective use of ICT by companies is a critical success factor for their innovation, competitiveness and growth. Because of that, the ICT industry and application is essential for each country, and a part of a very important industrial sector in

itself. It is obvious that investments in new ICT are growing and pushing up productivity, but is necessary to do it in correct way. The question today is not - whether ICT but how and how much ICT applications and what to do to create a favorable environment to be able to use the possibilities of ICT. Many mistakes are made in practice in deciding about ICT. Because of that, investments in ICT are very big business risk.

Therefore, ICT is potential engine and the infrastructure of each society's growth, both on national and on individual company's level. The continued investment into ICT is very high and growing. The ICT market importance and structure is reflected through the WEF (World Economic Forum), OECD Organization for Economic Co-operation and Development), WITSA (World IT Service Alliance), IDC, Gartner, EITO (European IT Observer) and other. Namely, the WITSA estimation predicts the total ICT investment worldwide to reach 4.000 billion \$ this year [15]. There are concrete sources on segments and structure of this market to be found in literature, such as [9, 11, 12].

However, there are many warnings that (high) investment into ICT is not in itself a guarantee of automatic business effects. This statement may be applied both to countries' and individual business systems. For that reason, serious research on the effects of such investments are being implemented on various levels – groups of countries, regions, individual countries, the so called aggregated analyses, as well as research on such effects on the level of direct business systems. It is the objective of this study to establish the position

of the Republic of Croatia in that respect as compared to other countries, and to try to identify the actions to be undertaken in order to make such investments more efficient. Croatia approximately invests 2.200.000.000 \$ per year into ICT, but so far there is no relevant research as to the relation between the investment and the business effects on the aggregated level. It is our plan to provide an initial contribution to such research with this article. We have engaged our efforts as follows:

1. We have identified and analyzed sources on the ICT investment amounts both globally and in Croatia.
2. Upon identification and examination of literature, we have selected relevant studies and articles dealing with ICT investment effects at the so-called aggregated levels. We have researched the nature and character of such sources, especially in terms of individual country capability to exploit the ICT potentials.
3. Using various sources, we have collected the data regarding Croatia, and which are relevant in determining Croatia's position in using such opportunities. We have positioned Croatia in relation to other countries.
4. We have also conducted concrete analyses on improvements in Croatia in order to stimulate the ICT investment effects.
5. We have opened the door to further research in the field.

2. Literature survey

2.1. Levels of Observation of the ICT Investment Effects

Establishing the measure to which ICT contributes to society's business success is a very complex problem. Many studies and research projects have been conducted in search of the answer. For the aggregated level, good sources include [5, 6, 11, 12], while for individual country level may be [8,13, 14].

As it is the purpose of this study to position Croatia on the global scale in the ICT potential exploitation and to propose necessary improvements, the review and the analysis of literature for the aggregated level are given in the text below.

2.2. Identification of Aggregated Research

2.2.1. WEF - The Network Readiness Index

In order to assess country's readiness in using the ICT potential, the World Economic Forum uses the Network Readiness Index (NRI), a metric developed at Harvard University [2]. This metric presupposes that the ICT potential use in a country is a function of 3 groups of factors: 1. Environment development level, 2. ICT readiness level and 3. ICT usage level.

1. **Environment** means market, political & regulatory and infrastructure environment. There are 20 individual indicators that measure the three dimensions of environment.
2. **Readiness** is composed of individual, business and government readiness to use ICT. There are 18 individual indicators that measure the three dimensions of readiness.
3. **Usage** is composed of individual, business and government usage of ICT. There are nine individual indicators that measure the three dimensions of usage by the various stakeholders.

Therefore, the NRI metric is being generated on the basis of the 3 said groups of major indicators, each having 3 sub-groups of indicators, or 9 in total. The number of indicators in the sub-groups differs, but the NRI is to establish 68 indicators in total. The NRI structure is presented in the Figure 1.

