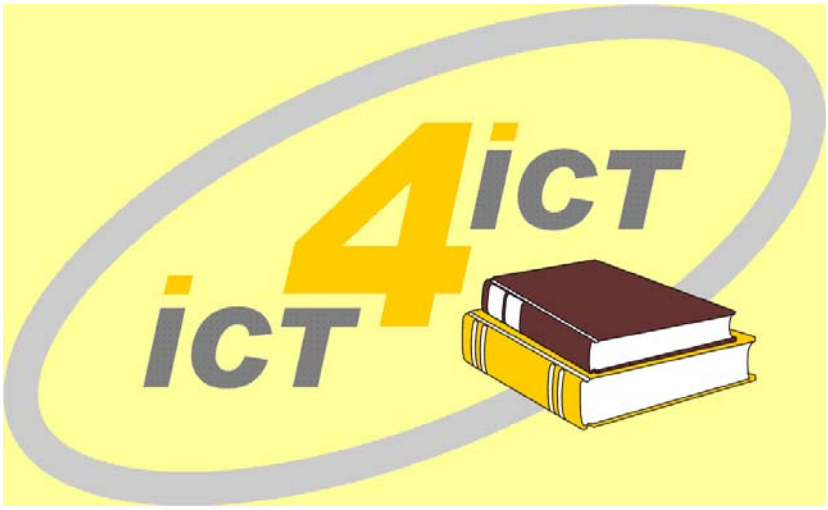
ICT4ICT

ICT Knowledge for ICT Diffusion

Information and Communication Division
Department of Information Technology and Media
Mid Sweden University



Sundsvall
May 2005

Content

Participants

IKS Division, ITM Department, Mid Sweden University, Sundsvall, Sweden

Iskra Popova (iskra.popova@miun.se), Rolf Dalin (rolf.dalin@miun.se), Oliver Popov (oliver.popov@miun.se), Stefan Pettersson, (stefan.petersson@miun.se), Karl W. Sandberg (karl.sandberg@miun.se)

Central and Eastern European Networking Association (CEENet), Vienna, Austria

Jacek Gajewski (Gajewski@ceenet.org), Oliver Popov (popov@ceenet.org)

Automation Department, Yerevan State University, Yerevan, Armenia

Tigran Zargaryan (tigran@ysu.am)

Institute of Informatics, Saints Cyril and Methodius University, Skopje, Macedonia

Biljana Stojcevska (biljanas@ii.edu.mk), Nevena Ackovska (nevena@ii.edu.mk)

Saint Clement Ohridski National and University Library, Skopje, Macedonia

Stana Jankoska (stana@nubsk.edu.mk)

Macedonian Academy of Sciences and Arts (MASA), Skopje, Macedonia

Peter Ilievski, Katerina Mladenovska (katemlad@yahoo.com)

Principal researchers

Iskra Popova
Oliver Popov
Rolf Dalin

Acknowledgments

Sincere gratitude to the SPIDER Centre, which made the project and research possible. Many thanks to all the participants from the partner institutions and organizations: Mid Sweden University, CEENet, Yerevan State University, Institute of Informatics, Saint Clement National and University Library, and Macedonian Academy of Sciences and Arts. Last, but not least, the support of the ITM administration is genuinely appreciated. Working in different countries and cultures sometimes requires going an extra mile to generate the necessary effort in order to accomplish the objectives. The enthusiasm of the people involved and the use of ICT made the endeavor challenging.

Presentations

The results of the work on ICT4ICT project were already presented at:

- Macedonian Academy of Arts and Sciences (Lecture given by Iskra Popova in Skopje, May 10th 2005)
- Mid Sweden University (IKS Seminar Series, Sundsvall, May 23, 2005)

The following presentations are expected at:

- Lund University (SPIDER Workshop, Lund, May 30, 2005)
- CEENet (CEENet GA, Warsaw, June 5, 2005)
- Information Technologies in Education Conference (OSI, Yerevan, June 5, 2005)
- NATO ANW: 10th CEENet NTW (CWNS, Ohrid, June 25, 2005)
- eChallenges (EU Conference, Ljubljana, October 20, 2005)

Abstract

The accessibility and the availability of information make the society that uses ICT extensively, transparent, open, economically sustainable, and democratically evolutionary. The intention of the project is to explore the experience with ICT diffusion in the CEE countries, selecting primarily those that have achieved high level of connectivity and ICT use, yet with limited resources and depending heavily upon the knowledge of its people. The lessons learned are to be used in finding the possibilities for facilitating the penetration of the information technology in the countries that have been less successful. Developed countries have grappled the technology to a greater or lesser extent rather early and have had decades to facilitate its diffusion. Unfortunately, the developing countries were the last to introduce this societally enabling and beneficial technology. Despite of the relatively high level of the human development index in most of the Central and Eastern European countries including the former Soviet republics, the degree of connectivity and Internet use demonstrates large discrepancies. Sharing the positive experience and results of some with the CEE countries that are lagging behind with respect to ICT diffusion and possibly reduce the digital divide. One of the goals is to devise a simple model of how to possibly overcome the debilitating ignorance that spans from an ordinary citizen to a high level decision maker, in understanding the width, depth, profoundness, and the power of the ICT in some of the CEE, which are not yet members of the EU. The pilot projects running in two of them will serve as a test bed for investigating how best practices in the CEE region can be used to implement the model developed under different local conditions. The local factors are identified in choosing the strategy for selecting and implementing a suitable model for each of the two countries. The authors believe that the future research will make the model more comprehensive and complete, and will extend its applicability and replicability in other developing regions.

Measuring ICT Diffusion

A Review of the Current Situation with Respect to Central and Eastern European Countries

1. Introduction

In the last thirty years, the developed world is rapidly moving from manufacturing to service industry and economy based on knowledge generation and utilization. In this ongoing process, the Information and Communication Technology has become one of the prerequisites for pervasive and effective knowledge dissemination and implementation that lead to sustainability and progress. ICT goes beyond set of tools for automating existing activities, processes and relationships in order to improve their quantitative attributes; it creates structural, organizational and content transformations that distinctly lead to new qualitative categories. The dynamics of ICT has indeed become one of the major driving forces for productivity, competitiveness, collaboration, and superposition of resources on both national and international level, which brings overall prosperity for countries and regions.

The developed countries have immensely invested in all aspects of the ICT infrastructure for the last forty years. The Governments of these countries have designed effective policies to facilitate the use of ICT in order to stimulate economic development. Statistics underpin policies; therefore numerable quantitative and qualitative indicators are defined to meet the information needs of the policymakers. They include metrics for measuring ICT penetration and for benchmarking countries. Many action plans based upon their values have been devised and carried out in order to boost the spread of the technology. Although there is still discrepancy in the penetration of the new technologies, such as broadband and Internet usage, these countries have been rather successful in adopting ICT.

The developing countries, including those from Central and Eastern Europe, were the last to introduce this enabling and beneficial technology. These countries are quite heterogeneous group and therefore there are major differences with respect to the conception and proliferation phases of ICT.

2. CEE Countries and the CEENet

After the remarkable political changes in 1989 the term „Central and Eastern Europe" became more than a mere geographical denomination of some region on the earth. It began standing collectively, although not exclusively, for the former communist countries, mostly those that either were part or under the umbrella of FSU.

The Iron Curtain has been opaque to any kind of information exchange in the past. Much of the ICT, mostly represented by the computer technology was shielded effectively from this region. With the fall of the Berlin wall, the CEE countries were undergoing a process of genuine political, economic and social transformation. In some cases there was a need to redefine territorial and cultural boundaries. The economic policy focused on social, economic and labor problems, as results of the old system collapse, and the necessity to dismantle inefficient and unproductive industries. Consequently, very little attention was paid to promote forward-looking policies in information and communications technology.

The CEE countries always had highly qualified scientists and technicians. They set up regional networks for the research institutions even under the most restricted and severe circumstances, building upon X.25 or UUCP and relying to a large extent on their own ingenuity. International connectivity was the most precious resource available only through makeshift communication trails rather than on communication highways. Only after Poland was connected to EARN in 1990, soon followed by Hungary and Czechoslovakia, international networking became more widely accessible, to the effect of further stimulating the development. Many others to follow established their EARN connections either via Austria or other geographically close developed country.

In order to enhance the framework of mutual collaboration and to ensure the most effective way of using the available national and international resources, the academic and research networks from 13 countries have founded the CEENet organization in Vienna in February 1994, [1]. Having the traditional cultural ties to the CEE countries, dating back from the Habsburg Empire, it was obvious and natural Austria to host and foster the foundation of CEENet. The member organizations were appointed by their official national authorities and authorized to represent national interests in regards to academic and research networking. In the years to come CEENet grew to include 25 countries (there were periods with even 28 members) such as Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Serbia and Monte Negro, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

The connection to the Internet and the spread of the ICT contributed to the accelerated growth in a number of CEE countries since 1994, which helped reduce the differences from the western European countries. However, many others lagged behind. This was perhaps due to divergent rates of ICT investments, but also due to the lack of communication infrastructure that can adopt and support the new technologies.

In the rest of this work different approaches for measuring ICT penetration or ICT readiness of the countries are described and the data concerning the countries members of the CEENet organization are presented.

3. Taxonomy of Different Approaches

Numerous attempts have been made to identify relevant factors that determine ICT diffusion and to calculate an index to be used for comparing the competitiveness in this area among different countries. Different approaches use different definitions of ICT and are interested in different aspects of the information society. The determinants taken into account and the methodology used mainly depend on the organization in which they were developed and the objectives and goals of the survey produced.

The following text presents several of these approaches and the results relevant for the CEE Countries.

3.1 CEENet Database

The CEENet organization has early recognized the importance of collecting relevant data that can be useful for the managers and designers of future networks. Therefore, besides its main activities a project for creating a database of telecommunication conditions in its member countries has been started. It was planned that the database consists of two parts. The first one should be a general overview of basic telecommunication data (in tabular form with the possibility to look into the individual country's record), and the second one a set of more detailed comparative studies of various

topics like e.g. telecommunication laws or DNS assignment policy. Unfortunately, only the very first phase of the project was completed. The data collected were the GDP per capita (Gross National Product), the number of hosts and Internet users (total and per 10000

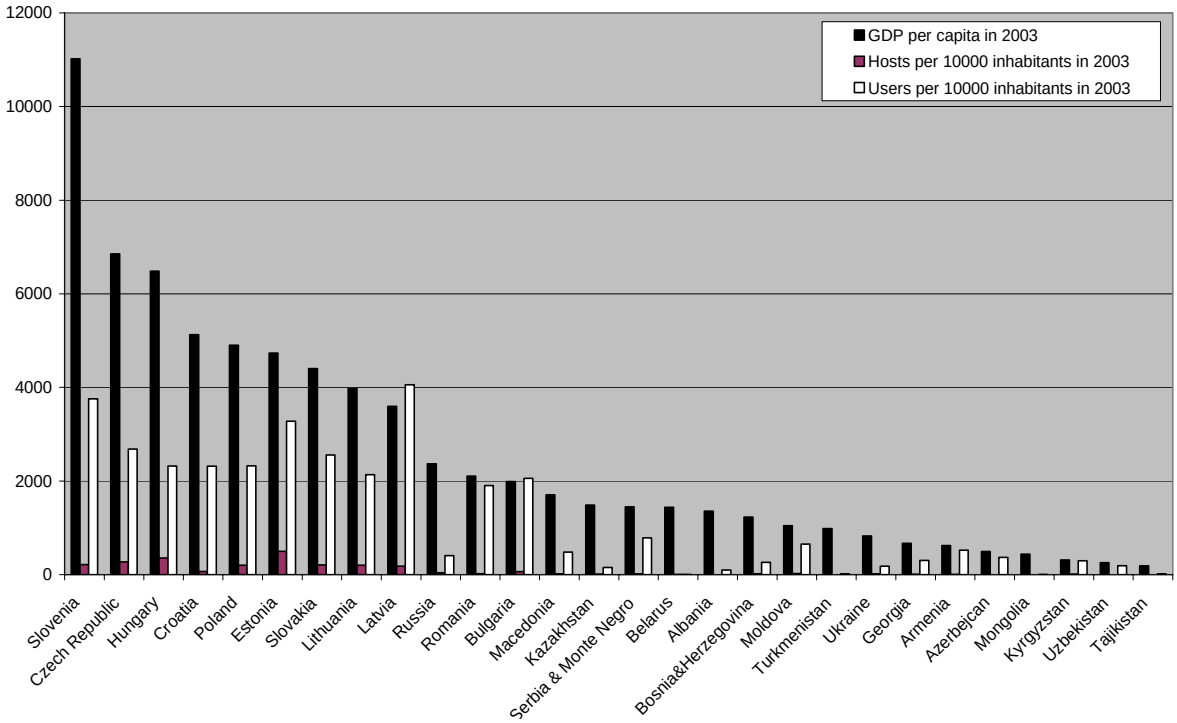


Figure 1: GDP , Hosts and Internet Users

inhabitants), the number of backbone ISPs, the typical backbone speed (in Mbps) and the total international connectivity (in Mbps). However, because of the problems with continuation of the project the data that exist in the database have not been updated in the last couple of years. Therefore, we present here the number of hosts and the Internet users together with the GDP per capita for the year 2003. These data re taken from the ITU database and they are presented on Figure 1 starting with the country with the highest GDP.

3.2 UNDP Human Development Index

A broader conception of human development is used in the United Nations Development Program (UNDP) Report on Human Development, published annually since 1992, [1]. The concept of development measured includes human autonomy and breadth of choice, equity and sustainability, empowerment as well as productivity. UNDP computes the Human Development Index (HDI) as a function of productivity, health and education. Although there are major disparities among the countries, this index still shows less variance among nations then the pure GDP per capita measure.

HDI is not an index that measures ICT penetration or ICT readiness. It certainly has influence over the ICT diffusion in the country, yet it is at the same time influenced by it. Therefore, when analyzing a group of countries, like the CEE countries, it is always beneficial to use it as a parameter showing the position of a particular country with respect to economic productivity, health, education, democracy, and quality of live.

3.3 ITU Digital Access Index

The Digital Access Index (DAI) is an integral part of the 2003 World Telecommunication Development Report: Access Indicators for the Information Society, created by the International Telecommunication Union, [2]. It was prepared for the first phase of the World Summit on the Information Society. Almost all other existing indices for ranking countries in relation to their ICT capabilities concentrate primarily on developed economies. Many of them include variables that are hard to measure quantitatively and are usually subject to interpretation by the group creating the index. ITU has tried to provide a transparent and globally measurable way of tracking progress towards improving access to ICT. Hence, it offers a global approach and concentrate on trends that can be measured to a comparable extent in every country.

The DAI is built around four fundamental factors that impact country's ability to access ICT namely: infrastructure, affordability, knowledge and quality. Until now, limited infrastructure has often been regarded as the main barrier to bridging the digital divide. ITU research indicates that affordability and education are equally important factors. A fifth factor, the actual usage of ICT is the key in matching the theory of the index with the reality in the country. The intention in defining DAI is to measure the overall ability of individuals in a country to access the ICT.

The aforementioned factors are called categories in the DAI terminology. Each category is described with a single or two variables. A maximum value or the so-called "goalpost" is defined for every variable. In addition whenever more then one variable is included in a category it is given a certain weight. The sum of the weights of all variables within a category equals to 1. Category indicators are calculated, as an average of the variables within the category and DAI is the average of all categories. Table 1 presents

Category	Variable	Variable description	Goal-post	Weight	Category Index
Infrastructure	FT	Fixed telephone subscribers per 100 inhabitants	60	1/2	1/2xFT/60 + 1/2xMT/100
	MT	Mobile cellular subscribers per 100 inhabitants	100	1/2	
Affordability	IA	Internet access price (as % of Gross National Income)	0	1	(100-IA)/100
Knowledge	AL	Adult literacy	100	2/3	2/3xAL/100 + 1/3xSE/100
	SE	Enrolment in schools	100	1/3	
Quality	IB	International Internet bandwidth per capita (bits/sec)	10000	1/2	1/2xIB/10000 + 1/2xBS/30
	BS	Broadband subscribers per 100 inhabitants	30	1/2	
Usage	IU	Internet users per 100 inhabitants	85	1	IA/85

Table 1: Category Indexes for the DAI

different categories, variables, goal-posts and weights and the formulas for calculating category indexes.

Based on DAI index, the countries' economies around the world are categorized as high-access (0.7 and above), upper access (05 – 0.69), middle access (03 – 0.49) and low access (below 0.29). The only CEE country that is ranked as high access economy is Slovenia with index 0.72; nine are classified as the upper access economies while the rest of them belong to the middle access. There are three of them that have not been included in the ranking.

In the reports on DAI, [3] most of the data for the variables is widely available and can be fetched from the national statistics offices or from UN databases. The accuracy of some of them was rather difficult to verify and validate.

Figure 2 presents the Digital Access Index together with the Human Development Index for all CEE countries.

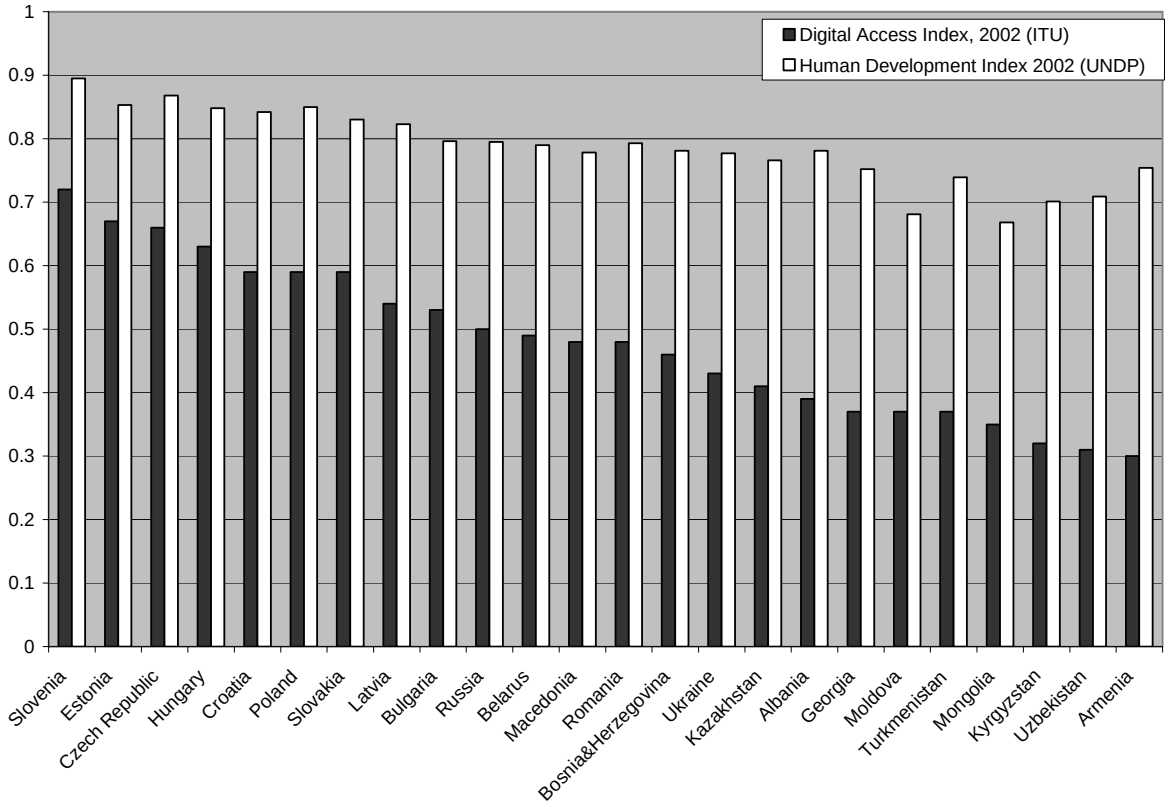


Figure 2: HDI and DAI

3.4 OECD Work on ICT Indicators

In the field of ICT indicators the OECD (Organization for Economic Co-operation and Development) have been discussing standards since 1997, mainly through the WPIIS (Working Party on Indicators for the Information Society). Aiming to assist developing countries in devising a strategy for ICT indicator measurement their approach is first to look at a set of basic indicators that will reveal the level of the country's ICT readiness, [4]. In case a satisfactory value, the next step would be measuring the intensity of ICT use. Three groups of readiness indicators are proposed:

1. Infrastructure
2. Imports and exports of ICT goods
3. Educational attainment of the population

The first group includes the following indicators: main fixed telephone subscribers, total telephone subscribers, cellular phone subscribers, number of personal computers, number of Internet users, monthly telephone subscription costs (residential and cellular and business), number of Internet hosts, Internet subscribers and web sites and the Internet access cost.

The second set consists of the value of imports and exports of ICT goods together with the value of total imports and exports. A detailed description of the manufacturing and services industries that comprise the ICT sector is given in [4].

The educational attainment is assessed through measuring the proportion of the population with completed secondary education, tertiary education, enrolment ratios in primary, secondary and tertiary education, proportion of enrolments in higher education in ICT field of study (as a % of total number of enrolments and as % of the corresponding age group) and the proportion of graduates in higher education in an ICT field of study (as % of total number of graduates and as a % of the corresponding age group).

