THE EVOLUTION OF IT INDUSTRY IN ESTONIA AND UKRAINE: THE ROLE OF THE STATE AND THE MARKET IN INSTITUTIONAL FRAMEWORKS

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ABSTRACT

This research explores the role of the *state* (via governmental policies and programs) and the *market* (via FDI) in shaping the institutions, indispensable for the success of the IT industry in Ukraine and Estonia. To trace the evolution of the IT industry in the 1990s and the 2000s in the two countries, such institutional arrangements as skill formation, R&D, capital provision, infrastructure and intellectual property rights protection were selected, as they allow for a major contribution on behalf of state and market. The goal of the analysis is to establish how a different composition and interaction of these key players influenced the development of different IT industry profiles in Ukraine and Estonia. The finding that IT industry in Estonia has embarked on the innovation-driven path and product-based model is explained by the involvement of FDI and the increased government attention to the development of the national innovation framework, whereas in Ukraine the lack of the two stimulated the local software firms to export IT services, as it best "fits" the existing institutional environment.

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List of Abbreviations

IT – information technology

ICT – information and communication technology

KBE – Knowledge-based economy

R&D – research and development

RTDI - research, technology development and innovation

RDI - R&D & Innovation

GERD – gross domestic expenditure on R&D

VC – venture capital

FDI – foreign direct investment

SME – small and medium enterprises

NIS – National Innovation System

INTRODUCTION

Effective generation and diffusion of knowledge is increasingly becoming an important determinant of economic growth. The successfully developing countries are building their economies based on knowledge by moving upwards from exploiting resources by unskilled labor to the set of assets produced by highly qualified labor. Hence, the importance of intellectual capital grows with the each successive step towards global competitiveness. The transition of Central and Eastern European (CEE) countries towards knowledge-based economy (KBE) is especially interesting to analyze, as these countries used to specialize chiefly in heavy industries during the Soviet period and recently have undergone a major restructuring of their economies. Despite the mixed results, the key challenge now for the majority of CEE economies is to capitalize on their innovation capability, as a low-cost strategy is not sustainable in the long run due to already noticeable increase in labor costs. However, there is no one general template for CEE countries for successful development of high-technology industries and movement towards a learning economy.

The contribution of information and communication technology (ICT) as a driver of innovations is remarkable, as this sector of so-called "new economy" offers great possibilities for faster economic growth and a resulting increase in standards of living. ICT plays a major role in increasing competitiveness of different sectors of the economy and consequently of the entire country, because ICT stimulates productivity, connects businesses globally, and keeps society informed. According to the 2007 European Commission's annual report on the implementation of the i2010 Information Strategy, ICT contributed approximately 50% to productivity growth in the period 2000-2004 and accounted for about 25% of GDP in the EU.[1] The input of ICT in CEE

[1] Europe's Information Society Thematic Portal. *ICT Drives 50% of EU Growth, Says Commission's Annual Report on the Digital Economy*. http://ec.europa.eu/information_society/newsroom/cf/itemlongdetail.cfm?item_id=3303

is also significant, as the sector was an active component of growth in the 1990s and in the beginning of 2002s.[2] Therefore, focusing on software and IT services, as the core boosters of ICT sector, is important in evaluating the ability of countries to compete in the global informational capitalism, as the IT industry by its virtue is the most human capital oriented and knowledge-intensive.

The potential of IT as a facilitator of the much desired economic growth and productivity, however, is likely to be marginal, if the appropriate *institutional framework* is lacking for the support of high-tech industry. Hence, the proper institutional infrastructure is needed to make possible the development the IT innovations, deployment of ICT and bridging the "technological trap".[3] Both state and market forces have a great possibility to shape the institutional setting, yet in academic and business world two rival opinions stand out as to which set of actors and under which circumstances play a vital role in industry development.