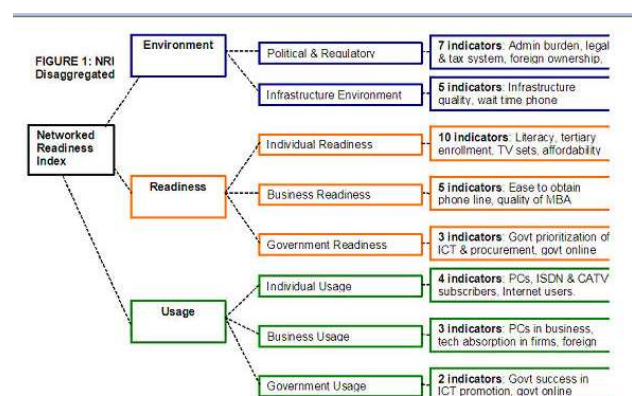


Figure 1. The NRI Structure [2]

WEF uses this metric in their annual report, the last of which was published in 2008 [2] and included 134 countries, Croatia among them. The NRI usage objectives are as follows:

- Unique method of the reached ICT level measurement in a country;
- Method of measurement of complex relation development level among the environment, readiness and usage factors impacting ICT;
- Provide for comparison among the countries;
- Identification of advantages and disadvantages of a country in relation to the ICT potential and
- Provide a basis for creating a more responsible relation of decision makers on ICT in a country.

2.2.2. Economic Intelligence Unit Approach

2.2.2.1. EIU E-Readiness

The e-readiness index is another metric similar in its usage to the NRI-u [5]. It presupposes that the higher the connectivity level in a country, the higher their economic effect shall be. The system comprises approximately 100 indicators of states, classified into 6 different groups: Connectivity and technology, Business environment, Social and cultural environment, Legal environment, Government policy and vision, and Consumer and business adoption.

E-readiness implies the ability to use ICT in a country in order to achieve faster economic and social development. Because what appears at the macro level can hide wide heterogeneity among organizations (educational institutions, government departments, etc.) local areas (cities, towns, etc.) individuals (female, individuals with disabilities, etc.) in digital access, at the micro level more detailed benchmarking is suggested to compute sub-measures for networking, applications, web-accessibility and readiness.

E-readiness can also be used to track the global digital divide, i.e. the gap between countries that have access to ICT and those that do not (mainly because of differences in income, education, etc.). It is constructed primarily to

measure how ICT is actually put to work for development.

Part of the system structure has been presented in the Table 1.

Table 1. Part of the e-readiness index

<i>Impact Area</i>	<i>Metrics</i>
Connectivity and technology (W-Weight = 20%)	broadband penetration broadband affordability mobile-phone penetration Internet penetration PC penetration Wi-Fi hotspot penetration Internet security Electronic ID
Business environment (W = 15 %)	Political environment Macroeconomic environment Market opportunities Policy toward private enterprise Foreign investment policy Foreign trade and exchange regimes Tax regime Financing Labour market

The system has been applied in assessment and classification of 69 countries, Croatia not included.

2.2.2.2. EIU – ICT Development Index

It is a common belief in scientific and economic circles that Europe is less capable of good exploitation of high technology potential as for example the USA. Although the EU countries have invested about 1,9 trillion € into ICT in the last 5 years, with their annual growth of 19% is still lagging behind the USA. For the purposes of a more in-depth research of this problem, the EU also applies the ICT infrastructure index in combination with the ICT enable index, which results in an indicator of country’s capability to use the ICT potential [6]. The ICT development matrix can be derived by application of this system which is

then used for comparison among the countries. This approach was used in researching 60 EU and non-EU countries. The ICT development matrix is presented in the Figure 2.

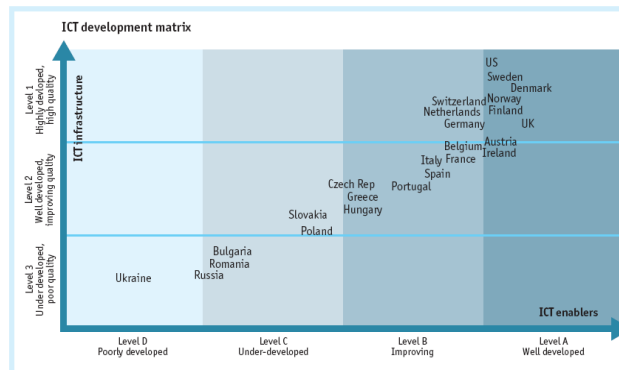


Figure 2. The ICT development matrix [5]

This study provides a series of conclusions. It also claims that there is no economic growth without the ICT investments; however, the main obstacles towards more significant effects range among:

- Inadequate realization that positive environment/ambient needs to be developed for the ICT potential use accompanied with inadequate efforts
- Lack of ICT know-how in senior management
- Business and ICT executives not working together effectively
- Inability to manage and harness data resources effectively
- Employee resistance to change.