Once the basic conditions for using ICT are fulfilled, the intensity of ICT is suggested to be gauged by looking at supply side indicators that assess the contribution the ICT producing sector makes to the economy. The indicators suggested are: the use of ICT by household, individuals, businesses and ICT related patents.

Statistics ranking OECD countries with respect to different indicators is available for its member countries and several others, [5]. Only four of the CEE countries (Check Republic, Hungary, Slovakia and Poland) are members of the association. This is the reason that the statistics of these indicators are not graphically presented.

3.5 The focus of EU

The European Union commission initiated the e-Europe program in December 1999. The aim was to guarantee that the EU would benefit from the advantages of digital technology and that the emerging information society would be useful to all European citizens. The e-Europe initiative listed ten different topics, [6], grouped around four key objectives as follows:

A cheaper, faster, and more secure Internet

Cheaper and faster Internet connections;

Faster Internet for researchers and students;

Secure network and smart cards.

Investing in people and skills

European youth into the digital age;

Working in the knowledge-based economy;

Participation for all in the knowledge-based economy.

Stimulate the use of the Internet

Accelerating e-commerce;

Government on-line;

Digital content for global networks;

Intelligent transport systems.

In order to monitor the implementation of the e-Europe action plan, 23 indicators, all quantitative in nature have been defined. Besides those similar to the ones used by ITU (number of fixed telephones, number of mobile phones, number of Internet users, etc), more sophisticated indicators are defined. Examples for some of them are:

- Percentage of population using the Internet regularly;
- Percentage of households connected to the Internet;
- Number of secure servers per million inhabitants;
- Number of computers per 100 students in primary, secondary and tertiary education;
- Percentage of workforce with basic IT training;
- Percentage of workforce involved in teleworking;
- Percentage of firms buying and selling via Internet.

Besides the EU countries, the monitoring carried out in 2003, included 10 out of 13 CEE country candidates: Bulgaria, Check Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia. The analyses, [7], showed that there were a wide range of factors influencing the development of the pathways towards their Information Societies. One of the most important factors for developing the ICT infrastructure is the GDP per capita and there is a considerable variation for these countries. For example it is highest in Slovenia (76% of the EU15[1] average) and the lowest in Bulgaria and Romania (30% of the EU15 average). On the other side the cost of a PC is a major inhibitor for household Internet access. In Bulgaria, Lithuania, Latvia and Romania, the cost of a PC is twice the average monthly salary. The three countries that are in the best performing positions with respect to most of the indicators measured are Check Republic, followed by Estonia and Slovenia. However, most countries are the top performers for some aspects of their Information Society, for example: computer and Internet penetration in schools in health clinics in Hungary, Internet penetration in secondary schools in Romania, for some aspects of e-commerce in Poland, for some aspects of ICT in enterprises in Slovakia and for broadband access in Bulgaria, Latvia and Lithuania.

The summary report on the ten CEE countries Information Society benchmarking classifies them into three groups. Three countries are the leaders (Estonia, the Check Republic and Slovenia). They have established appropriate infrastructure and access mechanisms and are starting to be interested in measuring impact of their ICT provision. The second group of countries, Hungary, Latvia, Lithuania, Poland and Slovakia, are making steady progress although at much lower level of achievement. Finally, Bulgaria and Romania are trailing behind and therefore are placed in the third group. It can be assumed that the rest of the CEE countries are either in this third or in some fourth or fifth group that can be created having in consideration only the basic data available for them.

[1] EU15 refers to the 15 EU member state before the enlargement in 2004

Some of the indicators present in the EU statistics and not present in the ITU statistics are shown in Figure 3.

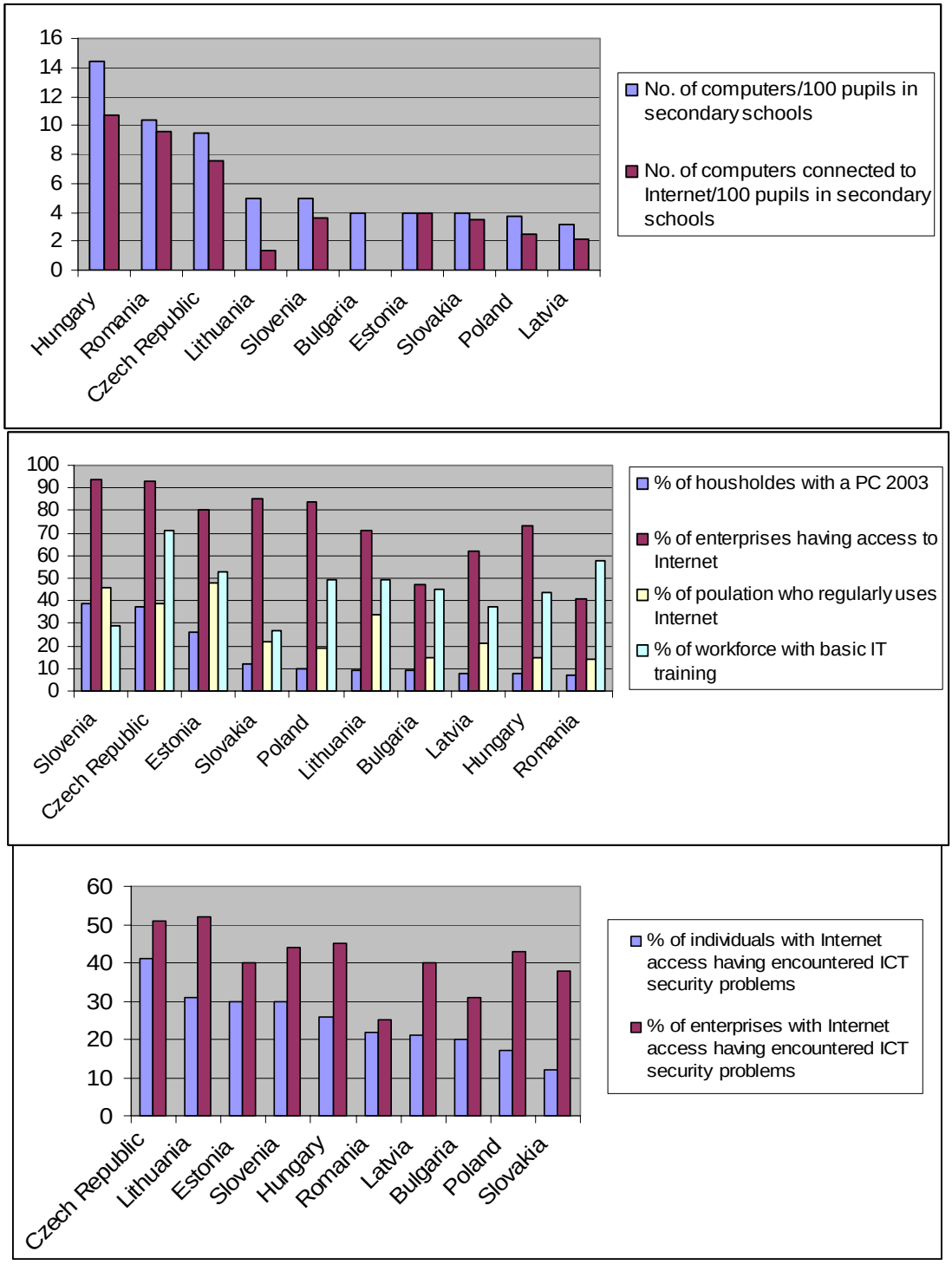


Figure 3: Some Indicators from EU Statistics

3.6 The Networked Readiness Index Report

The Networked Readiness Index (NRI) report has been produced as a result of a research performed by INSEAD business school in collaboration with the World Bank and

World Economic Forum. This was an effort to comprehend better the impact of ICT on the competitiveness of nations, [8]. NRI is defined as the degree of preparation of a nation or community to participate in and benefit from ICT developments. It is assumed that it consists of three components: the environment for ICT provided in the country, the readiness of the key stakeholders (individuals, business and governments) to use ICT, and the usage of ICT. Each of the components is further disaggregated into sub-indexes and variables. Totally 48 variables are used. Most of them are not exactly numerically measurable and are defined by the authors of the methodology.

The NRI framework is presented on Figure 4.

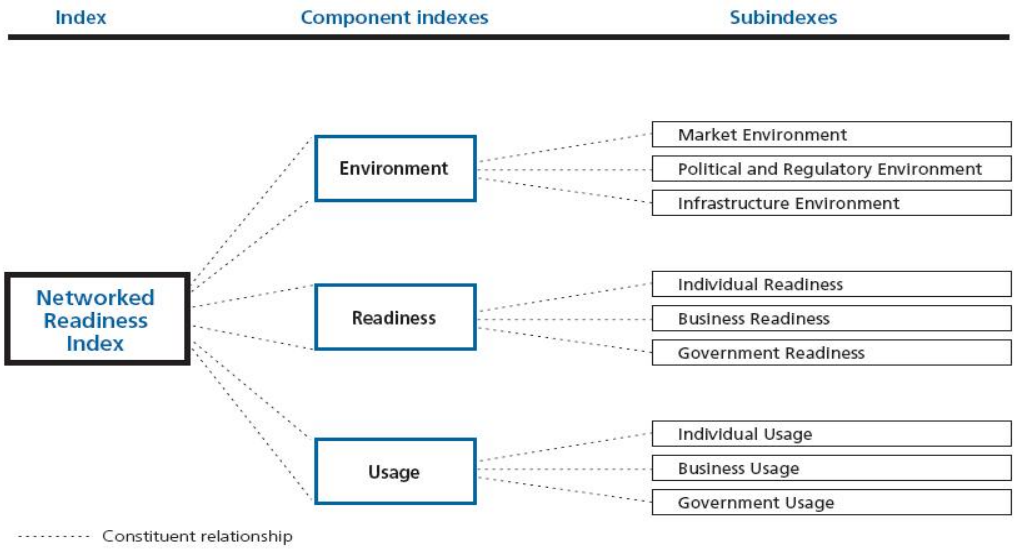


Figure 4: NRI Framework

The study has been conducted three times, starting with 82 countries in the 2001-2002 and ending with 102 countries for the period 2003-2004. Only 15 CEE countries are included in the report (Bulgaria, Croatia, Check Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Russia, Serbia and Montenegro, Slovakia, Slovenia and Ukraine). Figure 5 shows separate sub-indexes and the total NRI index for these countries.

The attempt to explore the relationship between the gross domestic product (GDP) per capita of a country and the total NRI index resulted in a conclusion that Estonia is over performing in its NRI score with respect to its GDP per capita. Another important conclusion in the report with respect to developing countries is the necessity for the country to achieve a threshold or a certain level of ICT readiness before there can be an effective usage of ICT and a consequent impact. A certain critical mass in terms of number of users or the availability of narrowband and broadband services, or of services on-line is essential before this is reflected in the usage metrics.

4. Conclusion

Before the wide spread of the computer networks and the Internet, the communication infrastructure was mainly measured by the number of the telephone subscribers per 100 inhabitants and the number of radio and TV sets per household. However, the information and telecommunication technologies (ICT) have changed dramatically in the last fifteen years. Computers have become smaller and cheaper, mobile

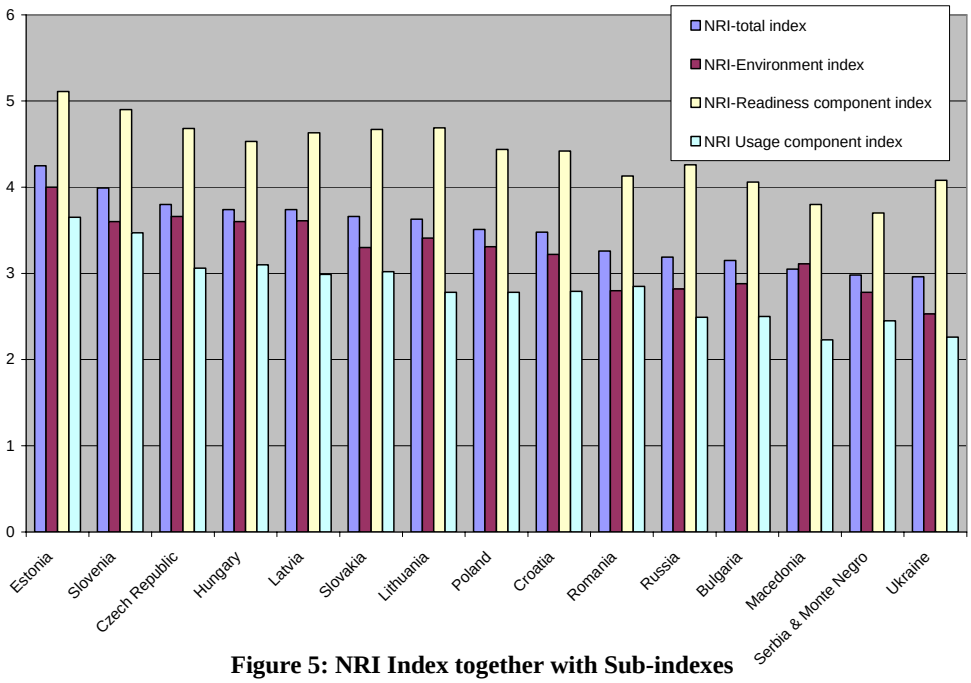


Figure 5: NRI Index together with Sub-indexes

telephones entered into everyday life of ordinary people and a new phenomenon called Internet came to light. With the emergence of the Internet, the most common means for measuring its status in various countries has been through the number of hosts or the number of users.

Internet was not a single innovation, but a cluster of related technologies that must be present together to support adoption decision by the end users. In addition, a certain level of education and training was required for efficient use of the services offered. The Internet cannot work unless there are servers, communication links, software, end user devices, such as all kinds of computers including today's 3G phones, and content to transmit. Therefore, measuring ICT diffusion using a single measurement variable does not capture the richness of the technologies.

Numerous methodologies have been developed to assess the ICT diffusion or the ICT readiness of the countries. Several of them have been presented here together with the data available for the CEE countries. This is just the first step towards achieving some of the objectives in the ICT4ICT project. The work proceeds with the analyses of the data available and development of a model for identifying crucial factors in ICT diffusion. It will be used in selecting CEE countries that have been most successful in implementing, spreading and using the ICT technologies. Their experience will show a road towards helping those that have been less successful.

References:

1. http://www.ceenet.org, accessed Jan.8th 2005
2. *Key Indicators of the Telecommunication/ICT Sector*, Third World Telecommunication/ICT indicators Meeting, Geneva, January 2003
3. *Gauging ICT Potential*, ITU News 10, pp. 6-17/2003

4. Schaaper M., *A Proposal for a Core List of Indicators for ICT Measurement*, UN Conference on Trade and Development, Geneva, 2003

5. http://www.oecd.org/document/23/0,2340,en_2649_37441_33987543_1_1_1_37441,00.html , accessed Jan.8th 2005

6. Sundström J. H, ICT Statistics at the New Millenium – Developing Official Statistics – Measuring the diffusion of ICT and its Impacts, IAOS Satelite Meeting on Statistics for Information Society, Aug. 2001, Tokyo, Japan

7. *Central and Easter Europe Information Society Benchmarks, Summary report*, prepared by a consortium that included University of Sunderland (UK) and Fraunhofer Institute for Systems and Innovation Research (D), 2004

8. Dutta Soumitra, *Global Information Technology Report 2002-2003, Readiness for the networked World*, World Economic Forum/Oxford University Press, 2003

In Search for a Model

An Open Model for ICT Diffusion

1. Introduction

ICT (Information and Communication Technology) commonly denotes the existence and use of a large number of services based on hardware and software systems capable of generating, converting, storing, protecting, processing, transmitting, exchanging, retrieving and communicating information. The convergence of the information processing and communication systems is explicit in the concept of ICT, which has an aggregation that of devices and applications encompassing radio, television, fixed and mobile phones, computers, Internet and Intranet networks, voice and video mails, and Web sites.

While radio, television and fixed telephones, can be considered as somewhat "older technologies", personal computers, mobile phones and in particular the Internet are novel, yet established paradigms that are genuinely changing the live of the ordinary citizens, and the society in general. One may argue that computers are almost as old as radio and television. Since the study is focused on diffusion, the position taken here is that the accessibility and affordability by the population of a technological breakthrough counts as the actual time when its impact becomes omnipresent. Computers for a long time were the privilege of government institutions and facilities, large companies, research and educational organizations. The picture drastically changed with the advent of the microprocessor, miniaturization of the hardware, and portability of the software including user interfaces and applications, which drove the cost down and over the two decades made the PC almost a household appliance.

The unforeseen growth of the Internet, often described as combinatorial, and the pervasiveness of its services, fortified the notion that computing, i.e. information processing, and communication have become virtually indistinguishable. Ever since 2002, the ratio between the traditional voice and data traffic between North America and Europe has been in favor of the later. The infusion of mobility, where the number of cellular phone subscribers is about to outnumber fixed line subscribers [1], and its blend with the Internet, makes it possible to move to 3G and 4G networking.

The spectrum of services and the multitude of transmission technologies posited the need for a set of unification rules and procedures, such as the Internet protocol (IP), which is based open standards and immensely scalable and robust. In a way, this protocol became through the Internet, the platform of the Information Society, where one of the goals is to use ICT to reach all the segments of the society and make its benefits available to most of its citizens.

A large scale development is underway to translate and transfer many of the governmental services offered to business and citizens on the Internet. This applies, inter alia, to health and education, travel and entertainment industry. Indeed, all these developments lead to building the infrastructure of the Information Society, such as e-government, e-health, e-education, e-commerce, and e-banking. In fact, the idea is to prefix with "e" all the aspects of the contemprorary society, and to stimulate e-inclusion and e-representation, both quite necessary for e-democracy. The intention is to go beyond simple transformation of the existing services and processes to the e-environment and to

produce value added benefits and effects. In reality, it means that by translating a social service, such as voting to e-voting, you increase, at least, public awareness and participation. It is evident that provided the infrastructure is already present, ICT is instrumental to higher degree of integration and collaboration in the society.

The text proceeds with an overview of the contemporary theories about diffusion of innovation. It supports an argument that these theories are not quite directly applicable to ICT. Then we proceed with a summary of the research related to the indicators of ICT diffusion in developing countries. The end deals with the rudimentary characteristics of an open model for ICT diffusion by identifying the key factors concerning developing countries and using as a domain of reference the CEE region.

2. The Diffusion Process

There is a long tradition of research in diffusion of innovation across a wide range of disciplines. Despite common behavioral patterns, there is no single, well-defined, and comprehensive theory. The literature, [2], [3], does describe some of these similarities concerning innovation adoption, explains the process of its use within a social system, and assists in the assessment of success or failure of innovation.

According to Rogers, [2], who has done a seminal work on diffusion, an innovation is defined as an idea, practice or an object perceived as new by an individual. Diffusion is treated as a process by which an innovation is communicated through certain channels over time among the members of the society.

Rogers, [2], identifies five characteristics that enhance the rate and the effectiveness of innovation diffusion. These are relative advantage, compatibility, complexity, trial ability, and observability. The relative advantage demonstrates how the ideas brought with the innovation are more effective than the ones being replaced; compatibility relates to the compliance with the existing values, past experience and adopters needs; complexity is an ease with which the innovation can be understood; trial ability shows the degree to which adopters can implement the innovation; and observability is the extent to which results of the innovations are visible to the others.

Accordingly, there are five phases in the adoption process. The potential adopters of an innovation must learn about the innovation (knowledge phase), be convinced about its advantages (persuasion phase), decide to adopt it (decision phase), put the innovation in use (implementation phase), and reaffirm the decision to adopt the innovation (confirmation phase). The activities taken in each phase are:

1. Knowledge - a person or a group learns and acquires knowledge about the innovation.
2. Persuasion - a person begins to create positive attitude towards the innovation through interactions with others.
3. Decision - there are enough reasons to decide to start using the innovation.
4. Implementation – the innovation is placed into exploitation and more information about its features is required.
5. Confirmation - continued use provokes justification or rejection based on the evidence of benefits or drawbacks.

When a technological innovation is introduced, the adoption rate varies with the diversity of adopters. Five categories of adopters are identified in [2]. The name for each category illustrates the pace of the innovation adoption, where the categories are: innovators, early adopters, early majority, late majority, and laggards. The innovators and early adopters are usually well educated, have higher social standing, belong to larger organizations, take greater risks and are more inclined towards accepting novel ideas than the other groups. Figure 1 shows the bell shaped distribution of individual innovativeness and the percentage of potential adopters in each category, [2].

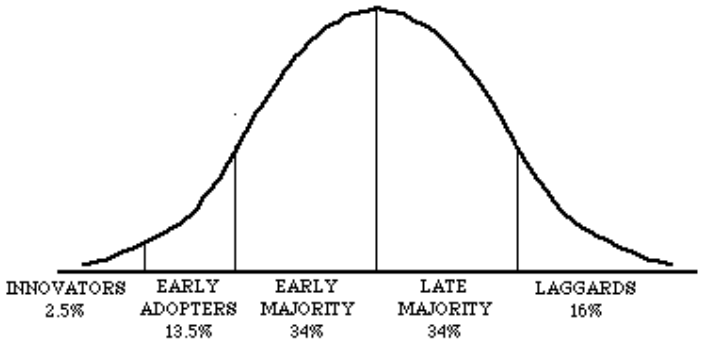


Figure 1: Bell shaped curve showing categories of individual innovativeness and percentage of each category

In the realm of ICT, for instance the Internet, the innovators have usually come from within the area itself. They are followed by both public and private research and education communities (faculty and students). The diffusion accelerates only when business gets aboard and connects. The result is an investment in infrastructure, which eventually increases the performance and geographical coverage. The consequences are the reduction of access cost for the users and an adoption by the local community organizations, which later may translate to the majority of citizens.