According to the statist proposition, upheld by Ha-Joon Chang, nowadays there is no country in the world which had not resorted at least at some point in time to state intervention in its development effort and reached the status of industrialized nation.[4] Considering the example of the US, a front-runner of hi-tech industries, its political economy proved to be conducive to the spread of new technologies, wherein the state played a central role in laying the foundation for the leading position of its IT industry in the world. The US government is prominent for

(accessed May 20, 2008). Additionally, the achievement is confirmed by OECD, *the OECD Information Technology Outlook, 2004*, Paris: OECD, 2005; PWC, *Rethinking the European ICT Agenda. Ten ICT-breakthroughs for reaching Lisbon goals, 2004.*

[2] Slavo Radosevic and Krzystof Piech "Countries and Industries in a Process of Change" in *The Knowledge-based Economy in Central and Eastern Europe* (New York: Palgrave McMillan, 2006): 2. Henceforth, *KBE*

[3] Marcin Piatkowski, "The 'New Economy' and Economic Growth in Transition Economies" *TIGER Working Paper Series*, no. 16 (2002): 4. http://www.tiger.edu.pl (accessed April 2006)

[4] Hong Kong, as an exception. Ha-Joon Chang, "An Institutionalist Perspective on the Role of State – Towards an Institutionalist Political Economy" in *Institutions and the Role of the State*, eds. Burlamaqui, Castro, Chang. http://www.econ.cam.ac.uk/faculty/chang/ipe-pdf.pdf (accessed April 2006).

employing a "military developmentalist" strategy, which ensured profound subsidies for private companies and support for military market which provided a critical boost for such companies and regions such as IBM and Silicon Valley respectively, and since then the latter has been revered as a symbol of success of the Anglo-Saxon model of capitalism.[5] In his analysis of Ireland, a developmental network state, O'Riain continues the argument stressing the importance of building effective *institutional support* and suggests that "development of the ICT industries has always been a socially and politically embedded process".[6] The author is mainly concerned with the state, which is described as decentralized and accountable, but simultaneously keeps contact with the local technical pool and international capital. What is conspicuous in his description of a flexible state is that it is "double-embedded", because either local or global factors by themselves are insufficient. Thus, state, social institutions and developmental strategies are important for the dynamics of an information economy in capitalist countries.[7]

With regard to Central and Eastern Europe, the opposing view is held by Grzegorz Kolodko, who argues that in order for the countries in transition to benefit from the opportunities that the "new economy" brings, they should first take care of the "old problems", such as corruption and finish necessary structural reforms, and only then move towards a knowledge based economy (KBE).[8] Hence, in the case of transition countries, the state may be a liability, rather than an asset. An alternative solution may be provided by foreign direct investment (FDI) as a channel of knowledge transfer, innovative technology, and capital. Exploring the key issues facing KBE in CEE countries, Slavo Radosevic suggests that CEECs should attract FDI in ICT

[5] Sean O'Riain. *The Politics of High-Tech Growth*. (Cambridge University Press, 2004): p. 6
[6] Ibid p.6
[7] Ibid p.5
[8] Gregorz Kolodko. 'The 'New Economy' and Old Problems. Prospects for Fast Growth in Postsocialist Countries', "TIGER Working Paper Series", No.9, Warsaw, June 2001. http://www.tiger.edu.pl/english/index.htm (accessed April 2006)

to benefit their domestic industries.[9] He argues that production integration through FDI-led value chains assures "high productivity, innovation linkages and regular sales to local firms".[10] As accurately pointed out by Attila Havas, if the "right" type of FDI is attracted and "anchored" for a longer time period, then the CEECs have a chance to benefit from learning from leading companies, accessing their markets and transforming their institutions in order to catch up with the EU15.[11]

While the debate on pros and cons of state-led or FDI-driven development has been widely discussed before, their influence on the institutional framework in CEE is under-researched. Neither presence of numerous state policies nor FDI by itself offer a quick fix to transformation towards KBE. Additionally, it is also no longer a question whether institutions matter, but rather, as correctly pointed out by Laszlo Csaba, how do they matter.[12] Thus, the role of state and market forces in shaping institutional infrastructure in CEE and their respective impact on the evolution of IT industry needs to be explored in more detail. My research strives to fill in this gap by taking a closer look at the IT industry in Estonia, an emerging Baltic Tiger, and Ukraine, a prominent location for IT outsourcing.