2.3. Review of Scientific Literature

There are many scientific works dealing with research of relation between the ICT investment and the resulting effects on aggregated level. For example, the studies by E. Shiel, K. Kreamer and J. Dedrick also presuppose ICT to be a major economic growth engine, but that some countries use the technology more successfully than others. It particularly refers to developing countries that as a rule have no knowledge in exploiting the ICT potentials [14].

S. Dewan and K. Kraemer’s study [3] is based on the research conducted in 36 countries. The

ICT importance was observed for each country through the Intercountry production function $Q = f(IT, K, L ; i, t)$, where for Country $i = 1, 2, \dots, N$ in Year $t = 1, 2, \dots, T$, the output Q is annual GDP, and the inputs are: IT capital, stock IT, non-IT capital stock K , and annual labour hours employed L . The impact of the ICT on the productivity growth and employment increase could be analyzed (the relation between the ICT investment and the GNP trends). The results were obtained for all countries under consideration, both the developed and developing countries. It was again concluded that there is a group of countries which have a leading knowledge of transferring their ICT investments into economic effects, as opposed to a group of countries which are not as capable. Unfortunately, the largest group is made of completely unsuccessful countries, meaning that the so-called ICT productivity paradox is an international phenomenon.

The study conducted at the Institute for Operations Research and the Management Sciences [3], also shows that the investments in information technology throughout the economy has been a source of widespread productivity growth in the United States and in other developed countries, while at the same time, the largest group of world countries still do not know how to use this potential. Shish, Kraemer and Dedrick reached the same conclusion - productivity benefits through ICT are not yet significant in developing countries [14].

The study [4] made for 40 countries reflects similar results. It is again concluded that apart from the usual factors such as ICT contributions, number of Internet connections etc., the environmental factors are decisive in successful ICT implementation in a country. It is the basic reason that the digital gap exists. The last K. Kraemera and J. Dedrick research [9], agrees with such a conclusion.

2.4. Conclusions Research based on Literature Analysis

There are many sources in world literature which deal with the relation between the ICT investment and aggregated effects. By examination of the current literature, we have

come across a series of works studying the amount and impact of the ICT investment to certain national economies, such as [1, 8, 13]. Analyzing those works, we have also reached the previously mentioned conclusion – the ICT investment effects are directly dependent on the environmental development level in which it functions. We have reached the following conclusions:

1. There is a generally accepted belief in literature that the ICT investment may result in economic effects on national level. However, there are no guarantees that large investments shall automatically yield positive impacts. Some countries are more successful, some only partially, while other countries are not at all. Therefore, the ICT investment amount is just one of the success factors, the more important being the environmental factor.
2. There are several ways to categorize country's success level in ICT exploitation, mostly by the use of metrics:
 - NRI
 - E-readiness index
 - Multifactor productivity (MFP)
 - Value chain analysis and
 - Statistical and empirical analyses and so on.

The application of these metrics, the order of countries' success in using the ICT potential may be made on global scale.

3. In order to affect the ICT diffusion rate and effects in a country, in its economy and the public sector, the adequate relation towards the ICT should constantly be developed. There are many implementation barriers in such diffusion which do not belong to the ICT. The statement „Don't blame ICT“ is very conveniently applied, as the main causes for obstacles are in the government (im)maturity, national economy, legal system etc. therefore, there should be an adequate ICT policy and ICT strategies on the national level, and incentive measures should be applied. These are the basic catalyzers of the diffusion process, while the decision makers should be aware of their role and responsibility. Continued

and persistent development of positive environment for the ICT penetration into the national economy and the public sector, along with the ICT industry maturity, are the basic presumptions of positive effects.

3. Positioning Croatia in ICT Potential Exploitation Know-How

3.1. Characteristics of Investment into ICT in Croatia

The analyzed literature as referred to in the section 2 contains only a part of the parameters required for establishment of Croatia's position in the ICT potential exploitation. Consequently, more serious research of this phenomenon is yet to ensue, with the purpose of this study being to point to such opportunities. Characteristics of a reached level of ICT usage in Croatia may be derived from the following facts:

- Total investments into the ICT in Croatia amount to 2,200,000,000 €, or the 8 % of the gross social product.
- Almost all 120 000 economic entities implement ICT, but the majority of its usage is located in 1% of large business systems, and only 4% of medium companies.
- The state is both a large investor and user of the ICT.
- ICT industry consists of 1650 of market oriented companies employing about 24000 ICT workers, with another 8000 working at the user side.
- The relative number of ICT employees in Croatia as compared to the total number of employed persons is approximately 1.5 to 5 times lower than in other countries in the region.
- The added value realized in Croatia through the ICT is 4 to 10 times lower than in other countries in the region [7].