Rogers has proposed a theory, based on the rate of adoption concept, which states that innovations are diffused over time in a pattern that resembles an S-shaped curve. An innovation goes through a period of slow, gradual growth before experiencing a period of relatively fast growth, after which the rate of adoption gradually stabilizes and eventually declines. The S-curve is presented in Figure 2.

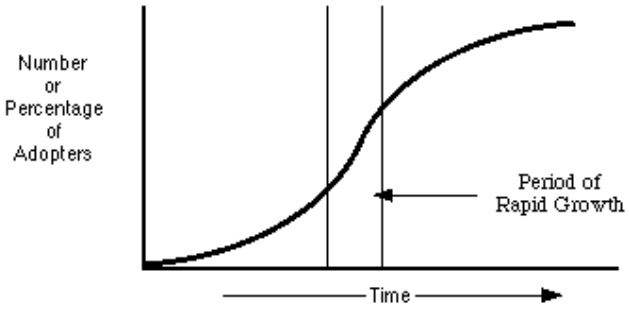


Figure 2: S-shaped curve presenting the rates of adoption of an innovation over time

The S-shaped curve is the result of the cumulative frequency basis over time of the curve in Figure 1 that represents the number of individuals adopting a new idea.

ICT is a complex set of technologies, used in a variety of ways and for many different purposes. Namely, it is very doubtful whether or not the diffusion theory put forward by Rogers is applicable, since it is almost impossible to treat ICT as a single innovation.

For example, the phrase “the user has adopted the Internet” can be quite misleading, since it invokes so many different meanings from “user can use the browser for looking at different content” to “the user can create html pages and configure its own web server”. Mobile phones users can exploit their capabilities in very different ways. Some people use phones for making calls or sending SMS; others will take advantage of a full range applications (personal organizer, e-mail, voice and video mails, and banking).

The new technologies offer huge possibilities for creating applications that effect many aspects of the society. Governmental services are available on-line, political involvement over the net is becoming feasible, and web-sites for leisure or recreational activities, trip planning, and tourism sites are blooming. Health care is to a large extent using the technology, though still mostly on the level of information dissemination. In addition, more and more businesses are either using the Net for advertising or are completely going on-line. Education follows the same steps. The on-line modules are offered as a supplement to the regular courses or on their own. The goal is, at least, twofold: to enhance training and boost results, and to reach out larger audience, as well.

The proliferation of studies to measure e-readiness has not been beneficial to the studies of the ICT adoption, as one would expect. Clearly, the complexity of this multifaceted phenomenon is one of the reasons why it is so difficult to measure it. An example of some positive efforts is the EU on-going project named “Benchmarking the Information Society: e-Europe Indicators for European Regions”, [4]. It is trying to assess the overall situation regarding ICT penetration in different regions.

In developing countries, the ICT infrastructure is still scarce. Quantitative values that measure the progress of the Internet and use of mobile phones in a number of sectors are either difficult to come by or not available at all. On the other hand the spread and usage of ICT is often measured by the number of mobile phones, personal computers, Internet hosts, and Internet users. While these parameters do not directly illustrate how much the technology is contributing towards changing people lives or creating new opportunities, they do give some indication on the usage of ICT.

4. Developing Countries

It is interesting that the S-shaped curve for many of the parameters used to show ICT diffusion looks differently in case of the developing countries. For example, the graph shown on Figure 3 presents the growth of the Internet host density for the developed and the less developed countries in the period of 1995 to 1999, [5]. Contrary to the more optimistic conception about less developed countries catching up on the information society and using it for their development, the “digital divide” continues to widen. The inequalities increase especially in terms of access to the Internet and the extent of use of its services. Together with it, the inequality in accessing knowledge, education and possibilities to improve life multiplies.

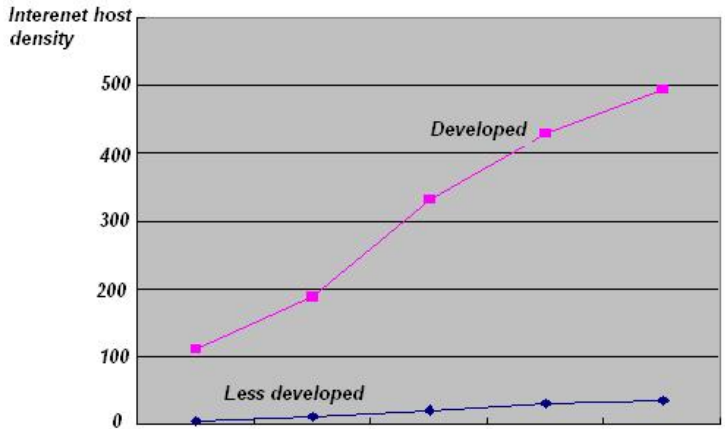


Figure 3: S-shaped curve presenting Internet host density growth for developed and less developed countries

A lot of research has been done to identify the indicators for ICT diffusion, [6] and to find explanation behind different patterns for the spread of ICT. The indicators that are considered as crucial are the wealth of the country expressed through the average income per citizen, the infrastructure development (the number of fixed subscriber lines and number of mobile phones, number of computers, Internet users and hosts), education expressed through the literacy of the population, the percentage of enrollment in secondary and tertiary education, as well as the training offered for using ICT, especially the computers and the Internet. Some argue that knowledge of foreign languages especially English, as well as the content offered in the local language are also important features for the increased demand, [7]. The impact of the government policies, the democracy exercised in the country, and the openness of the society are also considered as decisive factors too, [8].

The approach differs with respect to particular countries. One example is the causal model of Internet diffusion, which describes the diffusion in India and China [9]. According to [10], there are five categories of components necessary for rollout and use of the Internet :

1. National/Organizational needs and/or new opportunities;
2. Technology;
3. People/Skills;
4. Capital Resources; and
5. Management of the technology adoption and diffusion process.

In [11] a novel approach to social development of the Internet that has emerged in Latin America is being explored. NGOs and social movements are considered to be of a much greater influence on the early development of the Internet in Brazil and Peru, relative to commercial and other factors. Some NGOs played a similar role in a number of CEE and FSU countries.

Most frequently used model in studying technology diffusion in developing countries is the Gompertz model, [12, and 13]. The analytical model suggests that the rate of diffusion is directly proportional to the logarithm difference between the current value of a certain indicator and the long-term equilibrium (post-diffusion value). The selection of the variables used to calculate the long-term equilibrium is subject to different

methodologies. The impact on ICT diffusion for each variable is found then through calculating indexes of significance for all of them. Based on the model in [12], values for 47 countries are calculated. The results obtained suggest that the income in developing countries is the major determinant of ICT diffusion (which is somewhat to be expected) and that ICT diffusion does not seem to enhance education (which is surprising).

In the literature surveyed, the indexes calculated for measuring ICT diffusion are based on many different indicators. On the other hand, the work to be presented in the text that follows will attempt to identify the factors that influence the growth and penetration of ICT. The indicators like GDP per capita, Internet users per 10000 inhabitants, Internet hosts per 10000 inhabitants and mobile phones per 100 inhabitants are used only to show the relationship between some of them in the case of CEE countries. The data used are from the ITU[2] statistics database and CEENet[3] database. The intention is to develop an open model where most of the relevant factors that affect the overall conditions for ICT development will be enumerated, analyzed and organized. Thus, they can serve as guidelines when studying and investigating the situation of each particular country with respect to finding factors that have played or can play the dominant role in ICT diffusion.

3. Factors Associated with ICT Diffusion in CEE Countries

The transitional period from the controlled to market economy in the CEE countries, combined with profound political and social transformations, has been overlapping with the period of introducing the newer ICT technologies. Many of them have wisely used the technology to shorten the transition period and to boost the economic development. Others have not been so successful and have allowed the transition period to be an obstacle for the faster ICT diffusion. Some have even used it as an excuse for being too slow in adopting and efficiently using these new technologies.

There are three main groups of factors that influence ICT diffusion: economic factors, human capital and local or country specific factors.

3.1 Economic factors

GDP

In almost all the work concerned with the ICT diffusion, the economic strength of the country is usually represented through the GDP per capita. The gross domestic product (GDP) is a measure of the amount of economic production of the country and it is a statistic variable used by governments to measure progress. Many studies summarized in [10] have shown that economic wealth of the country, which is usually represented by GDP, has always been a major factor in the production and diffusion of a new technology. The assumption is fairly intuitive. Countries whose people are better off economically tend to have higher penetration of personal computers and Internet and higher number of mobile phones. This was proved to be valid in both, research based upon theoretical, as well as the one based upon empirical studies. An illustration of how ICT diffusion depends on GDP per capita for the CEE countries is presented on Figure 4 and Figure 5. The upper part of Figure 4 shows Internet users and the lower part the number of hosts per 10 000 inhabitants. Only the names of the countries that have significantly higher values then the

[2] http://www.itu.int/ITU-D/ict/statistics/

[3] http://www.ceenet.org/database/

trend represented with the straight line appear on the graph. Figure 5 presents the number of mobile subscribers.

Intuitively, the number of users can be considered to show the spread in using the technology to acquire information, while the number of hosts the spread of using the technology to create information. The graph shows that for the low-income countries both of them are rather low. Interestingly enough, some countries with not very high GDP are showing better performance. Bulgaria, Romania, Latvia and Estonia have significantly higher number of Internet users, whilst Estonia and Hungary have much higher number of hosts.

The data suggest (1) the presence of other factors possibly with stronger influence over the spread of the Internet in these countries, and (2) the wealth of the country is not always the critical factor.

In case of mobile phones the differences from the trend are not so high. They are actually similar for some of the low-income countries as for those with higher income. Examples are Albania and Serbia and Monte Negro.

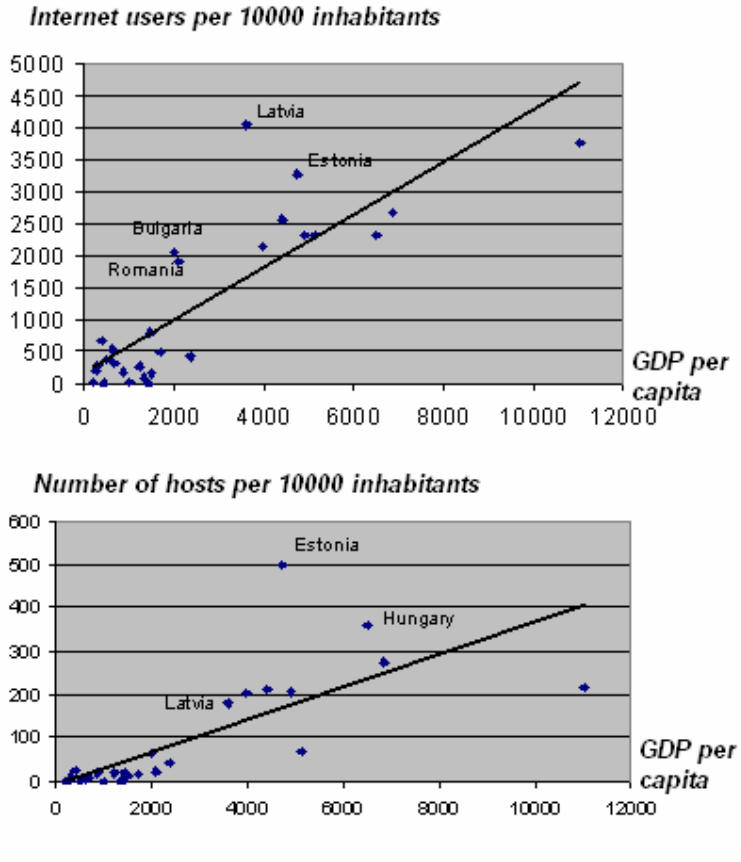


Figure 4: Internet users and number of hosts per 10000 inhabitants in 2003 (CEE countries)

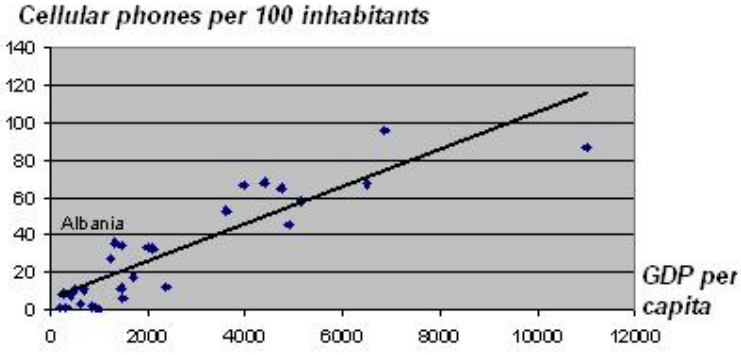


Figure 5: Cellular phones per 100 inhabitants in 2003 (CEE countries)

Telecommunication Infrastructure

Telecommunication infrastructure is commonly defined through the number of existing main fixed phone lines per 100 inhabitants, the number of mobile telephones and international links. In addition, the number of ISDN subscribers, ADSL usage, the amount of fiber optic cables and cable TV coverage are also considered as a part of the infrastructure.

Building exchange plants, laying down cables and placing other transmission equipment depends heavily on the economic potential of the country. In countries where

the adequate infrastructure is available, the initial capital investment for the introduction and use of the new ICT technologies tend to be low and thus the adoption rate is usually high. Conversely, when there is an absence of infrastructure, the capital intensive needs are high, which makes the usage low due to the cost prohibitive nature of access, and hence the effect of the adoption is rather adverse.

It appears that the spread of Internet and mobile telephony follows different patterns. A connection to the Internet requires a computer and a communication link. So, the relation between the Internet diffusion and the legacy telecommunication infrastructure seems obvious. Figure 6 shows how the number of Internet users and hosts is related to the number of telephone lines for the CEE countries. In case of the countries with the lower number of telephone lines the Internet users and hosts follow the trend. The graph shows that this is not the case with the rest of the countries. For instance, Latvia, Estonia, and Hungary show much higher Internet penetration than expected according to their number of telephone lines.

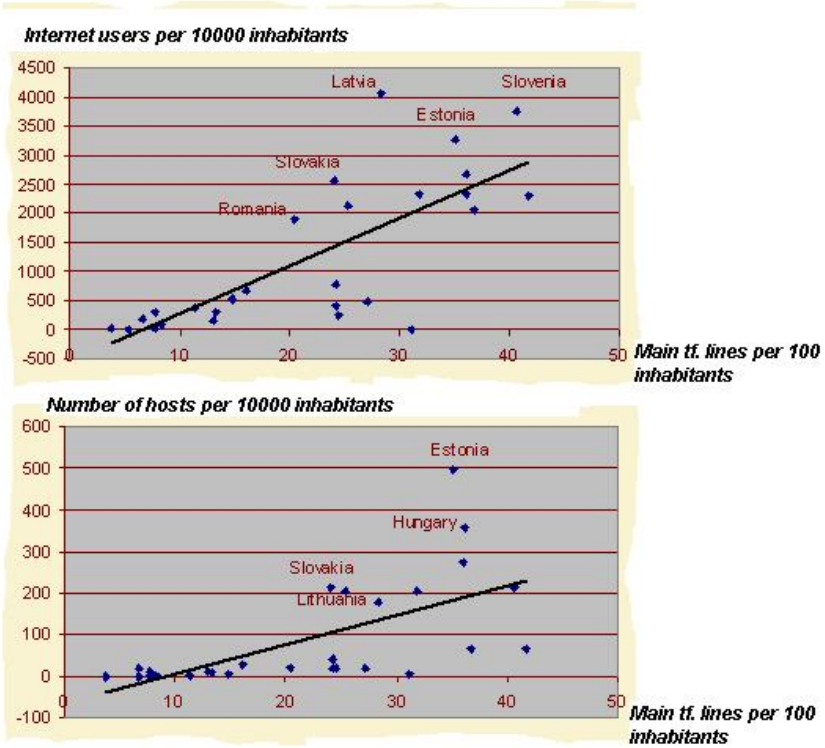


Figure 6: Internet users and number of hosts vs. main telephone lines, 2003, CEE countries

On the contrary, when mobile telephony is concerned, the opposite could be true. In some of the countries, the lack of infrastructure is one of the driving forces in building mobile networks. These are usually low-income countries and the spread of mobile telephony depends on the affordability of mobile devices. The prices of mobile phones have decreased in the last couple of years providing conditions for a profound infusion of the technology.

On Figure 7 the relationship between the telephone lines and mobile telephones is presented. Albania is an example for mobile telephony growth despite of the low GDP and lack of infrastructure.

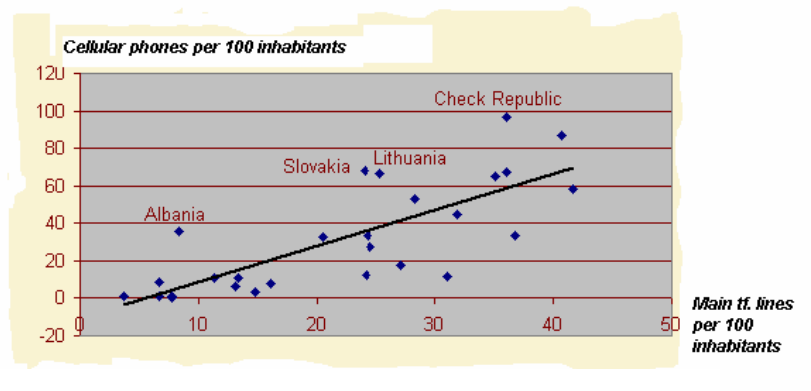


Figure7: Cellular phones, vs. main telephone lines, 2003, CEE countries

In most of the previous research the telecommunication infrastructure is treated as an independent indicator for ICT diffusion. However, if it is considered as a factor that should stimulate further growth of Internet connections and mobile phones, then its dependency on the economic strength of the country cannot be neglected. The model presented here treats telecommunication infrastructure as an economic factor.

ICT Production and Consumption

One of the standard indicators of ICT is the share of ICT in investment and the size of the sector that produces ICT goods and services. As expected, the share of ICT investment is largest in developed economies and rather small or almost insignificant for the developing countries [14]. Diffusion of ICT is stronger in more competitive environment and largely depends on the level of market competition. The dynamic growth of this sector has an impact on the economy, especially in creating new employments and in increasing productivity. The expenditure on ICT as a ratio of GDP or population does not reflect directly ICT diffusion, but is some indicator of the awareness of the government for the importance of ICT for the economy and the overall well being of the society. In most of the developed countries, even the balance between the expenditures on software and hardware is tilted in the favor of the former.

The data from 2003, concerning CEE countries [14], show that the growing transition economies such as Bulgaria, Croatia, Hungary, Slovenia, Slovakia, Check Republic, Poland and Romania are already investing in the ICT sector with an average of 5.7% of GDP. There is no evidence for such investments in the others, less competitive economies.

Other important economic factor for ICT diffusion is the cost of ICT technologies. Figure 8 shows monthly price for the Internet access as a percent of GDP per capita for the CEE countries. The exponential trend explains why cost is a substantial barrier for the diffusion of Internet. One can argue that it is correlated to the number of Internet users and as this number increases, a decrease in the price is to be expected. Telecommunication services including the Internet have decreased much more in countries with the telecom sector was deregulated then in those where virtual monopoly is sustained or the deregulation process is quite slow.

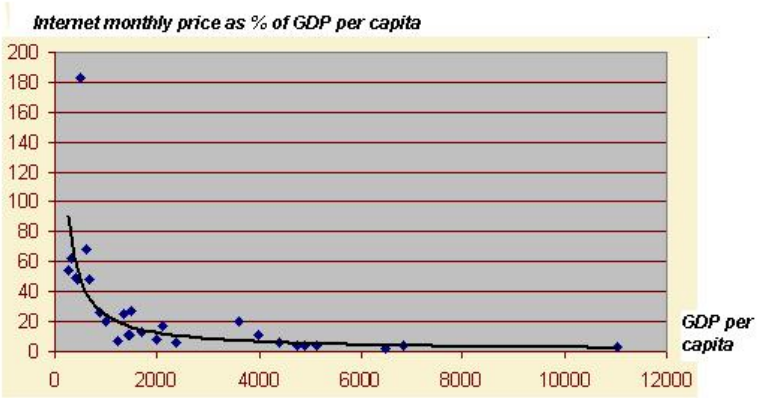


Figure 8: Internet monthly prices in CEE countries

Foreign Direct Investments

Foreign direct investments in a developing country can be an important factor for its overall development. Once entering the country they present a more stable form of funding than either development assistance or loans. In case when investments are put in the ICT sector a speedier economic growth is facilitated, job opportunities are increased and exports are stimulated. Estonia, Hungary or Check Republic are just a few example CEE countries that have benefited largely from FDI.