It is important to list these parameters in order to understand the significance of positioning Croatia in relation to other countries and the opportunities to transform the ICT into business value in Croatia. Moreover, examination of these parameters would lead to a better understanding as what to do to

improve the current state. The mentioned studies provide no answers to this question. In conclusion, where is Croatia's place in the context and what should be done to improve the current state?

3.2. Croatia and ICT Potential Metrics

Among the 134 countries under consideration, the analysis conducted by the World Economic Forum (WEF) [2] also lists data for Croatia based on the NRI metric used by the WEF, Croatia is positioned at 49th place. Some of the results which were used as a base for determination of the position have been presented in the Table 2.

Table 2. Some results of Croatian position using NRI index

Component	Rank	Subcomponent	Rank
Environment component	49	Market environment	54
		Political and regulatory environment	67
		Infrastructure environment	46
Readiness component	47	Individual readiness	41
		Business readiness	46
		Government readiness	56
Usage component	49	Individual usage	42
		Business usage	57
		Government usage	75

Croatia was not included in the research applying the e-readiness metric, thus its position was never established. Croatia was neither included in the research conducted by the EIU [5], meaning that there is no accurate positioning of Croatia according to this metric either. However, we believe that the approach may be used to make an approximation of Croatia's position per 4 success leagues and 3 levels of capability in using the ICT. It may be derived by analogy that Croatia most probably belongs to the C league (Under-developed,

Figure 2) along with exp. Slovakia, Poland, Bulgaria and Romania, and to the 2nd level (Well developed, improving quality). However, this should be taken only as an approximation and it would be very useful to include Croatia in the following analysis.

4. Research on Required Improvements in Capability to Use ICT Potential in Croatia

4.1. Croatia's Advantages and Weaknesses

By combining several sources and through further in-depth analysis of individual NRI indexes, Croatia's advantages and disadvantages may be established for the purposes of environmental development for the ICT potential usage. The Table 3 presents variables of 10 major advantages and disadvantages in the NRI structure.

Table 3. Croatia's major advantages and disadvantages in the NRI structure

Strengths

Variable Name	Rank
Residential telephone	4
Computer	13
Mobile telephone sub.	27
Internet bandwidth	29
Quality of education	30
Total tax rate	31
Telephone lines	31
Utility patents	35
Internet users	35
Secure Internet servers	36

Weaknesses

Variable Name	Rank
State of cluster develop.	114
Burden of government reg.	107
Firm-level technology sub.	100
Time to new business	100
Extent and effect of taxation	97
Freedom of the press	96
Judicial independence	94
Local supplier quantity	90
Efficiency of legal framework	88
ICT use and government efficiency	85

It is evident from the table 3 that most advantages are to be found in the technological category, along with the quality of Croatian education. On the other hand, disadvantages are mostly located in the business environment and ICT usage area. This particularly refers to the state of cluster development, burden of government regulation, firm level technology absorption, time extent and effect of taxation, freedom of the press, judicial independence, local supplier quantity, efficiency of legal framework, and ICT use and government efficiency. It may be derived that these blocking areas are the main obstacles in the ICT potential exploitation. Croatia is compared to other countries in the text that follows.

4.2. Comparison of Croatia and Other Countries

NRI is also suitable for comparison between the countries. The Figure 3 for example presents the comparison between Croatia and Austria, Slovenia, Finland and the Czech Republic for the following parameters: total NRI, Environment component, Readiness component and Political and regulatory environment of Croatia and Austria.