Therefore governments in developing countries provide incentives to attract FDI through building necessary infrastructure and creating political stability. Recent studies, [15], show that not only FDI has a positive impact on ICT, but higher ICT readiness of the region has a positive effect on the FDI inflows.

Spending on Research, Development and Education

ICT, particularly the Internet, is in some ways different from earlier technological innovations. The Internet is primarily result of research in the academic community, though financed through somewhat military objectives. During the early period, the system was actually used to study network performance, robustness, scalability, reliability, and cost. Despite the fact that the network evolved significantly throughout the years, there is clear evidence of consistent efforts for development of new applications, extension of the usage domains, increasing the heterogeneous nature of the available devices that can communicate, and services.

It is obvious that the investment in research and development are essential for innovation and its adoption. ICT technology is no exception. The research and education sectors in the CEE countries were acutely aware about the importance of the Internet since its early days. Nevertheless, a combination of economic factors, such as lack of funds and political will, the presence of the “cold war” and the restriction imposed on the CEE countries by the West concerning the export of technology, along with the paranoid view of the CEE governments with respect to the informative and pervasive character of the technology, provided not so friendly environment for ICT early adoption and proper localization, suited to the needs of the citizen in the respective countries.

Computer novices find Internet difficult to use. Older individuals, women, or persons with lack of education are generally afraid even of trying it. Although a lot of work has been done to create graphical and user-friendly machine interface, it is still not at a point where the ordinary user would like it to be. It can be said that with respect to ease of

use, the technology is still in its infancy. This represents a significant constraint for the early and late majority to adopt the browser. The idea of computers being devices used by only technically educated persons is still present in the minds of many people in the CEE countries, making the persuasion of trying the technology even harder. Since, training and know-how are prerequisites for the usage of the technology, the investment in education is as important as it is in research.

While research, development, and education can be thought of as human capital, the investment in this area is closely related to financial issues and therefore is placed under economic factors.

3.2 Human Capital

Education

The assertion that education is one of the societal pillars is almost axiomatic. The quality of education and its availability are some of the metrics for the human potential and the progress of a country. The education empowers individuals. Moreover, it is the central ingredient for economic, political and social development that leads to the welfare of every citizen. The new ICT technology requires from the users to be acquainted with the technology in order to be able to use it. Educated individuals are more likely to posses skills needed to adopt and practice the technology. Moreover, they are more capable to understand the innovations brought with ICT, to connect it to their current work and to implement it in a best possible manner.

The level of education in a country is often expressed by the adult literacy or the enrollment in the primary, secondary and/or tertiary education. The higher these numbers are the better education level for the country is. When ICT is concerned the number of graduates in computer science and related disciplines becomes also important. Another significant issue is the quality of education and its capability to be part of the current developments. Rapid changes of technology require reform and restructuring of the curriculum at all levels of education. ICT is not only a subject of study, but also a set of tools for improving the process of teaching and learning. Teachers are not anymore the only source of information. Students can easily search and find knowledge using ICT; it is possible to access information stored anywhere in the world. The potential of ICT is enormous, yet not all of it is fully explored.

Schools and universities are equipped with computers connected to Internet. Both teachers and students are trained to create web pages and deliver content in various electronic formats, including text, pictures, animations, and movies. The evolving nature of the technology makes it difficult for them to understand the full extent of the issues, challenges, impact and efforts needed to pioneer novel technologies in the teaching process. It is very time consuming, occasionally not properly executed, and thus failing to fulfill the intentions of the process. Suggestions for overcoming frustrations for teachers-innovators and helping the rest of educators to adopt the web technology in educational purposes are presented in [16].

ICT facilitates communication on several different levels between students and staff and among the students themselves, which is vital for the effectiveness of the teaching process especially with a student-centered pedagogy. An assortment of chat and IP telephony programs, video and tele-conferencing have stipulated and created conditions for interactive participation of teachers and students in the education process.

The specific software platforms for creating and running on-line courses represent another aspect of ICT and education. The goal is to offer asynchronous mode of education, to attract larger audience, with operating modes invariant of time and place. E learning is considered to be convenient way to reduce the cost of education, make it global (cross-regions and cross boarders), and independent of the place of creation and execution. It can be therefore considered as an opportunity for getting standardized quality education for everyone and everywhere. This, in particular, is important for developing countries.

The education index for almost all CEE countries measured by the level of literacy and enrolment at different level of education is rather high. However, if they are compared by the percent of population that have got sufficient ICT training, only data for some of the CEE countries are available. These are the countries with the highest ICT diffusion. Figure 9 shows the relationship between Internet hosts and the percentage of population that have obtained IT education. The data are taken from [14].

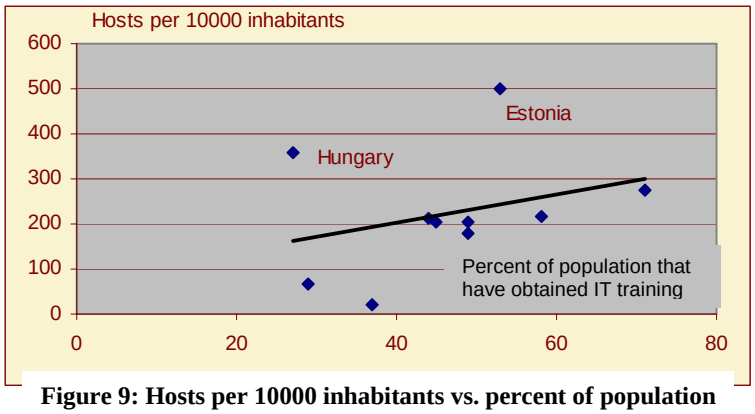


Figure 9: Hosts per 10000 inhabitants vs. percent of population that have obtained IT training, 2003

Research and Education Community

Computer networks are not only a platform for the provision of various services for the researchers; they are also an important playground for the development, testing and introduction of network services and applications. Indeed, networks are not only a tool for but also a subject of research. Therefore a strong involvement of the research and development community is essential for ICT diffusion.

It comes to no surprise that in many CEE countries, the research and education communities were the frontrunners in establishing the first Internet connections. This was followed with the enactment of separate organizational units termed as Research and Educational Networks (RENs). Their primary mission of REN is the provision of all sorts of services to the wider research and education community. REN creates the right milieu for a country to lead in science and technology, improve productivity and quality of the research community, increase collaboration among researchers, facilitate technology transfer, and broaden and extend the dissemination of research results, [16].

CEE countries have early recognized the importance of creating RENs. These organizations exist in every country. Moreover, CEENet (which stands for Central and Eastern Networking Association) that consists of twenty-five CEE RENs was founded in 1994. CEENet has understood that the widespread usage and acceptance of the Internet, networking and information technology depends on well trained and educated individuals involved in building infrastructure, enacting services, and effecting the management of

networks. The main objective of the Association has been to encourage education initiatives in a form of workshops, conferences, and distance courses offered over the Internet for participants in the CEE countries.

Government Policies, Law and Practice

The adoption of such a disruptive technology as in some instance ICT is does not evolve spontaneously. Some see legitimate concerns in the fact that the Internet and universal access will tip the balance on the market with respect to traditional telecoms, broadcasting and entertainment companies. In this case a strong pro-active public policy is needed that explains, educates and steers. The regulatory regime of a country can greatly affect the acceptance and deployment of a new technology, especially when it is associated with accessing information out of the borders of the country. Generally, the government adopting a positive attitude towards ICT may engage and use the technology in restructuring the domestic economy and develop adaptive policies to encourage its diffusion. In some of the developing countries, governments have played a major role in Internet development through initiating and funding the Internet and Internet-related technologies. In other countries, ICT has been badly impacted by reluctant governments that actually impeded diffusion, [5].

Government interest, procurement and promotion of ICT are factors in proper ICT diffusion. They influence the growth of domestic ICT market and foreign investments. With the exception of a few (like Estonia and Slovenia), CEE countries have almost missed the opportunity to develop independent and coherent national ICT strategy. For the record, certain elements of the information society concept could be found in the programmes and goals of the relevant ministries, [18]. In other countries (Slovakia, Lithuania), the initial programs on ICT development were not taken seriously and have not been prioritized by their government due to the need for structural reforms and lack of human and institutional capacity.

An affordable Internet access and competition in the telecom industry go together. In countries where one provider has typically monopolized the market and has generated significant revenues for the state, Internet access tends to be expensive and frequently unreliable. The monopoly position of the telecom operators does not create incentive to offer state-of-the-art ICT resources and to reduce prices. The actions of the government towards deregulation and liberalization are essential to overcome the barriers imposed by the monopoly. Estonia and its rather high rate of adoption are an example of a commitment to open market, which has lead to one of the most competitive telecom markets in the CEE region, [19].

Democracy and Openness of the Society

It is in the nature of ICT to promote democracy and openness. The accessibility and the availability of information, and hence knowledge, makes the society that uses ICT a transparent, open, economically sustainable, and in continues search for the most adequate forms of democratic expression and life. This is an enabling technology, namely promotes a fast exchange of ideas and practices, and makes people demand transparency and accountability in the public sector. E-government, e-democracy and similar projects are emerging in the countries that promote freedom of information law. They are used as instrumental tools for implementing this law. The most sensitive information at the government offices can now be easily made available through the office web pages. In addition interactive pages will allow citizens to make proposals and participate in debates whenever some decision that concerns them is taken.

There is no E-democracy without a democracy in a country. The openness and democracy of the society are closely related to the government policies and the issues discussed in the previous section. Political leaders in countries that have had little or no exposure to democratic processes and lack democratic institutions are usually concerned about allowing greater access to information to the public. They fear that this can lead towards greater decent and possibility for government change.

Today, CEE countries are categorized as “free” or “mostly free” in their economic freedom, according to the Heritage foundation index, [20]. On the other hand, democracy, freedom of the press, and corruption ranks calculated by the World Audit Organization, [21] differ significantly from country to country. Figure 10 shows how the number of Internet users per 10000 inhabitants depends on the democracy index. With some exceptions the countries with a higher level of democracy (lower rank on the list of all countries) have much higher ICT diffusion.

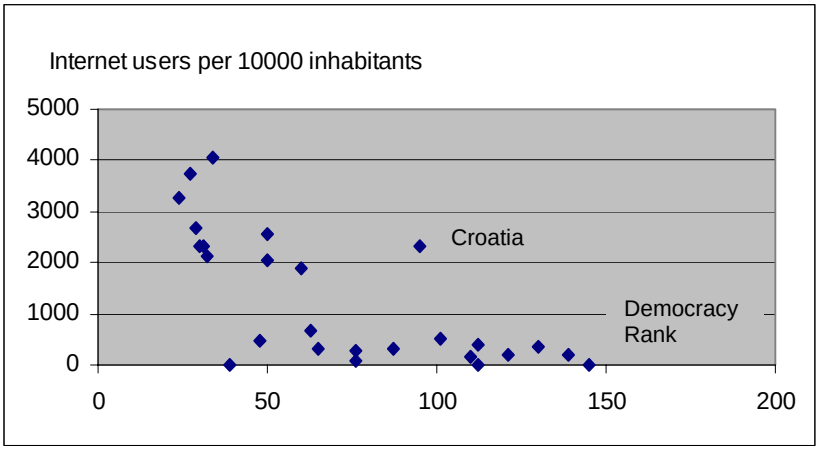


Figure 10: Internet users vs. democracy rank

Content and Demand

The emergence of many diverse applications associated with ICT poses a question about how the content offered through the new media can increase the demand for the technology. Previous experience shows that an innovation often demonstrates a demand for something else than the original intent.

For example, the predecessor of Internet, ARPANET was mainly built to provide education and research community with access to powerful computers due to scarce computing resources. E-mail was only an accompanying application. It turned out that people liked to exchange messages and communicate using computers. In the seventies of the last century, e-mail became one of the first killer applications on the Internet.

Today, many different tools for communication among people have been developed. In addition to e-mail, there are chat programs, IP telephony, bulletin boards, and videoconferences. It is along the line of one of the basic requirements on the ICT technology, to provide a synchronous or asynchronous interaction among individuals and groups. However, in addition to this, the new ICT technologies offer possibilities for other different ways of communication. Firstly, organizations, as well as individuals can present information and can offer different kinds of services to the public. Secondly, consumers can use the information and services offered only if they believe they can fulfill some of their needs. From the point of view of an average citizen the new technology is useful if it

fulfils his/her rational and relatively trivial needs, for example on line tickets booking, on-line shopping, on-line banking and other on-line services. If the properties from the Roger's theory of diffusion are checked against these services, the following conclusions are obtained.

1. Time saving and 24 hours service are advantages.
2. It is compatible if the user interface simulates the actions the consumers used to take when he/she used the same service before.
3. The ease of use is still not at a satisfactory level [18], which is mostly due to the complexity of the new technology. Nevertheless, tremendous improvements in all aspects have been made in the last couple of years, from self-configuring hardware to user friendly and adaptable software. This creates hope for even more sophisticated tools that will make the technology easy to use.
4. Trial ability is actually a function of the availability of the necessary hardware and software. Once the customer is equipped with access to Internet, he/she can try using the service offered.
5. The services offered through Internet, by default comply with the property called observability.

The services just explored and many others, like e-government, e-health, e-education are not yet present in all CEE countries. Some have made bigger steps towards creating content according to the demand of their citizens and there are many that are lagging behind. The later are just starting to recognize that a web page of an organization is not only an advertisement for the building, the staff or the activities in progress, but can also provide service for its customers. Web pages with content useful for the customers, applications that enable all sorts of communication for the users accompanied with an easy to use interface can contribute towards increased demand of ICT.

3.3 Local Factors

Geography

Geographical location of a country can play an important role in the transfer of technology. It is natural to expect that countries that are close to developed countries can accept and transfer new ideas and technologies faster and easier, although this is not always a rule. If CEE countries are surveyed, this assumption holds for most of them. For example Slovenia, Check Republic and Hungary are bordering with Western European countries and show rather high ICT diffusion. The size of the country is important when it comes to the pervasiveness of the technology. It is harder to achieve homogenous penetration in large countries then in smaller ones.

Culture, Language, and Gender

Cultural factors include individual moral and beliefs, value systems and habits, attitudes to information sharing and other types of behavior of a human being as a member of a society. The language and the view points on gender issues can be considered as cultural factors, too. ICT offers a possibility of accessing unrestricted information and this rich world of all sorts of data and choices can provoke either positive or negative reaction based upon the way it is interpreted. Traditional societies might be concerned about the impact of this abundance of information on the younger generations. Some cultures do not

allow individuals to get more and diverse education than the majority has. It can also hinder the diffusion of innovations.

The language barrier was considered one of the problems facing the spread of the Internet in non-English speaking countries in the 90-ties. The statistics gathered lately show that this is not true anymore[4]. Besides English, the most of the on-line content is in Spanish, German, French, Japanese and Chinese. While many developing countries have succeeded to produce, some still lack content in their own language. The use of English or some other of the aforementioned languages is still prevalent one. Although using another language to retrieve relevant information can be assumed as a language exercise and can be looked at as positive experience, the real penetration of the Internet into communities requires using Internet applications in the local language and reflecting the local social milieu.

In the developing and the developed countries women have been discriminated due to their ability to bare children and take care about the home. The differences are of course emphasized in the developing countries and in traditional cultures. The ICT statistics available does not reveal the gender of Internet users or mobile phone subscribers. However, it can be intuitively concluded that the number of male adopters of ICT is higher then the female. The intuition is based on the facts that female participation in sciences connected with Mathematics and Technology is usually much smaller and some technical knowledge is required for ICT.

Almost all of the CEE countries have rather similar culture as the countries from Western Europe, though they all speak different languages. They share similar political background and similar attitudes towards the gender issues. This leads to the conclusion that the cultural factors have not been predominant for the differences in ICT diffusion that appear among them. However, it should be taken in consideration that all of these countries made a transition from being a part of Soviet Union, former Yugoslavia or a member of the Warsaw Pact to becoming independent entities and some of them experienced wars to certain extent in the 90-ties or early 2000.

Non-Governmental Organizations (NGOs)

NGO community consists of rather heterogeneous organizations, separate from the government and the commercial sector. In many of the developing countries some of them have had a great influence on introducing the academic community with the new technology such as Internet and its early development and extension to other sectors of the society. Such a positive example is the involvement of some of these organizations in spreading Internet in Brazil and Peru, [11], In collaboration with the University they have trained people in how to use Internet for organizing purposes, succeeded to create non-profit ISPs and to establish models for setting up small cyber-cafes or tele-centers.

A particular region or country attracts attention of different NGOs, which the involvement of NGOs to be classified as the local factor for ICT diffusion. An organization that has played the crucial role in introducing and diffusing Internet in the CEE region was the Open Society Institute (OSI) financed by the financier and philanthropist George Soros.

At the end of 1993, Jonathan Peizer created the Network Internet Program for OSI and became its program Director. According to the interview [22], 750000 people in the

[4] http://www.nua.com/surveys/?f=VS&art_id=905357989&rel=true.

region have benefited directly from content, training, infrastructure and connectivity projects by this program since its inception till 1997. As the basic connectivity in almost all of the CEE countries was established by 1997, in the later period the program was focusing on the content and the training grants in all of the countries with exception of those in Central Asia and the Caucuses region where the lack of infrastructure was still an issue. Soros grants were used mainly to sponsor pilot projects. Among others OSI together with NATO Science Programme, have financially assisted more than twenty workshops/conferences organized by CEENet and thus contributed towards ICT education and training of more than a thousand people in the CEE countries. These individuals became the seed for ICT proliferation in the whole region. However, the objective with all the pilot projects was to help their initialization, to show the others their importance and usefulness and to expect them to nurture what the project has achieved. Nurturing means to have the ability to create plans, propose and implement strategies, provide funds, and foster human resources to keep the initial success going on and becoming sustainable.

4. Modeling ICT Diffusion

The idea for creating a model of ICT diffusion has emerged from the need to identify the factor or group of factors that has been predominant in a case of a particular country. The model is presented on Figure 11.

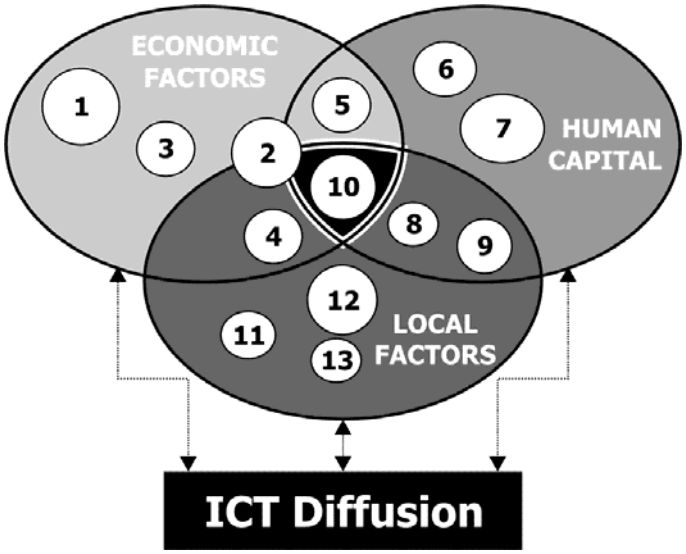


Figure 11: Open model for ICT diffusion

1. GDP
2. Telecommunication infrastructure
3. ICT Production and Consumption
4. Direct Foreign Investment
5. Spending on Research, Development
6. Education
7. Research and Education Community (NREN)
8. Government, Policies, Law and Practice
9. Democracy and Openness of the Society
10. Content and demand

The groups as described in section 3 are presented as ovals and the factors as circles. The overlapping of groups demonstrates non-rigid classification of the factors. The model is considered open which introduces a possibility of extending the groups or number of factors. The arrows show a feedback between the factors and ICT diffusion. The size of each circle can differ when a situation in each particular country is considered.

When the model is applied to a particular country, the size of each circle is coarsely proportional to the impact it has had for ICT diffusion. Table 1 shows an example for determining the level of importance for the group of economic factors in case of Estonia. Each column in the table is devoted to a single factor and the data relevant for each of them are presented for Estonia and the CEE country with the highest value. A ratio between the two values expressed as percentage is then found. After normalisation a coarse proportion in the size of the circles representing factors 1 to 5 is obtained.

Factor 1		**Factor 2**				**Factor 3**		**Factor 4**		**Factor 5**	
GDP per capita in 2002 in US$ (ITU)		Main Telephone lines per 100 inhabitants in 2003 (ITU)		Cellular mobile subscribers in 2003 per 100 inhabitants (ITU)		Average share of ICT spending (in %) in GDP, 93-01 (WITSA source)		Foreign Direct Investment per capita from 1990-98 (in US$)		Research and Development expenditure as % of GDP, 1996 - 2001 (UN)	
Estonia	Slovenia	Estonia	Croatia	Estonia	Check Rep.	Estonia	Check Rep.	Estonia	Hungary	Estonia	Slovenia
4732	11020	35,06	41,72	65,02	96,46	1	6,8	805	1509	0,7	1,6
Slovenia/Estonia (%)		Croatia/Estonia (%)		Check Rep./Estonia (%)		Check Rep./Estonia (%)		Hungary/Estonia (%)		Slovenia/Estonia (%)	
		84		67		15		53		44	
		average of 84 and 67									
43		75									
Coarse proportion of the circles representing each factor in the open model											
2.8		5				1		3.5		2.9	
1		2				3		4		5	

Table 1: Determining the size of each circle; an example with economic factors for Estonia

5. Conclusions

The ubiquity of ICT and its potential to profoundly change the quality of human life has made it one of the premier vehicles for development as posited by the establishment of the UN ICT Task Force, the declarations of the WSIS, and the Millennium goals. The idea is that no human being should be left behind.

By recognizing the importance of ICT in an axiomatic way, the article that is based on the several reports on the ongoing research into the factors that influence the penetration and the diffusion of the technology, tries to elaborate a model, which can be used first to explain the different paths of proliferation of the technology in various countries and the reasons behind them, and second to use it in the less developed countries as a blueprint and a catalyst for enhancing the progress of ICT and its societal impact. In a way the model is self-referential, hence the name ICT4ICT that is it looks into the technology as the main vehicle to propagate itself across the all segments of the society and thus create a positive feedback for further diffusion.

The processes, which are to be captured, represented and in a way simulated, are open and multifaceted. In this case, the technology itself is hardly a problem, however its interaction with the economic factor, the human capital and the local aspects, inevitably lead to intractability and the need for simplification. The domain for reference is limited to

the CEE countries that underwent extreme political, economic and social transformation in the fifteen years. Some of these countries show striking differences in the manner they have embraced and used ICT for their own development and stability.

The Open model for ICT diffusion was built on the data from the CEE countries. It has some similarities with the models for ICT diffusion in China, India, and Latin America. The differences from the other models are its openness, the number of the principal factors, the non-rigid classification of the factors in categories, and their interaction. The data so far confirms many of the assumptions incorporated in the model. Combined with the results of the pilot projects, which are an integral part of the further research, it will be interesting to look into the additional verification instances of the open model, and its degree of applicability and replicability in another developing regions and countries.

In the model, still rather coarse and in need for higher granularity, one of the objectives is to emphasize the cross-fertilization between the three different categories of factors and the feedback, which is not necessarily recursive (the possibility for serendipity). Another interesting venue might be to look into the justification of replacing e-readiness with e-diffusion. The reason being is that later has more dynamic nature than the former. Consequently, one may try to quantify diffusion, and talk about different degrees of e-diffusion. One way to do so is to sort out the various metrics for diffusion, in our case twelve, in order of importance. Based on this provisional hierarchy, one could try to develop an e-strategy for e-diffusion (a clear motivation behind ICT4ICT). Is it possible and if so how can we make the model scalable? A phenomenon that we have not looked into, but intend to so in the future, is outsourcing in ICT. While in the beginning it was confined mostly to routine and trivial ICT work, today a lot of software, from network protocols to applications, is being developed in countries different than their major markets. The same applies to the hardware (though in most cases the creative portion is still done in the developed world). These had definitely very positive effect in the developing countries. Is this effect sustainable and replicable, or it just migrates to the next country that offers more competitive labour force.

Finally, one of the next steps is to look into the dynamic of diffusions – the necessary structure, organization, and human potential, what parts induce discrete behaviour and what parts are evolutionary.

References:

1. ITU (2000), *Digital Mobile Growth*, International Telecommunications Union.
2. Rogers P., *Diffusion of Innovations, 5th edition*, New York: Free Press, 2003
3. Kautz K., Larsen E. A., Diffusion Theory and Practice. Disseminating quality management and software process improvement innovations. Information Technology and People, 2000, No. 13, pp. 11-26
4. http://www.biser-eu.com/home.htm , accessed March 2005
5. Zhao H., Suh T., Kim S. H., Du J., On the Determinants of Global Internet Diffusion: A Cross-country Analyses, A presentation for Temple University CIBER Workshop, 2004
6. Popova I., *Measuring ICT Diffusion – A Review of the Current Work with Respect to CEE Countries*, Technical report within ICT4ICT project at Mid Sweden University, January, 2005

7. Hargrittai E., Weaving the Western Web: Explaining differences in Internet connectivity among OECD Countries, Telecommunications Policy, 1999, No. 23 (10/11), pp. 701-718

8. Vu K., Embracing the ICT Revolution to Promote Economic Growth in Developing Countries: Policy Changes, January 2004

9. Dutta A, Roy R., *Internet Diffusion in India and China – Comparison Based on Feedback Loop Dominance*, Proceedings of the 37th Hawaii International Conference on System Science, 2004

10. Bazar B., Boalch G., *A Preliminary Model of Internet Diffusion within Developing Countries*, 3rd Australian WWW Conference, Lismore, NSW, 1997

11. Fuantes-Bautista M., Straubhaar J., Spence J., *The Social Shaping of Internet from Below: NGOs and Gouvernment's Roles in Internet Development in Brazil and Peru*, 53rd Annual Conference of ACM, San Diego, CA, May 2003

12. Beilock R., Dimitrova D., An Exploratory Model of Inter-country Internet Diffusion, Telecommunication Policy, 2003, No. 27, pp. 237-252

13. Baliamoune M. N., *The New Economy and Developing Countries*, Discussion Paper No. 2002/77, United Nations University, August 2002

14. *Central and Easter Europe Information Society Benchmarks, Summary report*, prepared by a consortium that included University of Sunderland (UK) and Fraunhofer Institute for Systems and Innovation Research (D), 2004

15. Gholami R., Lee S. Y. T., Heshmati A., *The Causal Relationship between Information and Communication Technology and Foreign Direct Investment*, Discussion Paper No. 2003/30, WIDER,United Nations University

16. Jones D., Jamieson K., Clark D., *A model for Evolving Potential WBE Innovations*,

17. Gallagan D., Modeling Management of Research and Education networks, PhD Thesis, ISBN: 90-9018398-1, 2004

18. Bogdanovicz M., Gaspar P., *Determinants of Diffusion and Productive Use f ICT: The Broader European Picture*, Proceedings of the 4th International Conference organized by "Transformation, Integration and Globalization Economic Research", May 2004, Warsaw, Poland

19. Kitsing M., *Encouraging Internet Diffusion: Lessons from and for Transition Economies*, Policy Paper 2003, Center for Policy Studies affiliated with the Open Society Institute and Central European University, Budapest, 2003

20. http://www.heritage.org/research/features/index/countries.cfm , accessed March 2005

21. http://www.worldaudit.org/democracy.htm, accessed March 2005

22. http://amsterdam.nettime.org/Lists-Archives/nettime-l-9901/msg00011.html, accessed March 2005

Estonia: A Primer to Follow

Implementing the Open Model to Estonia

1. Introduction

Estonia is recognized as one of the CEE countries with significantly high usage of ICT services. This is despite the country not having the highest GDP per capita in the region, [1]. The metrics such as the density of the main telephone lines and the number of computers per household lag also behind those in Croatia, Slovenia or Check Republic. On the other hand, Estonia has expressed very high inclination and enthusiasm towards experimenting with and fast adoption of the contemporary technologies. The research and development strategy for the period from 2001 to 2006, entitled Knowledge-based Estonia, [2], envisions a research oriented towards new knowledge society, skills, competence, and the development of human resources that generate competitiveness, and improve quality of life. The main objectives of the Estonian policy in building the information society have been the introduction of e-government services, the growth of export in the ICT sector, and attain the ICT comparable with EU average.

The decisive factors for the establishment and development of the information society in Estonia, according to the report done by Praxis centre for policy studies, [3], have been (1) building up modern infrastructure; (2) Tiger's Leap Project in computerizing schools and universities; (3) adopting regulations for information society; (4) government IT-programs; (5) collaboration between the government, private sector and non governmental initiatives, and (6) last but not least luck.

The text that follows briefly describes Estonia. Then it tries to analyze the factors that have influenced ICT diffusion in the country in the context of the open model presented in the study, [4]. We shall attempt to identify the presence and the extent of all the factors enumerated in the model, in the process of ICT diffusion in Estonia. Next, the absence of the factors in the model, if any, and yet relevant to Estonia shall be used for rectifying the model itself. This will eventually increase both the integrity and the credibility of the Open model.

2. Country Overview

Estonia, as show on Figure 1, is a rather small country. It has about 45 thousands square meters, and population that is less than 1.5 million. It is located in Eastern Europe, across Sweden, bordering the Baltic Sea and Gulf of Finland, between Latvia and Russia. The official language is Estonian, but 28% of the population is Russian.

Figure 1: Estonia

After centuries of Danish, Swedish, German, and Russian rule, Estonia gained independence in 1918. It was incorporated into the USSR in 1940. Almost fifty years later, in 1991 became independent Soviet Union collapsed. When the last Russian troops left in 1994, Estonia started vigorously to promote economic and political ties with

Western Europe. Estonia is a member of UN and OSCE since 1991, the Council of Europe since 1993, WTO since 1999, and joined both NATO and the EU in the spring of 2004.

The constitution from 1992 established Estonia as democratic parliamentary republic. The people elect the parliament (Riigikogu), while the executive power rests with the government. Administratively Estonia is divided into 15 counties, 202 rural municipalities and 39 towns. The head of the state is the President of the Republic. The capital is Tallinn with less than a half million population.

In the period before the break of SU, even the proximity of Scandinavia could not improve the diffusion of the innovative technology due to the tight controls imposed by the Coordination Committee on Multilateral Export Controls. The number of main telephone lines per 100 inhabitants was about 20, almost a double then the average in SU. Most of the heavy industry, left from the Soviet era, became useless after the privatization. The political barriers imposed by Russion Federation made the Russian market hardly accessible. The lack of quality and standards excluded Estonian products from serious competition in Western Europe.

Sweden, Denmark and Finland, as neighbors, have had a major impact in transforming the Estonian society. This was supported by a large amount of direct foreign investment, good education on average, and in particluar the widespread of technical skills and knowledge. The Institute of Cybernetics, founded in 1969 focused its research on computer programming, thus investing in future ICT experts. All of this made it possible for the large part of population to easily adopt modern technologies such as ICT.

3. Factors for ICT diffusion

3.1 Economic Factors

GDP

The period right after the dissolution of SU in Estonia is characterized by the deep decline in the GDP due to the transition from controlled to market economy. The government soon liberalised trade and prices; it was later followed by the privatization of several important companies, [5]. Currency was reformed and Currency Board system established. In 1994, with the increased macro-economic efficiency and stability, the economic growth became reality. The rate of the growth from 1994 to 1998 exceeded the average growth of the EU countries. Unfortunately, the devaluation of the rouble in 1998 and other CIS (Commonwealth of Independent state) currencies had negative impact on the economy and caused a drawback in GDP growth. Nevertheless, it pushed ahead orientation to the Westtern markets and provoked structural changes. So the pace of economic growth picked up again after 2001. Another plausible cause for the increase of GDP per capita was the decrease in population due to negative natural growth and migration.

Although the GDP growth rates have been quite good, the value of USD 4700 for the year 2002 places Estonia behind five other CEE countries. Interestingly enough, while the per capita GDP is about 2.5 times higher in Slovenia, the number of Internet users per 10000 inhabitants is higher in Estonia then in Slovenia.

Telecommunication infrastructure

In the early 1990es, Estonia had rather inadequate infrastructure for telephone services. The analogue network though better off than in many other SU regions had only 363 thousends main lines, which made the queue for telephone installation unacceptably long. The lines and the exchanges were with a poor quality. The transformation of the state

telecom into a private company Eesti Telecom in 1994 helped in creating favorable conditions for building the new infrastructure.

Today, there are direct cable connections to Sweden and Finland and links to the Russia and Latvia. These links notably improve data transmission and network capacity. Several large companies in Estonia have joined their forces to develop the Internet within the country. The goal is to make the Internet accessible to the majority of Estonian residents. Because of the focus placed on the expansion of the core network infrastructure and suitable access to the general population, Estonia has one of the highest degrees of connectivity in Europe. Figure 2 illustrates the rapid growth of main telephone lines and digitalization.

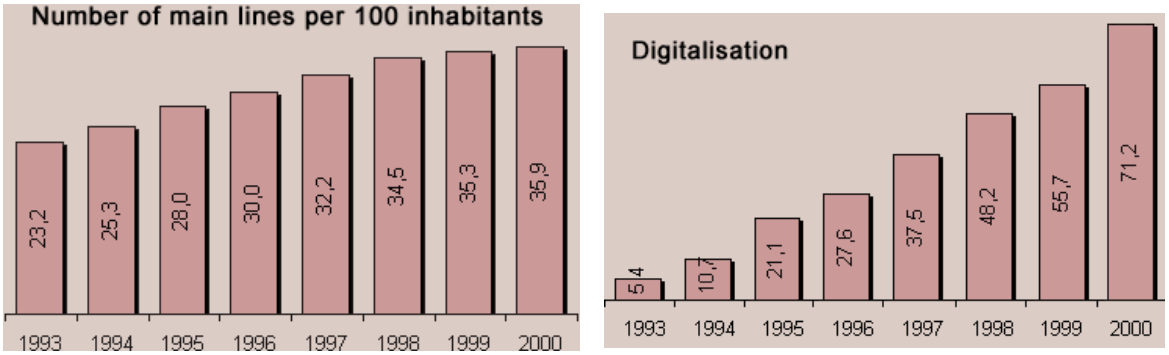


Figure 2: Telecommunication infrastructure growth

The penetration of the telecommunication infrastructure into the most of the rural areas was accomplished through the Concession Agreement with the Estonian Telephone Company. The connectivity in rural and scarcely populated areas was stimulated with lucrative urban contracts. The government is actively extending connectivity throughout the country. By 2002, Estonia has built over 300 public Internet access points providing free email. These points are also places where citizens can conduct the majority of transactions related to e-government (public administration) services.

The major telecommunications operator in the country is Eesti Telefon. Smaller companies that compete on the mobile phone market are AS Eesti MobiiltelefonAS, Radiolinija, Eesti and Ritabell. Estonia has two mobile communication networks, one based on the NMT-450 standard and the other on the GSM standard.

The railway company AS Eesti Raudtee, the gas company AS Eesti Gaas, the energy company AS Eesti Energia, and several cable TV service providers offer telecommunication services too.

ICT Production and Consumption

Estonia, similar to many countries in the CEE region emerging from planned economies, inherited an extensive industrial sector with low productivity and a desperate need for restructuring, [3]. The largest share of the direct foreign investments was absorbed by the finance and transport sector. The development of the ICT sector has been rather slow in the first decade. Despite of low investment in the ICT industry, the production has slightly started to pick up after year 2000. The major drivers for domestic ICT cluster were the telecommunication sector, banking and governmental structures. It was estimated that

there were about 450 ICT companies in 2002, most of them as subcontractors to foreign corporations and vendors. Very few of them were capable of selling on their own due to the lack of high standards and low product sophistication. The leading exporter Elcoteq and few others related to telecom stuff export 20 times more than the rest of the ICT sector. The Largest trade partners for ICT goods are Finland and Sweden.

For now, in the field of ICT Estonia is more user then producer. Estonian Telephone Company (Eesti Telefon) held the monopoly in the telecom services until 2001 when the liberalization and deregulation stared. The hope that the emergence strong competition would reduce the high tariffs for data communication services did not materialize right-a-way. The incumbent Eesti Telefon has been trying to take advantage of its dominant position on the fixed telephone market with unreasonably high connection fees in stark opposition to the policies of the National Communications Board. The significant reduction in international calls was counter-balanced with the increase in the local calls. The leased line Internet connection prices were cut to one-half. What is more important, according to the Estonian Telecommunication Act, the Internet access is considered as an universal service and all telephone network operators are obliged to provide it at the sound price to everyone and everywhere in the country.

Foreign Direct Investment

Immediately its independence in 1990, Estonia has attracted foreign direct investment. The amount invested have been steadily growing till 1994, slightly diminished in 1995 and 1996 and peaked in 1998. As the domestic saving rate is far too low for funding necessary investments, the influx of foreign capital has remarkably contributed to investments, [5]. The main portion of the foreign investments was made by leading ICT nations like Sweden and Finland as shown on Figure 3.

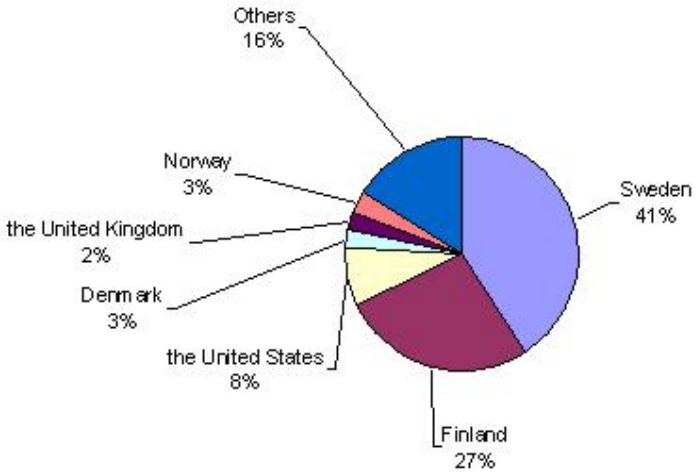


Figure 3: Direct investment stock by countries (December, 2002)

A hefty share of the foreign investment in Estonia was in the banking sector mainly due to the strong presence of the Nordic banks. Transport, storage, and the telecom sector were other segments for investment, especially after the privatization and liberalization. Swedish and Finish companies own most of the enterprises in ICT sector. The capital from these countries supported technology transfer, improved management culture and promoted ICT penetration. The foreign direct investment per capita in Estonia compared to some other CEE countries in the period 1990 -98 is presented on Figure 4.

Spending in Research, Development and Education

When compared with the situation in the EU countries (average of 1.7% of the GDP), the R&D investment in Estonia lags considerably behind. The percentage is smaller when compared with some of the CEE countries (for example, Slovenia which has 1.6%).

In 2001, the Parlament adopted the national research and development strategy where the government commits itself to much larger support to the top scientiest. Figure 5 presents the research development expenditure with the plans for the future.

The annual average growth rate of spending for R&D during 1998–2003 was

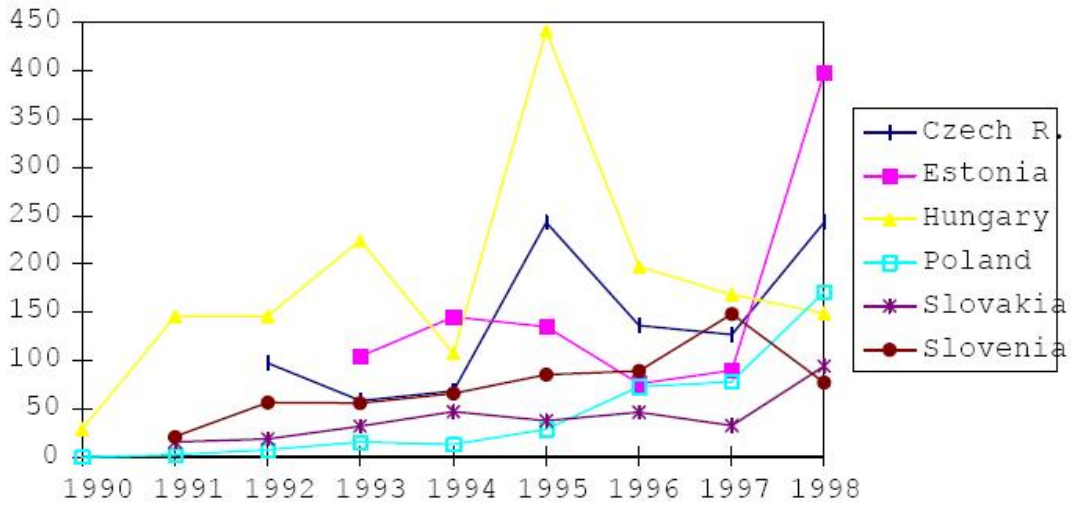


Figure 4: FDI inflow per capita in US$

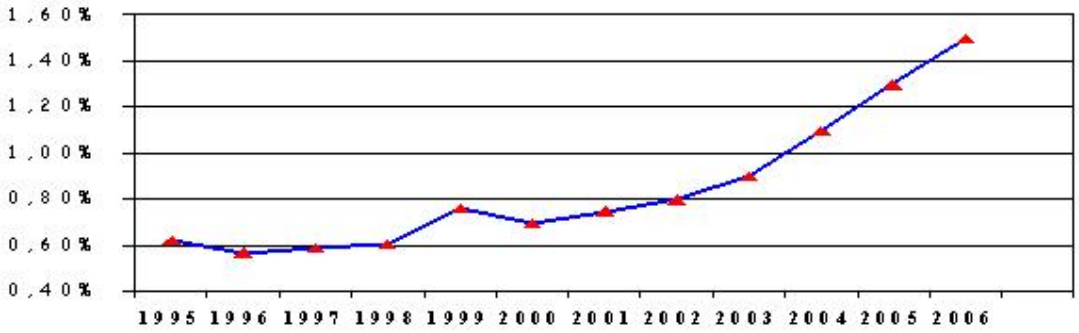


Figure 5: Total research and development expenditure with plans for the future

higher than the rate in the gross domestic product (GDP). The value of investment in higher education doubled, which hugely increased the potential of universities.