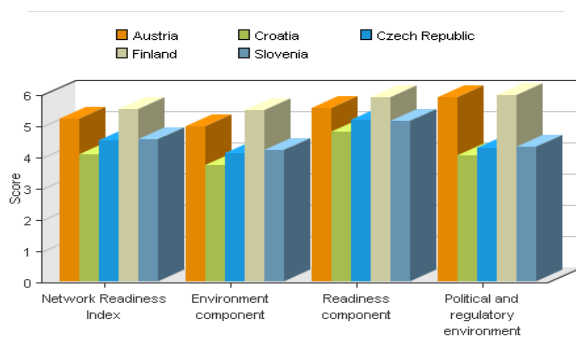


Figure 3. Comparison between Croatia and several countries for individual NRI Components

If 68 indicators for Croatia be compared in ways the NRI is being determined through the same indicators for other countries, such as Slovenia, Austria, Ireland, Czech Republic, Finland and Romania, and if the required regression testing be made, there are many interesting elements to be noticed. The Table 4 presents the Friedman testing results, while the Table 5 presents Pearson correlation results. The Table 6 presents Spearman correlation ranges.

Table 4. Friedman testing results

Variable	Friedman ANOVA ANOVA Chi Sqr. (N = 68, df = 6) = 208,4823 p = 0,00000 Aver. rank r =,50369			
	Average Rank	Sum of Ranks	Mean	Std.Dev.
Rank Croatia	5,779412	393,0000	59,72059	22,70304
Rank Slovenia	4,419118	300,5000	42,13235	21,77216
Rank Austria	2,500000	170,0000	21,54412	17,64106
Rank Ireland	3,176471	216,0000	27,14706	16,18205
Rank Czech Republic	4,470588	304,0000	44,07353	27,70490
Rank Finland	1,860294	126,5000	14,72059	17,83159
Rank Romania	5,794118	394,0000	62,69118	25,40963

Table 5. Pearson correlations between the considered country ranks

Variable	Correlations (World_economic_forum) Marked correlations are significant at p <,05000 N=68						
	Rank Croatia	Rank Slovenia	Rank Austria	Rank Ireland	Rank Czech Republic	Rank Finland	Rank Romania
Rank Croatia	1,00	0,43	-0,04	0,07	0,22	0,07	0,41
Rank Slovenia	0,43	1,00	0,19	0,20	0,24	0,27	0,24
Rank Austria	-0,04	0,19	1,00	0,03	0,30	0,58	-0,16
Rank Ireland	0,07	0,20	0,03	1,00	0,27	-0,04	0,04
Rank Czech Republic	0,22	0,24	0,30	0,27	1,00	0,14	0,21
Rank Finland	0,07	0,27	0,58	-0,04	0,14	1,00	0,10

Table 6. Results of Spearman's testing

Variable	Spearman Rank Order Correlations Marked correlations are significant at p <,05000						
	Rank Croatia	Rank Slovenia	Rank Austria	Rank Ireland	Rank Czech Republic	Rank Finland	Rank Romania
Rank Croatia	1,000000	0,520890	-0,129357	0,074140	0,270088	0,033605	0,461431
Rank Slovenia	0,520890	1,000000	0,080082	0,128069	0,222766	0,151615	0,312406
Rank Austria	0,129357	0,080082	1,000000	0,108896	0,265565	0,213114	0,267164
Rank Ireland	0,074140	0,128069	0,108896	1,000000	0,084620	0,077684	0,004088
Rank Czech Republic	0,270088	0,222766	0,265565	0,084620	1,000000	0,134215	0,274543
Rank Finland	0,033605	0,151615	0,213114	0,077684	0,134215	1,000000	0,045303

Non-parameter Friedman's test shows that among the considered countries there is a significant difference ($p \ll 0.05$) between Croatia and Slovenia, Austria, Ireland, Czech Republic and Finland, while in comparison with Romania the same difference does not exist. The same conclusion may be drawn from the Pearson and Spearman testing.

4.3. Additional In-Depth Research

If further research were undertaken by the regression analysis for the individual NRI variable/category groups, several conclusions may be reached. Such for example, in the Business Environmental category where there are 30 indicators, Croatia is positioned significantly below Slovenia, Ireland, Czech Republic and Finland ($\alpha=0.05$), while the comparison with Romania reveals no difference. The completely same conclusion applies for the ICT readiness category, which is made of 23 indicators, while in the ICT usage category, made of 15 indicators, there are no significant differences between Croatia and Romania or Czech Republic.

Due to the limitations of this study, there is no possibility for further presentations of other results obtained by this research. Very interesting are comparisons between Croatia and other countries for each of the 68 variables, or the comparison of certain groups of variables. These results even more reflect the need to invest efforts in Croatia for the environmental development which would favor the ICT and in more efficient use of its potential.