Summary on Economic Factors

Figure 6 presents the relation between the economic factors from the model in [4] applied for Estonia, as described above, and the factors for establishment and development of the information society as described in [3]. The size of the circles representing each factor corresponds to the importance the particular factor have had for Estonia in the period since the independence in 1991 to the year 2002. It is derived from the values in Table 1

where the numbers for Estonia are compared to the numbers for a CEE country with the highest value for the particular parameter for the year 2002.

Economic Factors										
GDP		Telecommunication Infrastructure				ICT production and Consumption		FDI	Spending in Research and Development	
GDP per capita in 2002 in US$ (ITU)		Main Telephone lines per 100 inhabitants in 2003 (ITU)		Cellular mobile subscribers in 2003 per 100 inhabitants (ITU)		Avarage share of ICT spending (in %) in GDP, 93-01 (WITSA source)		Foreign Direct Investment	Research and Development expenditure as % of GDP, 1996 - 2001 (UN)	
Estonia	Slovenia	Estonia	Croatia	Estonia	Check Republic	Estonia	Check Republic	Figure 4	Estonia	Slovenia
4732	11020	35,06	41,72	65,02	96,46	no data	6,8		0,7	1,6

Table 1: Economic factors for Estonia compared to the country with the highest value

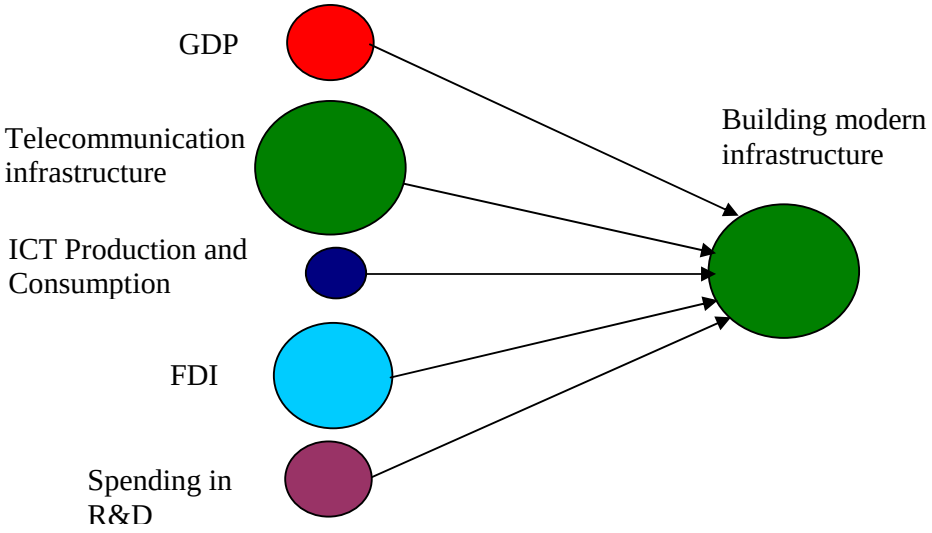


Figure 6: Economic factors

The only factor mentioned in [3] and referred to as "building up the infrastructure" is considered to include all the economic factors from the model in [4]. One could ague that the modern infrastructure is the driving force in developing the information society and a precondition for ICT penetration. All the others should be considered as having only a minor contribution towards creating this necessary environment. Obviously the model presented in [4] had given a wider view, taking into account many more aspects of economic nature that influence the increase of ICT diffusion and contribute to the rise of information society.

3.2 Human Capital

Education

Estonia is a highly literate society and places a strong emphasis upon education. There is a social consensus in Estonia about one of the main prerequisites for development. Highly qualified human resources have main impact on assuring the social growth and the diffusion of knowledge. The importance of educated people was especially emphasized during the process of transition towards the knowledge-based economy. Therefore, the state has demonstrated readiness to provide education compatible with the needs of information society.

Emphasis on building a good education system has been one of the critical success factors. The country now boasts a highly educated and skilled workforce, with nearly 45 percent of all citizens pursuing tertiary education. To meet the demand for the growing ICT workforce and to supply knowledge workers, an emphasis on practical skills has become part of the university curricula. The net result is users who are highly adaptable to technology change.

In 1997, the government embarked on the ambitious project termed as Tiger Leap. The key objective was to connect all Estonian schools to the Internet. Before the start of the project, the schools were rarely equipped with personal computers or Internet access. Teachers with basic computer skills were very limited resource.

The program has developed IT infrastructure in schools, trained Estonian teachers in computer proficiency and the Internet, and opened new possibilities for teaching their subjects. In addition, it supported curricula development with the help of an interactive learning environment, promoting learning skills and connecting the educational system to information databases, [3]. By 2000, the Estonian schools were computerized and the Tiger Leap Plus Program was an expected extension. The "Plus" program focuses on ICT competencies, virtual learning, sustainable development, and collaboration among the government, schools, parents and organizations.

Five universities (University of Tartu, Tallinn Technical University, Estonian Business School, University Nord and Tallinn Pedagogical University) and a number of polytechnics offer degrees in information technologies and management. Another specialized IT College was established in the year 2000. It is a private institution that works closely wit ICT industry and has a considerable support from the Swedish government, [6]. The E-Governance Academy, created in 2002 aims to transfer knowledge to top policy makers and government ICT specialists in less developed countries.

To carry out the lifelong learning paradigm and to offer the opportunity to learn anywhere and at any time, four major universities (University of Tartu, Tallinn University of Educational Science, Tallinn Technical University and Concordia International University Estonia) have produced distance-learning programs.

Undeniably, with priorities on education and training offered at all the levels of the education system provided the country with the opportunity to spread and propagate ICT in the whole society. Together with the political decisions taken by a youthful and innovative Estonian's government it is a major contributing factor to the ranking that Estonia has today with respect to ICT readiness.

Research and Education Community

Estonian Educational and Research Network (EENet) was established in August 1993. The mandate of the EENet was to manage, co-ordinate and develop a computer network for science, education and culture. The services of EENet include connection to the Internet, and services such as web hosting, e-mail, ftp, DNS, and CERT. It operates as a state agency administered by the Ministry of Education and Research and has been involved in most of the ICT projects.

In 1993, the whole network that has spanned over the two major Estonian cities, Tartu and Tallinn, had less than two hundred computers. The expansion has been immense and impressive. The number of end-users of Estonian academic network today is over 210,000 researchers, teachers and students from almost all counties in Estonia. Through Sweden, EENet is connected to the European Education and Research Network, GÉANT, with interconnection speed to Europe at 155 Mbps and to the rest of the world at 45 Mbps.

The interconnection speed between EENet and larger ISPs in Estonia is 100 Mbps. EENet is actively involved in large number of projects carried out in cooperation with universities and institutes. For example, the "Estonian GRID" (Eesti GRID) project has started in 2004.

Government Policies, Law and Practice

The Estonian government recognized the potential of ICT rather early and induced fertile environment for its penetration. The technology was one of the means for the government of young free marketers, under the premiership of Mart Laar, to increase the effectiveness of the public sector and demonstrate its progressive character in the 1990s. Estonia is often taken as a primer for the positive influence of the state policy to the raise of the information society.

In 1993, the government formed a special IT departement to co-ordinate all of the activites related to the national ICT strategy. These activies included the design and the implementation of a functioning state information system. The key part of this strategy was IT procurment, which encouraged private businesses to employ information technology as much as possible and to offer on-line services for the citizens to reduce the size of the government administration. The funds allocated for this purpose from the budget were not that impressive. The stability in financing, unambiguous objectives, and focused activities proved to be successful. In parallel with fostering EENet and ICT in academic institutions, all the ministries and government agencies were connected to the Internet and equiped with ICT. The EEBone connects more than 600 state institutions with 80% of them enjoying 2MBps (often 10MBps and more), [6].

One of the principal goals was to establish a mechanism for rapid privatization and liberalization process. It was followed by the decision to avoid protective measures on foreign trade and restrictions on the movement of international capital. Many foreign firms entered the Estonian market. While the incumbent PTO was privatized in early 90s. the liberalization of the telecom market was not possible without delay. Nevertheless, the Concession Agreement made with the Estonian Telephone Company proved to be a wise decision. The obligation of the company to improve the telecommunication infrastructure in the rural areas increased ICT diffusion. This was essential for further development of the information society. The other important feature of the Concession Agreement was the end of the monopoly in 2000, much early than anyone else in the CEE region. The possibility of other companies entering the telecom market was considered favorable for both price reduction and adoption of ICT.

The framework for building Estonian information society was documented in the “Principles of Estonian Information Policy” and approved by the Parliament in 1998. There are four main areas defined in the Policy Action Plan:

- Modernization of legislation;
- Supporting the development of the private sector;
- Shaping the interaction between the State and citizens;
- Raising awareness of problems concerning the information society.

Within the action plan a variety of e-Services have been developed by both private and public sector. In 1997 the public procurement system was started. The decision by the Government provided for the establishment of State Procurement Register, which later became the fundamental institute for public procurement. As a result, all activities related to public procurement are Internet-based. The register was launched on 1 April 2002. The e-government portal, as a common access point for all Estonian government institutions

was available since 1998. Its content, interface and services offered are continuously improved with new content, databases and links. In order to enhance the participation in the decision-making process of the state, the e-government portal includes a democracy portal also. Citizens can submit ideas, guidelines, and comments on any draft legislation.

The new ID cards provided Estonians with an electronic identity. E-citizen is a nation-wide project for developing cooperation between Estonian citizens and the public sector through the Internet. E-TaxBoard application launched in 2000 enables the taxpayers to communicate with the Tax Board quickly, easily and safely. Within the Development Program of Public Internet Access Points, all public libraries will have tele-centers free access to the Net. Project e-Justice is about the information system of legislative proceedings, while the National Land Information System gives information about land properties and estates in Estonia.

The vision of the leadership and its commitment have been fundamental the propagation of ICT across number of sectors, including government and education. Instead of trying to position for ICT-related production or for outsourcing of ICT services, they produced a comprehensive and global effort that relied on synergy also. Strategic policies like the encouragement of ICT providers to support rural development through concession incentives, the support for co-operation with the Nordic telecommunications companies, decoupling politics from the computerization issue by channeling government investments through non-governmental agencies, and aggressive marketing campaign to encourage demand on range of services offered through the Internet.

Democracy and Openness of the Society

The transition to democracy in Estonia occurred both gradually and suddenly. The former took place during Era of Perestroika when various political and civic movements worked peacefully for reforms in the society. The failed coop attempt in Moscow during 1991 was a sudden event that made possible full independence and sovereignty.

The notion of restoration dominated the road to democracy. Many pre-war political and social institutions were eventually restored. There is ample evidence that Estonia during the last decade became one of the most politically free and economically open countries in the CEE region.

Estonia is a multicultural country. It has relatively high percentage of Russian population. The government understands that the lack of cohesion among the majority (Estonians) and the minority (Russians) is a potential danger for both the present and the future of the country. Language and linguistic homogenization of the population are principal measures for building a nation-based society. The method is considered to be relatively restrictive, [7], and is subject to many complaints by the Russian-speaking minority.

Content and Demand

The high level of connectivity and ICT use are immediate consequence of the active efforts by all relevant players that deal with content and applications. The number of web sites exceeds one million in Estonia, [6]. The spectrum of web services reflects different age groups and different needs. While the favorite activity of the youngest group is playing games, those in the range of 15-24 years prefer to communicate via e-mail. The Internet usage of older age groups is more related to the content offered. The following numbers were obtained from an extensive survey over the large sample of population, [8]. Those who have used Internet during a week have done it for the following purposes:

76 % sending and reading mail

56% using search engines

62 % searching for specific information from databases or home pages

57% visiting portals

57% using Internet bank

The government has merged as the driving force for development of various societal services. Hence, the majority of governmental institutions have integrated their web sites into the State Web Center, which made possible to get almost all official forms and to file tax reports via the net.

The most popular Internet service in Estonia is e-banking. This is largely due to the portals developed by every bank and to the new ID cards as a precursor to e-identity. With respect to e-banking Estonia is at par with the Nordic countries.

Electronic trade in Estonia is still far from being popular. There are a number of Internet shops offering books and publications, software and hardware, multimedia, flowers, and some durable goods, [5]. One of the reasons why e-Commerce does not fly yet is the fact that the teenagers make the majority of Internet, and their financial potential makes them least likely to buy goods via the net.

A portal called Miksike is an integrated learning environment for teachers in schools that provide education in Estonian language for schools outside Estonia and to parents for home instruction and education. Miksike servers get 80-100000 page viewers per a school day, [5].

The health information system in Estonia is not yet integrated. There are many databases, but no federation has been established. Health related services like interactive advice or appointments for hospitals are available on-line. The health sector project 2015, approved by the government, aims in restructuring the health care system and producing an integrated e-health information system, [5].

It is very attractive to use value-added services via mobile phones, [5]. Estonia was the first country to have mobile positioning system in commercial use, and one of the first to have emergency calls linked to it in order to determine the origin of each call. Payment of parking fees and other bank related services are also possible from a mobile phone. Mobile transport ticketing pilot project was launched in 2002 and has been deemed to be successful.

There is a recursive relationship between the pervasiveness of the technology, the content offered, and the demand for services. The more people are provided with Internet access, the bigger is the competition for designing attractive services. The larger is the variety and the better the quality of the services offered, the higher is the number of persons to use them. In Estonia, the high level of connectivity and ICT use are a direct consequence of the active efforts by the stakeholders from multiple sectors to provide relevant applications and content.

Summary on Human Capital

Figure 7 gives the correspondence of the factors as described in [4] and those in [3]. The large circles representing each of them show that this group of factors has been the

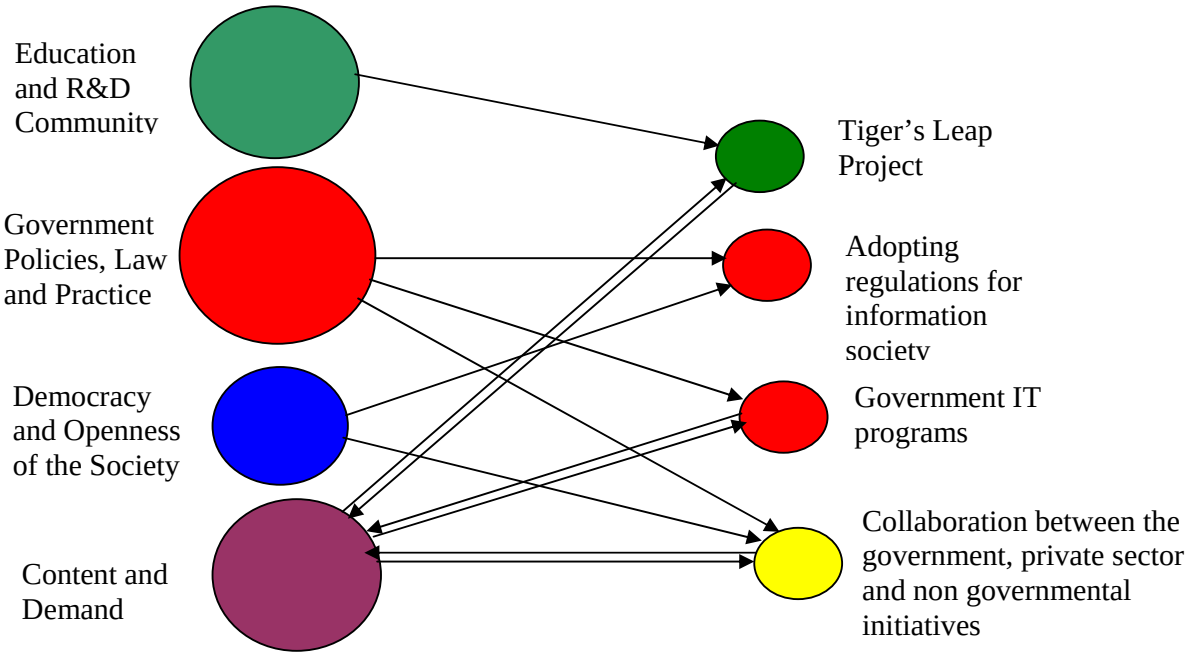


Figure 7: Human Capital

most prevalent towards ICT diffusion in the case of Estonia. There are no numeric figures that will correspond to the significance for each of them. The size of the circles are free qualitative estimates by the authors and correspond to the facts stated in the text.

3.3 Local factors

Geography

The location and the size favored ICT diffusion in Estonia. Being close to the Nordic countries, which are leaders in ICT, and having rather small territory and population are potential advantages, [6]. It was only natural that the major direct foreign investment would flow from Sweden and Finland. The same is true for the companies that entered the telecommunication field, as well as for the majority of joint projects.

Culture, Language, Gender Issues

The study on digital divide in Estonia, [10] shows that it still exists. The reasons for it are age, gender, language, social status and others. Two groups of people who are not using the Internet are identified as "Blue collars" and "Passive people". The first group consists mainly of unskilled workers who do not need computers for their job and therefore are not interested in new technology – no direct benefit from it. In addition, they usually lack skills in computers and foreign languages. The second group includes those over 50 years of age, without any interest to change their daily routines, and those who prefer the traditional media to a new one. The main barriers for shying of the Internet in both groups are mainly lack of motivation, distrust of e-services, no information content in the required language, lack of skills, and reluctance to use public places for Internet access. The prevalent percentage in both groups comes from the Russian language population.

The study identifies the non-users, and addresses polices for e-inclusion. The recommendations are mainly directed to the Government of Estonia underwriting that their accomplishment is conditioned on cooperation with the private sector. The conclusions stress that public and private sector information content and services available in Russian would be become more effective if accompanied by a relevant advertising campaign. Another important issue is overcoming the skill barrier by offering education courses and creating points for hands-on training.

Involvement of the NGOs

The number of NGOs in Estonia is large. Some of them have had an impact on the decisions made by the state authorities, [9]. There is a difference among the NGOs and their place in the society in general. Quite few are hobby groups that do not have much interest in influencing state policies. The size of an average NGO is small, so that further diminishes its ability to participate in policy-making. Strong and prominent NGOs that could have considerable influence on state authorities are only handful.

Several positive examples of partnership between the NGOs, the private sector and the government concerning ICT really make the case for the synergy. One example is the project Look@World, which aims at supporting the use of Internet and improving the quality of life of the Estonian residents. As a result, more than 60000 people, from all regions, got the opportunity to use web-based public services offered by the state through the local municipalities and other Internet based facilities. The collaboration between the government and the Open Society Institute (OSI) produced the Regional e-Governance Center. Its aim was to serve as a point for training in coordination, organization and usage of ICT services for the public sector managers, specialists, and representatives of the third sector from the FSU countries, CEE region, and Asia.

Summary on Local Factors

Figure 8 presents the local factors in the model for ICT diffusion. There is only a partial relation to the factors enumerated in [3]. We have also assumed that the factor named as “luck” could be included here and related to geography, culture, language and gender issues. It is our belief that these factors influenced ICT diffusion in Estonia during the last twelve years.

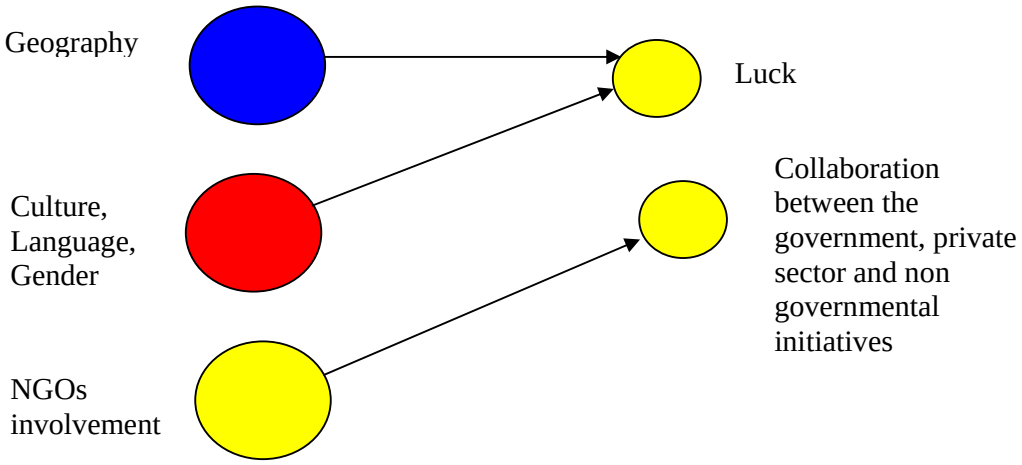


Figure 8: Local Factors

3. Conclusions

The major factors that have made Estonia a relative success story concerning ICT and its proliferation and usage are subject of the paper. By inducing a favorable environment for close cooperation between the public sector, companies and civil society, the country has built the necessary infrastructure and produced information society services available to all citizens. More then 40% of the population uses Internet services regularly, 38% owns computers and 82 % mobile phones, which makes Estonia one of the leaders in CEE in reference to e-readiness.

Well-educated population combined with a strong political will to use ICT, as a vehicle to speed up the development, positive citizen attitude towards new technologies, and constructive influence from the neighbors were dominant in the process of ICT diffusion. The infusion of content and variety of services (G2G, C2G, G2C, C2B, and B2C) made the case for pervasive diffusion even stronger. The data supplied by the Figures 6, 7, and 8, only confirms the dominance of human capital in putting Estonia on the right track to Information society.

References:

1. *Measuring the ICT Diffusion, A Review on the current situation,* presented as a part of the ICT4ICT project report
2. *Knowledge Based Estonia,* Estonian Research and Development Strategy 2002-2006, Tallinn 2002
3. Krull A., *ICT Infrastructure and E-readiness Assessment Report: Estonia*, Praxis Center for Policy Studies, 2002-2003
4. My model
5. Puss T., Rajasalu T., Venesaar U., Viies M., *Factors and Impacts in the Information Society; A Prospective Analyses in the Candidate Countries; Report on Estonia*, Technical Report EUR 21284 EN, March 2004
6. Siil I., *Estonia: Preparing for the Information Age*, *ICA Information*, No. 75, June 2001
7. Pettai V., *Competing Conceptions of Multiethnic Democracy: Debating Minority Integration in Estonia*, presented at the European Consortium for Political Research, April 200, Copenhagen, Denmark
8. Kerem K., *Internet Banking in Estonia*, research paper financed by the International Bank for Reconstruction and Development (IBRD) allocated to PRAXIS Center for Policy Studies.
9. *Implementing Life-long Learning Strategy in Estonia*, Progress Report on the follow-up to the 2002 Council resolution, Reply to the Commission questionnaire, Brussels 2003
10. Kalkun M., Kalvet T., *Digital Divide in Estonia and how to bridge it: Executive summary,* Publication of Praxis Center for Policy Studies, No. 1, 2002

Pilot 1

ICT and Official Statistics for Development

Contact Persons: Rolf Dalin, Mid Sweden University

Tigran Zargaryan, Automation Department, Yerevan State University, Yerevan, Armenia

Arevik Hakobyan - National Institute of Education (Armenia);

Sona Martirosyan - National Institute of Education (Armenia)

Evaluation of the Armenian activity in the Spider project ICT4ICT

The Armenian activity within the Mid Sweden University Spider project ICT4ICT consists of creating and running a brief course in a Life Long Learning (LLL) setting. This means that the target groups are professionals who are already educated, but who may need to add specific professional skills to their competency profiles. Considering this target group, attention must be paid to the delivering the course in such a flexible manner that it meets the needs for the participants in that target group. The main objective of the project is that the course will be given to an international audience, and this is combined with the requirement of participants' flexibility. The abovementioned requirements could be satisfied through using the Internet in an e-learning setting.

The development of this idea of an Internet based course in a LLL-context is based on the needs analysis done by Tigran Zargaryan, who has been leading the Armenian activity. Through the following brief overview of the Armenian situation on ICT, it is clear how the idea of the course development activity was derived.

Needs analysis in terms of the present ICT-development in Armenia

In the field of implementation of ICT in Armenia local authorities and experts, specialists from NGOs and donor organizations are trying to coordinate activities in 3 directions:

- Connectivity;
- Competency;
- Content.

The resulting situation in the above-mentioned directions could be formulated in the following way:

Connectivity

Starting from 1997, Project Harmony, World Bank, IREX, OSI, Eurasia foundation, NATO, CRDF, UNDP, USAID have financed and successfully implemented projects on connecting Armenian schools, Universities, public libraries to Internet, and equipping organizations with personal computers. In republic we have a fiber optic backbone, which connects educational, academic and cultural organizations and institutions to each other with high-speed broadband channel. Armenian research and educational network of academic institutions (ARENA) connects cultural and educational organizations to the world information space. ARENA center, as an independent organization, is established and is functioning in the building of State Engineering University. UNDP has established an Internet free access center in Yerevan - http://www.freenet.am. In regional public libraries and village school libraries "Community centers" are established (financed by Open Society Institute), from were community members can have an Internet access. One mobile computer classroom is functioning in Gegharkunik region (sponsored by Project Harmony).

Competency

During the last 10 years the donor organizations and several local NGOs actively are involved in organizing and conducting training courses. Topics, covered during the training sessions could be divided into the following subjects:

- System administrators for Linux and Windows servers;
- Managers of regional tele centers;
- Administrators of WebCT;
- Basics of computer literacy /word-processing systems, spreadsheets, Internet, Windows, Web design etc./ for:

- School teachers;
- Librarians, museum workers and archivists;
- Municipal workers;
- Students and pupils.

Since 1998, specialists from Armenia have started to participate in WireEd workshops organized by CEENet.

Content

Although the Competency and Connectivity aspects are being developed during a long period of time, the Content aspect is still in a stage of formation. One of the significant projects in Content creation is "Armenian libraries Union Catalogue" - http://www.armunicat.am:4505/ALEPH (financed by Open Society Institute). Catalogue now contains more than 1,000,000 records in Armenian, Cyrillic and Latin scripts. 12 major Armenian libraries are amongst the project participants. Several other content databases, having connection with digital library modules, are in a creation process. During the discussions with local IT experts, they mentioned the importance of the implementation of e-learning platforms /commercial and open source/, creation of distance learning courses, and making them accessible to students, specialists and residents from rural regions.

According to the suggestions, in a range of ICT4ICT project we focused our work on 4 directions:

1. Creating wireless access points and placing three "Pentium 4" personal computers with Internet connection in Yerevan State University library, as a public access points for students and teachers.

2. Creating a web-based course "ICT and Official Statistics for Development". WebCT being one of the world e-learning systems for educational needs has been selected for the course development. Besides, many Armenian specialists have passed WebCT trainings during the CEENET workshops and training courses for telecenter managers.

3. Pilot testing of a course with the help of experts from National Assembly, Yerevan State University and National Institute of Education.

4. Advertising project results.

The structure of this evaluation and frame of reference

For a project activity of this kind to be valuable, it should create a useful product that is sustainable. Therefore, the evaluation basically will focus on these three concepts – usefulness, sustainability and replicability.

Usefulness

Since this project activity is aimed at creating a specific training course, the course must be *useful* for a specific target group for which the training is developed. So, the target group specification together with the needs for the training in that target group compose the first item on the evaluation agenda. But to be useful the course has also to be *accessible* to the target group. This will be the second item. If the course has a useful content and is accessible to the target group, we will consider it to fulfil the usefulness criteria. In the specific case of the course we are discussing here, accessibility has also another aspect. The course is about using official statistics, so these statistics must obviously be accessible.

Sustainability

The sustainability issues of an e-learning course are mainly on the institutional level. One such issue in this kind of enterprise is the question of *future delivery*.

Another issue is the *maintenance of the course*, which goes for both course environment and content.

Replicability

For a course as a product of a project to be replicable, it must be *reusable* without much extra work. Replicability is also about *lessons learnt* from experiences.

Frame of reference

As a frame of reference suitable for evaluating this LLL pilot course we are using the analysis of the concept of flexible learning which has been made in a discussion paper by professor Louise Moran, at the time associated to Mid Sweden University (Moran 1998). The part of the analysis which is the most applicable for LLL is the one which brings up the issues of the learner and of the strategies required:

"Flexible learning

- Applies to teaching and learning wherever they occur – on campus, off campus, and across campus
- Frees up the place, time, methods and pace of learning and teaching
- Is learner-centered rather than teacher-centered
- Seeks to help students become independent, lifelong learners
- Changes the role of the teacher who becomes a mentor and facilitator of learning.

Implementation requires the integration of:

- Teachers who have the skills in course design and teaching necessary to support student-centred, lifelong learning
- For students from diverse backgrounds, learning styles and motivations to study
- To assist them to achieve their personal goals and the University's goals for qualities of its graduates

Through strategies such as:

Courses:

- Degree and course plans which set out specific learning outcomes and generic graduate qualities, and the ways in which each will be achieved
- Course content which takes account of students' backgrounds and recognises that we live in a global community

Teaching and learning:

- Use of learning materials and technologies which are appropriate to the subject and needs of the students
- Teaching methods which free up the time, place, mode and pace of learning
- Information literacy and support programs which assist students to become independent lifelong learners

Organisational arrangements:

- Teachers working in networked partnership with academic support specialists
- Organisational structures, planning and resource mechanisms which enable rapid, networked support to flexible learning
- Collaborative networks that free up modes of teaching and the range of courses available on any campus, at home or at work

Based on:

- Evaluations of experience and practice in flexible learning in higher education
- Research into the educational, social, technological and policy issues underpinning university teaching and learning in a rapidly changing environment."

Usefulness

Target group needs

The use of official statistics is essential in the development of planning and monitoring on national and regional levels, considering both regions among countries and regions within countries. Such planning and monitoring typically include setting targets for change, and monitoring the development. Indicators are then defined to give a picture of the baseline situation as clearly as possible. These indicators can be both qualitative and quantitative, but the quantitative indicators that can be found within the realm of official statistics are very important both in describing the baseline situation and in the monitoring process. These statistics are typically published periodically and updated annually, quarterly or by any other periodicity. Since the indicators are updated periodically, the baseline situation of a certain development need can be described not only as to the level of the indicator(s) at a specific time, but also as to the trend during the latest periods before that time or any other systematic pattern of variation in the data.

The indicators defined for baseline description and for the monitoring process do not have to be the exact indicators provided by official statistics. Instead, an indicator used in the development analysis process could be a ratio or difference of one indicator to another, or any relevant recalculation based on an indicator from official statistics. If the target is to have a development in one indicator which is better than average among similar regions within the same country, a ratio of these two official statistics can be the relevant indicator to use, etc.

The discussion above about setting targets for development needs and finding relevant indicators for the baseline description and the monitoring process, helps to identify a target group of this course and its needs for specific knowledge and skills. The target group consists of anyone who will be working with development efforts in a structured way in any field of society.

Some of the skills needed will be to define and find official statistical data on relevant indicators for development in the specified field, doing the necessary computer work of retrieving the data from these official sources, performing the further calculations needed, illustrating with relevant graphs of the baseline situation and the change monitoring. This work is typically being done using the Internet for data retrieval and using a spreadsheet program (such as Microsoft Excel) for calculations and constructions of diagrams and tables. All results of this descriptive and monitoring work have to result in answers to questions or conclusions drawn about the development being made, so communication of findings is essential. This is done by reporting the findings in a document which typically will be illustrated by charts and tables generated in the data analysis process.

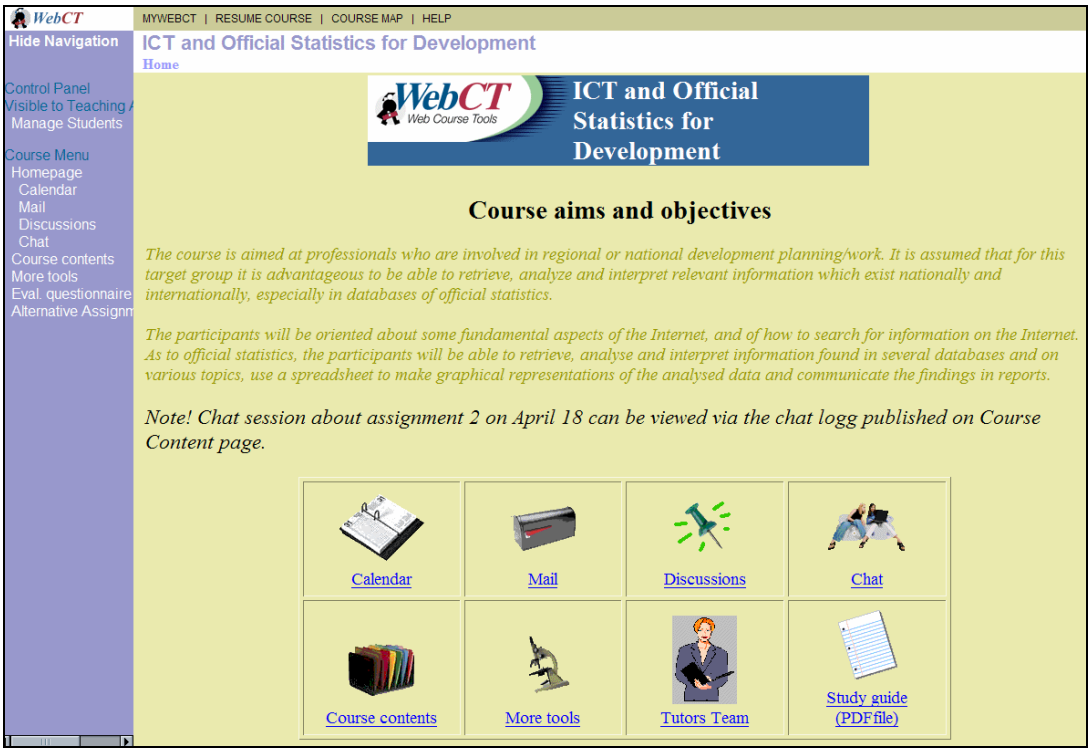
The skills mentioned above are of two kinds, when considering the level of abstract thinking. Defining the development problems and questions, aims/targets, indicators etc., as well as drawing conclusions from the data analysis and from the monitoring process, implies higher order thinking skills which typically requires higher education to achieve. Accessing and analyzing data by doing recalculations, by constructing diagrams and tables, and by communicating these results are examples of work that requires advanced skills but possibly of a somehow lower level of abstract thinking. This suggests that a training course aimed at meeting these needs could be delivered in two steps, where the second step involves mostly what is mentioned in the beginning of this paragraph as higher order thinking skills.

The experiences from our target group members in this training is that all of them find the course useful and valuable stating that they have gained new knowledge and skills. This is confirmed by the following statements by participants in the course evaluation: “It was useful for me. I learned news.”; “I upgraded my knowledge and think you should do another level with this course”; “ … a very interesting and challanging course”; “… statistical facts and make diagrams, which I can use in my work”; “I have never used official statistics before, and it has been very valuable.” /Also see the Conclusion./

Target group accessibility

In the LLL setting of this project, people belonging to the target group need the course to be flexible in certain respects. This will put specific demands and restrictions on the delivery of the course. Participants are likely to be occupied with other work most of the week and one participant’s occupation will mostly be independent of that of the others, so synchronic sessions are likely to have low attendance by most participants. Participants are also not likely to meet with each other in their regular study work, so they will need to collaborate and communicate a-synchronically with each other, typically using some web-based platform, so called learning management system - LMS. (See image 1.) Synchronic sessions need to be limited to special occasions and should preferably be optional in some way. I.e. if a chat session is used to discuss some topic, the text from the chat - the chat log should be made available for those who could not attend. So, this kind of course need not necessarily to be free from synchronic sessions, even face to face meetings could be planned and are usually very valuable, if the participants are not too far apart. Still it must be considered how a participant can have an alternative way to access most of what will be covered at such occasions.

Image 1



The learning management system allows all course functions, contents, communication and administration to be comprehensively managed by instructors and students in a web-based environment.

An obvious flexibility aspect which is not mentioned above is that participants who are fully employed, also need a course to have a limited workload measured in study hours per week, and also that course work load can be shifted between weeks to some extent by the students themselves. A balance between the need for individual flexibility and the need for collaboration must be considered. If individual flexibility is maximized, the collaboration in the course work between students will be broken down. It is technically possible even to have an individually flexible course to start and finish, and some participants could need this flexibility. But the difficulty with collaboration and communication other than with the teacher is obvious in such a mode of delivery, especially since the balance between the flexibility and structure is typically upheld by setting deadlines for exercises/assignments. For collaboration purposes collective deadlines are more or less necessary, so generally it is difficult to combine collaboration with flexible course start unless you have a very large number of participants.

It could also be noted that some of the demands and restrictions mentioned in the beginning of this section are typical for a single course, and if the LLL activity were a full curricula/programme, it could be planned for a target group consisting of full time students, and then the target group needs analyses would result in another set of restrictions.

The access to computers and to the Internet may be solved in one of several ways by the participant of the LLL activity, such as accessing a computer at the workplace, in access points in public libraries, in study centres or similar, or in the private home of the participant.

The experiences from our target group members in this training is that all of them find the course useful and valuable stating that they have gained new knowledge and skills /see the Conclusion/

During the last decade a lot of development has taken place in the field of official statistics. More and more official statistics bureaus are delivering more and more data freely, i.e. without charging any cost for the access and use of the data. Examples of this are Eurostat, Statistics Sweden and others. Besides of free access, the retrieval of data is also promoted by web-based interfaces that facilitate the composition of totally customized tables of data. This has been accomplished by database storage of data and by an interface for the user to retrieve data from that database. Many countries have less developed ways to present official statistics, and also cannot provide data on so many variables and in so many fields. Still useful data can be accessed and retrieved for use as indicators in development contexts in most countries. Data from more developed statistics agencies can then be used as comparisons to help in determining targets in the terms of indicators in the development planning process.

In the case of this course, the data used for exercises and examples were accessible over the Internet in Excel, HTML or Word formats. All participants were educated professionals in different areas, using computers in their daily work. Still some of them—three or four on each question—reported that they had insufficient skills in areas which are crucial for being able to benefit from this course: the areas were computer skills, web use skills, familiarity with Excel and fluency in English. This is all a matter of a prerequisite aspect of accessibility, and must be addressed when offering LLL-courses online. Language prerequisite can only partially be removed by translation, since international statistical agencies must be considered, regardless of participants' nationalities.

Sustainability

For future use and delivery a course in the LLL setting must be made available on a server, marketed by an organization/institution, and either offered like a resource that people can use for their own purposes just in time for their needs, or be delivered with tutors and with possibilities for participants to collaborate.

In the case of our pilot course participants were specialists from Armenia and Macedonia:

National Institute of Education of the Republic of Armenia – 7 participants;

National Assembly of the Republic of Armenia – 8 participants;

Yerevan state University – 2 participants;

Saint Clement Ohridski National University Library in Skopje – 4 participants;

Faculty for Natural Sciences, Saints Cyril and Metodius University, Skopje – 3 participants.

For the maintenance of the course content to be optimal, it should be in accordance with recent knowledge in the field. So the content should be maintained by a research institution with research in the field, or in collaboration with such an institution. In this case it could mean an official statistics agency, an institution dealing with regional development research or an academic institution which is carrying out research in the relevant field.

Maintenance of course environment could be done by an institution with competence and experience in e-learning/web-based distance education, and with the required technical resources.

The pilot course consists of theoretical and assignments modules, synchronous and a-synchronous discussions, self tests etc. Submission process of assignments was organized automatically, using WebCT functional capabilities, which helps sustainability since all files are easily maintained and also portable between similar systems.

Replicability

In the case of e-learning based courses, the replicability issue means that learning management system is providing facilities for automatic course backup and restoring it for further use, especially if it is compatible with other similar systems. This makes the content, the study guide and the tools needed for the learning, communication and collaboration easily portable.

In this pilot project we also wanted to gather experience of running an international course in a less than optimal environment as to bandwidth etc. and therefore the technical platform used was situated in Yerevan, although the bandwidth when connecting to the Yerevan server from abroad was limited. Therefore the situation was somehow similar to the situation faced when delivering e-learning in developing countries, even if you will have to adjust to smaller bandwidth still in many places in these parts of the world.

Deliver organizational matter

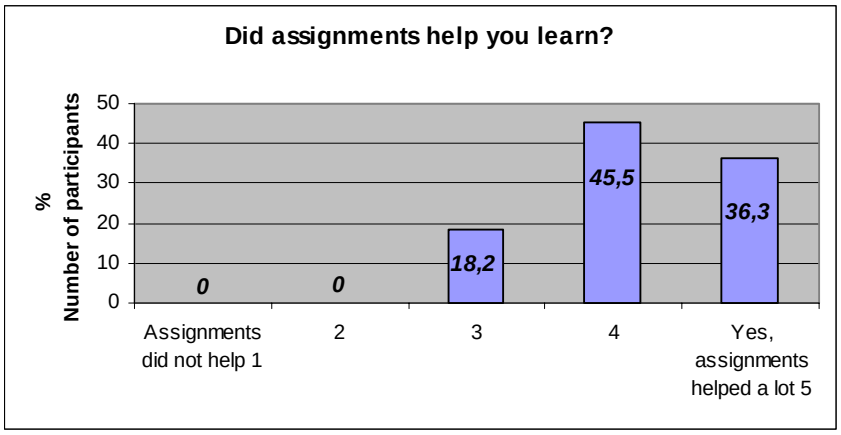
The course content has been delivered in an understandable and easy-to-use way. After each example there was an exercise which was aimed at acquiring skills how to get, retrieve and analyze data, construct diagrams and tables, as well as draw relevant conclusion. Then, two assignments were provided with the deadlines of first draft, peer feedback and final report. For the majority of the participants the deadlines were acceptable and no time pressure was felt during the entire course period. Participants were distributed within four subgroups, which made collaboration among participants more organized and productive. Each participant was required to share the first drafts with the subgroup members through the discussion forum. For individual questions e-mail was available for each participant. And for group-discussion questions and/or problems chat rooms were available, which particularly was used in clarifying the requirements of the Assignment 2. After submitting each assignment, all participants got very useful comments on their works by the tutors. By the end of the course participants were offered to evaluate the productivity of the course and make comments on further improvements. For this purpose, the tutors' team prepared an online questionnaire consisting of 45 questions, which were divided to the following subsections:

- Course content and design;
- Course delivery process;
- Course outcomes.