It would also be very interesting to conduct research on relation between the ICT investment and GDP levels, or on relation between the ICT investment and the NRI, and to make a series of other possible analyses, which would most certainly increase the awareness of the tight connection between the domains considered in this article.

5. Conclusion

There is a general consensus in the relevant literature that ICT is of crucial importance for every country's development. However, the expectations that the mere investment into the ICT would automatically result in significant

business effects have proven to be unfounded. Continuous development of the environment in which ICT is being applied is also of essential importance. There are several types of metrics applied for positioning a country on a global scale of success in the ICT potential exploitation. Unfortunately, most of the studies conducted by the competent global (OECD, WEF, EIU) do not include Croatia, and the effort should be made in the future to achieve such results. Only the WEF, as an exception, comprises the analysis for Croatia. The combination of data found in the WEF annual report and other sources (World Bank, Gartner, IDC etc.) was used for this study in order to make a research for Croatia. It is shown that in terms of the ICT investment, Croatia belongs to a more developed group of countries. However, the obstacles to a faster diffusion of the ICT implementation in Croatia are not technological in nature, but the insufficiently developed environment in view of business ambient, capability level to use its potential and means of this technology utilization.

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Literature

[1] Cette, G.; Mairesse, J.; Kocoglu, Y.: **The Contribution of Information and Communication Technology to French Economy Growth**. Banque de France Bulletin Digest, No. 90, June 2001. pp. 23-37.

[2] Dutta, S.; Mia, I.: **The Global Information Technology Report 2008 – 2009**. World Economic Forum, http://www.insead.edu/v1/wef/mail/fullreport/pdfreader_frame08.html, Accessed 15. May 2009.

- [3] Dewan, S.; Kraemer, K.: **Information Technology and Productivity: Evidence from Country-Level Data.** Management Science, Vol. 46, April 2000. pp. 548-562.
- [4] Dwen, S.; Ganley, D.; Kraemer, K.: **Across the Digital Divide: A Cross-Country Mult_Technology Analysis of the Determinants of IT Penetration.** AIS – Journal of the Association for Information Systems, Vol. 6 No. 12, December 2005. pp. 409-432.
- [5] EIU: **The 2008 e-readiness ranking – Raising the bar.** Economist Intelligence Unit, 2008. Available at <http://a330.g.akamai.net/7/330>, Accessed: 15. January 2009
- [6] EIU: **Reaping the benefits of ICT – Europe,s productivity challenge.** Economist Intelligence Unit, 2005. Available at http://graphics.eiu.com/files/ad_pdfs/Ereadines.s. Accessed: 1. February 2007.
- [7] IDC: **Analiza hrvatske ICT industrije 1999 – 2004.** Hrvatska udruga poslodavaca, Studija, Zagreb, April 2006. pp 1-16.
- [8] Kegels, Ch.; Overbeke, M.; Zandweghe, W.: **ICT Contribution to Economic Performance in Belgium: preliminary evidence.** Belgian Federal Planning Bureau, April 2002. pp. 1-87.
- [9] Kraemer, K.; Dedrick J.: **Determinantes of Country-Level Investment in Information Technology.** Management Science, Vol. 53, No. 3, March 2007. pp. 521–528.
- [10] OECD: **The ICT productivity Paradox: Insights from Micro Data.** OECD Economic Studies No. 38. 2004. pp. 1-112.
- [11] OECD: **Information Technology Outlook 2008.** OECD Publications Service, Paris, France, 2008. Available at http://www.oecd.org/document/20/0,3343,en_2649. Accessed: 5.March 2009.
- [12] OECD: **ICT and Economic Growth, Evidence from OECD Contries, Industries and Firms.** Organisation for Economic Co-operation and Development, OECD Publications Service, Paris, France, 2006. pp. 1-62.
- [13] Piatkowski, M.: **The Contibution of ICT Investment to Economic Growth and Labor Productivity in Poland.** Tiger Working Paper Series, No. 43, Warsaw, July 2003. pp. 1-23.
- [14] Shih, E.; Kraemer, K.; Dedrick, J.: **IT Difusion in Developing Counties.** Communications of the ACM, Vol. 51 No. 2, February 2008. pp. 43-48.
- [15] WITSA: **Digital Planet 2006.** The Global Information Economy, World Information Technology and Services, WITSA Publication Service, Arlington, USA, 2006. pp. 1-100.