Conclusions

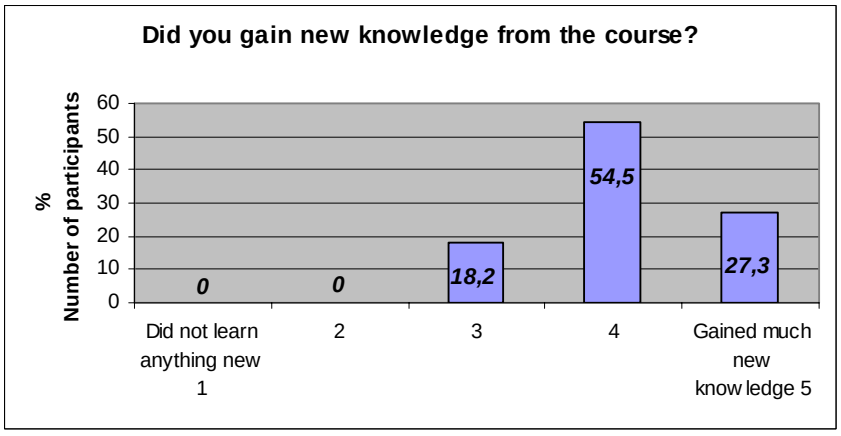
Life Long Learning courses are very useful, productive and valuable for specialists who want to broaden their scope of professional knowledge, obtain and develop new competences and skills parallel with occupational activities. The success of the developed course is evident from the results of the evaluation made by the participants of the target group, some of which are presented in image 2 – 4 bellow:

Image 2



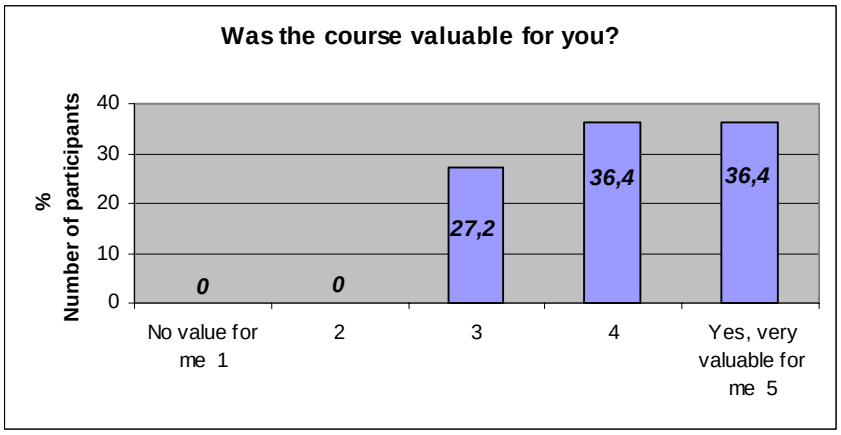
According to the chart above, for more than 80 percent of the respondents the assignments were helpful.

Image 3



From this chart it could be inferred that all participants acquired some new knowledge.

Image 4



For the significant portion of the target group members (about 75%) the course was very valuable.

The qualitative analyses show that for participants working in a new educational environment is challenging and productive, and they are interested in participating in such type of courses.

For specific competence development in the developing world, distance education, especially in a Life Long Learning context, has major possibilities. In the realm of higher education, courses and curricula will also be made accessible by web-based means of learning, but looking at the situation of people already educated and possibly in the workforce, many parts of the professional society in developing countries will require re-training and further education. This will require the development of specific courses in certain fields, making them accessible and flexible. It is a challenge to increase knowledge about the usefulness of this in a context of developing communities.

Pilot 2

Scientific Terminology

Contact Persons: Iskra Popova, Mid Sweden University

Nevena Ackovska, Institute of Informatics, Faculty for Natural Sciences, St. Cyril and Metodij University, Skopje, Macedonia

Petar Ilievski, Head of the Scientific Terminology Committee, Macedonian Academy of Sciences and Arts, Skopje, Macedonia

Katerina Mladenovska, Administrator of the Project for Scientific Terminology, Macedonian Academy of Sciences and Arts, Skopje, Macedonia

1. Needs Analyses

During 1980es, Macedonia had a proactive policy towards computerization of schools and building computer network infrastructure. Many schools were equipped with computers and courses in Informatics (or Computer Science) became a standard part of the secondary schools curricula. A packet-computer network based on X-25 technology was built by the Yugoslav telecom company. Due to its rather unique politial position, Yugoslavia was the only CEE country, which was a member of EARN (European Academic and Research Network). Through EARN and BITNet the academic community in Yugoslavia had the first experience with the Internet. The Yugoslav academci and research network was also part of RARE (a precedent of TERENA). The international connection to BITNet was provided via the node in Linz (Austria).

When the dissolution of the federation started in the middle of 1991, UN imposed sanctions to Yugoslavia. The connection between Belgrade and Linz was cut, and Macedonia lost its connectivity to the outside world. The events that followed through mid 1990s such as the war in the other parts of former Yugoslavia, disagreements with the neighboring countries over the name, the language, the border, the ethnical minorities, and sheltering of Kosovo refugees, whose number amounted to 15 percent of the total population of the country), had negative impact on all the sectors in the society. The conflict in 2001 has disrupted the minor progress that has been done by the end of the 1990s. Being occupied more with political problems Macedonian government did not early pay the well deserved attention to the information society. As a consequence Macedonia is lagging far behind compared to what it could have achieved if the political surroundings have been more favorable, the leadership was more visionary, and the management of the resources was wisely exercised. For example, it is estimated that the number of Internet users is less than 5% of the population although the telecommunication infrastructure is fairly in a good shape.

The country is determined to integrate in EU and to meet its obligations from the Stabilization and Association Agreement. So, the Government is making continuous efforts so as to adapt and accept the EU policies on ICT. In this context the Parliament recently adopted the Strategy on Development of the Electronic Communications and Information Society, [1], which defines the long term activities in the area of ICT on the national level.

The report on the ten most visited web sites, [2], shows that most of them are those delivering the local news (daily news papers, magazines or broadcasting media). Next in the list are government web pages offering information from the different Ministries, the National and University library site, the ISP pages, the pages belonging to the companies selling computer equipment, foreign embassies, etc. The first impression concerning the content is the fact that most of the pages are declarative and rarely offer a particular service to some target audience or better level of interaction.

The research within the ICT4ICT project and the lessons learnt from the road of Estonia to high ICT diffusion has shown that one of the important factors for bridging the digital divide is the development of e-services, which are attractive to the citizens.

The penetration of the Internet in Macedonia is rather low. It is at the stage where the early adopters (the first 13.5% of the population) are still not using the technology. A large portion of this group belongs to the academic community (students, educators, researchers). Creating content that is available through the Internet for the academic community could raise public awareness of the possibilities of ICT and induce creation of other useful applications.

2. Macedonian Scientific Terminology Project

Macedonian Scientific Terminology is one of the first scientific projects within the Macedonian Academy of Sciences and Arts. It was conceived in 1970 by the academician Blaze Koneski, the President of the Academy at that time. The aim of the project was to open the prospects for the development of the Macedonian language, recognized for the first time in the history after the Second World War. The project has had a special significance during the period when Macedonia was a part of the Yugoslav federation as a tool for developing the language that has been denied for a very long time. It is even more important now when Macedonia has still to struggle for proving its identity due to many hinders imposed by its neighbors and somewhat ignorant international factors. The Macedonia language is one of the few tools left to this small nation in the South of Europe to fight the series of historical injustices imposed in the first half of the twentieth century. Therefore, the semantics and the implications of the terminology project go beyond mere Web application.

The principal activities of the project consist of collecting terminology in a range of scientific areas. Each term in Macedonian language is accompanied with a description and its equivalents in Russian, English, French, and German language. The work has been published in 107 volumes of the periodical “Bulletin of Macedonian Scientific Terminology”. The Department of Linguistics and Literature Science along with the Lexicographic Center at Macedonian Academy of Sciences and Arts are taking care for the continuation of the project. The revision and reprinting of some volumes are expected in the near future.

A small portion of the terminology material, from 1992 to 1998, was saved in an electronic form. The scientific fields and the number of terms are the following:

- Agro-Chemistry and Plant Nutrition, 1507
- Soil Science, 1698
- Civil Engineering, 811
- Monetary Economics, 536
- Weeds, 1586
- Mechanical Engineering (Letters A and B), 422
- Demography, 416
- Wood - Anatomy and Technical Properties, 338

So far there have been no incentives to make this knowledge widely available by creating Macedonian terminology web pages that will make the existing databases accessible through the Internet.

The research within the ICT4ICT project has shown that one of the important factors for ICT diffusion in the country is increasing the interest of the users, as well as the

authors of the content, by creating easily accessible and useful web pages from already existent content. In this context, the idea for using the terminology material available in electronic form and creating a web application to make it accessible through the Internet was born.

The idea was accepted and encouraged by Petar Ilievski and Katerina Mladenovska at the meeting in January 2005. The Macedonian Academy of Sciences and Arts at the moment lacks some human resources for developing this kind of application. A partnership with Institute of Informatics was forged in order to develop and host the Web service on Scientific Terminology, stella.ii.edu.mk/mtp.

The web interface is similar to the one used in the printed version with the possibility for advanced search. Currently, the search in Macedonian and English language is available. A snapshot of one of the pages is presented in Figure 1.

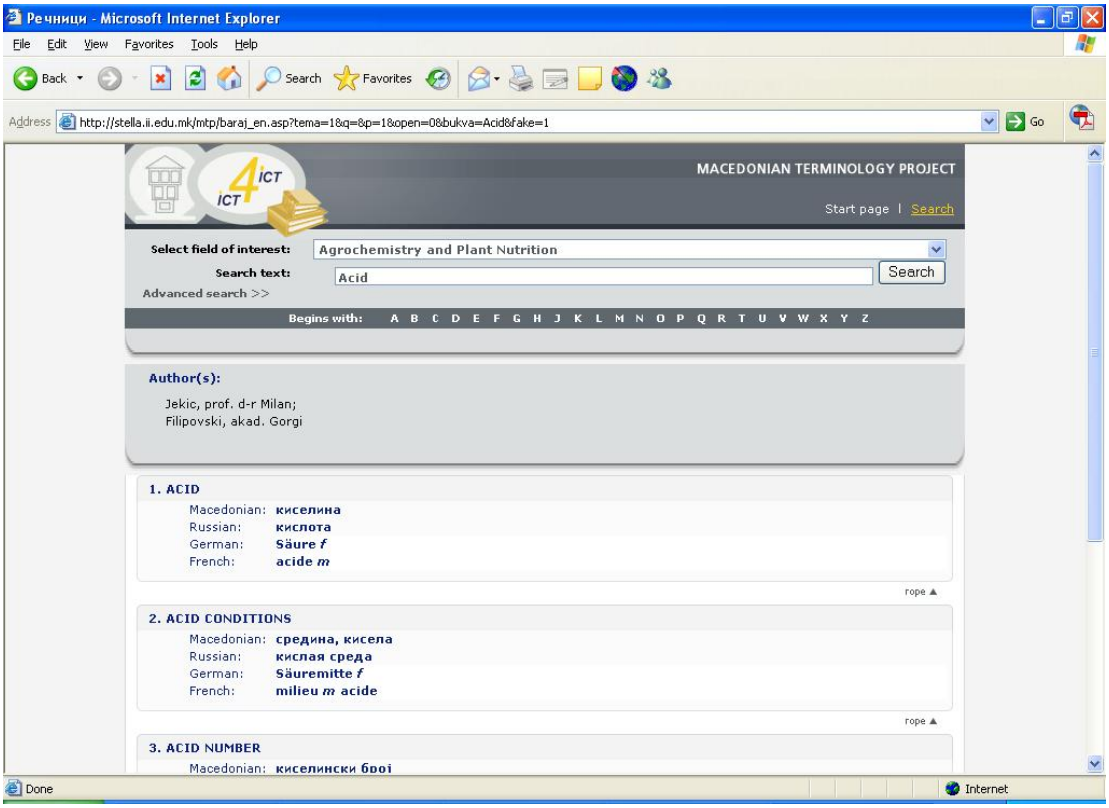


Figure 1: A page from the Web-terminology service

SPIDER program, ICT4ICT project together with the Scientific Terminology web service were presented at the Macedonian Academy of Sciences and Arts on May 10th 2005. Figure 2 captures some moments during this presentation.

Figure 2: Pictures from the presentation

2. Conclusions

The availability of the terminology material is beneficial for the junior researchers and for the academicians, who are also, in most of the cases, contents providers for the Macedonian terminology project. The first will easily find the necessary terms in different languages and the second will become aware about the potential of the ICT technology and will hopefully continue to enrich the content of the databases and push for better ICT proliferation both in the Institution and in the academic community country-wide.

Most of the authors of the terminology material and the wider public from the academic community have not only encouraged publishing of the scientific terminology using the Web technology, but have requested that all the other scientific fields are published in the same way.

There are very strong indications from the authorities in the Academy about taking steps to extend the project to a full fledged e-Dictionary that will eventually cover all significant fields of science and culture.

References:

1. *National Strategy for Information Society and Action Plan* – Government of the Republic of Macedonia, March 2005
2. http://www2.findanisp.com/top100/by/country/top100.php?TLD=mk&country=Macedonia , accessed March 2005

Pilot 3

Community Networking

Contact Persons: Iskra Popova, Oliver Popov, Mid Sweden University

Biljana Stojcevska, Institute of Informatics, Faculty for Natural Sciences, St. Cyril and Metodij University, Skopje, Macedonia

Stana Jankoska, St. Clement Ohridski National and University Libraray

1. Needs Analyses

The prices of telecommunication services in Macedonia are moderate to high when compared to the other CEE countries. The reason behind this is the monopoly position of the Makedonski Telecommunikacii, the Macedonian telecom company.

Until the end of 1996, the Macedonian PTT functioned as a state-owned company providing national and international telecommunications and postal services. At the beginning of 1997, it was divided into two new state-owned companies: Macedonian Posts and Macedonian Telecommunications. In December 2000 the Macedonian government sold 51% stake of Macedonian Telecommunications to the Hungarian Telecommunication company, Mataf (60% owned by Deutsche Telecom). This was the biggest single foreign investment in the country since its independence in 1991. The concession gave the company an exclusivity period for monopoly in fixed telephone services until the end of 2004. The public fixed telephony network covers the following: public telephone switches (100% digital) in all cities and settlements in the state, subscribers' fixed telephony network, optical and radio network of transmission systems between public telephone switches in the state and international telecommunications centers. The number of fixed lines is about 26.7 lines per 100 inhabitants and there is a direct fiber optic links to the European backbones. Compared with the data for other CEE countries the level telecommunication infrastructure can be considered as moderate.

The market for data communications including Internet access is fully liberalized since 1995. It is provided on a concession basis by 5 Internet service providers, the biggest one being MT Net, a sector within the Macedonian Telecommunications. However, being a part of Macedonian Telecommunications, MT Net has a virtual monopoly.

Until the year 2003 Internet services were mainly offered through dial-up or leased lines. In 2004 MT Net introduced the broadband access through ADSL technology. Unfavorable conditions for the same service offered to the other ISPs actually stop them for using it. The packages MT Net offers for different bit rates are rather expensive and pose a limit to the number of end devices used at home or in a small office.

The cable TV companies in Macedonia are just staring to emerge and offering Internet access will soon be part of their services. At this moment, we do not have any information about the prices they will have.

Internet and networking technology in their very essence, which goes all the way how they work on level of protocols, are inherently collaborative, force sharing and naturally foster co-operation. And co-operative efforts are behind deploying small community networks, like tiny islands for knowledge diffusion through the medium of Internet for building a sustainable societal milieu.

The advent of the wireless networks, in addition to the location freedom, provides a low cost, simple and almost maintenance free alternative for rapid installation of home, office and neighbourhood networks, where the actual link to the Internet is being shared.

Indeed, as posited earlier in the text, this is very important in the countries where the communication infrastructure and the associated services are limited, expensive and thus still under the umbrella of virtual monopolies of different sorts.

2. Building Community Networks Using Wireless Technology

The pilot project aims to spread the information about the enactment of community networks and the know-how of deploying wireless technology, and consequently connecting them to the Internet. The web pages Community Networking with Wireless technology were created as a collaboration effort between the MidSweden University and Institute of Informatics at the Faculty of Natural Sciences. The pages are hosted at the Institute of Informatics, http://twins.pmf.ukim.edu.mk/CN/ . The texts are available in English, Macedonian and Albanian language, since 22% of the population in Macedonia speaks Albanian. Assuming that similar content might be interesting for communities in Armenia, there are plans for them to be translated in Armenian language, too.

A practical demonstration of wireless technology is created in a form of a tele-centre, established in the Saint Clement Ohridski National University Library in Skopje and the Library at the Technical University in Yerevan. Figure 1 shows the tele-centre in Skopje that started its operation on May 18th 2005.

Figure 1: The opening of the tele-centre in Skopje

Libraries are places that have a very high flow of educated young people, who are the primary movers behind the penetration of ICT among the population in both countries. The tele-centers will provide a free Internet access to the general public at any time during the opening hours of the Library, as well as an appropriate Web site that addresses the spirit of sharing that made the Internet the global medium of communication, the knowledge that explains why and how one can build a community network and use wireless technology to do so.

Conclusions

The ubiquity of ICT and its potential to profoundly change the quality of human life has made it one of the premier vehicles for development as posited by the establishment of the UN ICT Task Force, the declarations of the WSIS, and the Millennium goals. The idea is that no human being should be left behind.

By recognizing the importance of ICT in an axiomatic way, this report is based on the several reports on the ongoing research into the factors that influence the penetration and the diffusion of the technology, tries to elaborate a model, which can be used first to explain the different paths of poliferation of the technology in various countries and the reasons behind them, and second to use it in the less developed countries as a blueprint and a catalyst for enhancing the progress of ICT and its societal impact. In a way the model is self-referential, hence the name ICT4ICT, that is it looks into the technology as the main vehicle to propagate itself across the all segments of the society and thus create a positive feedback for further diffusion.

Clearly, while the model is still in its rudimentary form, it is indeed very complex by necessity since the processes, which are to be captured, represented and in a way simulated, are open and infinitely complex. In this case, the technology itself is the smallest problem, but its interaction with economic factor, the human capital and the local aspects, lead to intractability and the need for simplification. The domain for reference is limited to the CEE countries that underwent extreme political, economic and social transformation in the fifteen years. Some of these countries show striking differences in the manner they have embraced and used ICT for their own development and stability. A case in point are Estonia that in spite of low GDP and modest start, today is commonly viewed as one of the European countries with highest degree of e-readiness, and Armenia and Macedonia, where the start up conditions were similar to Estonia, and yet ICT penetration is on the low side.

In order to verify some of the basic model parameters, reduced to thirteen and grouped in three main categories, three instances have been created in a form of pilot projects. The pilot projects, one set in Armenia and two in Macedonia, address ICT diffusion in different segments of the population. In Armenia, the objective is to infuse ICT applications among the decision makers, while in Macedonia the first domain is the research and education community, and the second one is the general public. The effects and the results of the pilot project will be closely monitored in the next six months, so they can be accordingly contrasted against the model in order to assess its validity.

The Open model for ICT diffusion was built on the data from the CEE countries, and on similar models for ICT diffusion in China, India, and Latin America. The differences from the other models are its openness, the number of the principal factors, the non-rigid classification of the factors in categories, and their interaction. The data so far confirms many of the assumptions incorporated in the model. Combined with the results of the pilot projects, which are an integral part of the further research, it will be interesting to look into the additional verification instances of the open model, and its degree of applicability and replicability in another developing regions and countries.

Plans for Future Work

In many ways the research done so far, is first of a kind at Mid Sweden University, as the principal coordinator, but also at some of the partner institutions. The synergy between all of the participants has been very valuable and there is a very strong commitment by all involved about the need and the benefit of the continuation of the project. Moreover, the activity of CEENet, which has recently addressed countries well beyond the Caucuses, such as Turkmenistan and Afghanistan, provides a rather fertile ground for non-biased and relatively clean verification of the model. Combined with the results of the pilot projects, which are an integral part of the further research, it will be interesting to look into the additional verification instances of the open model, and its degree of applicability and replicability in another developing regions and countries.

An additional incentive is one of the main research profiles at Mid Sweden University, termed as Public Information Systems, as an element of the framework Digital Societies, which inter alia, looks at the I-centric (I - individual) and C-centric (C - citizen) service and their penetration as key entities in the development of information society. The reflections of this research, based on the scalability and proportionality, will most certainly be useful even in the developing context.

In summary, the future work will focus both on research and development, such as:

1. Formulating a sound and consistent theory related to the Open model of ICT diffusion
2. Extending the model through refinement and validation against the data from various developing countries
3. Studying the behavior of the model with respect to a subset of parameters, especially those that related to I/C-centric services.
4. Exploring the plausibility of automatic model generation and mapping from raw data that describes the ICT status of the country based on the metrics encompassed by the model
5. Implementing and broadening the course ICT and Official Statistics for Development in other CEENet countries
6. Creating a comprehensive e-Dictionary that includes all significant area of science and culture, and providing input and basis for co-operation with other CEE countries
7. Establishing new tele-centers both with respect to community networking and other content relative to ICT proliferation