Previously, the authors who discussed the success of high tech industries in the CEE have so far drawn attention to the lack of institutional complementarities and comparative institutional advantage as one of the reasons for lagging behind the developed western capitalist states, but not specified how the existing institutional framework influenced the performance of such an innovative industry as IT. In this line, for example, Marcin Piatkowski only ranks such

[9] Slavo Radosevic "The Knowledge-based Economy in Central and Eastern Europe: An Overview of Key Issues" in *KBE* (New York: Palgrave McMillan, 2006): p. 44
[10] Radosevic, p. 48
[11] Attla Havas "Knowledge-intensive Activities versus High-tech Sectors" in *KBE* (New York: Palgrave McMillan, 2006): p. 274.
[12] Laszlo, Csaba "Growth Theory and the New Economy in a Neo-Institutionalist Perspective" in Paradigm Shift – Information, Knowledge and Innovation in the New Economy, University of Debrecen, 2005, p. 184.

institutions as flexible labor markets, R&D systems, infrastructure, developed financial markets and entrepreneurship, which according to the author are among the prerequisites for the adoption of the "new economy" in CEE.[13] The cases, where scholars studied how national social and economic institutions led to certain industrial outcomes and innovation strategies, were mainly concerned with Western capitalist countries[14], while the issue has not been investigated in the context of transition economies.

In order to trace the role of state (government policies) and market (FDI) on shaping institutions pertinent to the development of IT industry, I will concentrate mostly on such arrangements as provision of *capital, skilled labor, infrastructure, research and development (R&D), and intellectual property rights (IPR) protection*. These five criteria are derived from the "four pillars" into which the World Bank divides a knowledge-based economy:

- "An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship.
- An educated and skilled population that can create, share, and use knowledge well.
- An efficient innovation system of firms, research centers, universities, think tanks, consultants, and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.
- Information infrastructure that can facilitate the effective communication, dissemination, and processing of information."[15]

Moreover, the national innovation system (NIS) is not just an issue of R&D, but as corroborated by Chris Freeman, it is connected to how markets are organized and operate, including also legal and cultural norms of society.[16] Finally, Richard Heeks, when proposing software strategies for

[13] Marcin Piatkowski, "The 'New Economy' and Economic Growth in Transition Economies", p. 9

[14] Literature on Varieties of Capitalism. For example, Steven Casper, Mark Lehrer and David Soskice researched institutional infrastructure in Germany and USA in "Can High-Technology Industries Prosper in Germany? Institutional Frameworks and the Evolution of the German Software and Biotechnology Industries", *Industry and Innovation*, vol.6, no.1, June 1999.

[15] World Bank. *Framework for Knowledge-based Economy.* http://web.worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/KFDLP/0,,contentMDK:20269026~menuPK:461205~pagePK:64156158~piPK:64152884~theSitePK:461198,00.html#Knowledgehttp://www.ceu.hu/home (accessed May 2008)

[16] Chris Freeman "'Catching Up' and Innovation Systems" in *KBE* (New York: Palgrave McMillan, 2006): p. 18

developing countries, designated such areas as finance, education and training, research and development, intellectual property rights, infrastructure and procurement as cornerstones of the national strategy aimed at developing "cyber-tigers".[17] Therefore, the chosen five institutions include the most important categories for industry assessment. In addition, they are considered to be major determinants of the success of innovative sectors, hence they will be my focal points of evaluation with regard to their affect on the IT industry profile in Ukraine and Estonia, which have rapidly developing software and IT services segments and explicitly declared desire to embrace the KBE model. The findings may serve as basis for recommendation for greater attention of governments to certain gaps in NIS or linkages with FDI for more effective realization of innovation-oriented strategy. At any rate, the study will contribute to the current debate on impact of institutions on development and potential of CEE economies to reach the EU Lisbon objectives.[18]

The thesis will unfold in the following way. Chapter 1 will provide the methodological backdrop, focusing on the selection of cases and elaboration of the two-dimension analysis (state vs. market and their impact on the 5 institutions). In Chapter 2, a brief IT market overview in the two countries will be given. In Chapter 3, skill formation is analyzed in two selected countries. Chapter 4 reviews R&D activities. Chapter 5 focuses on capital market and quality of infrastructure in the two countries. Chapter 6 assesses IPR protection. Chapter 7 explains the cross-national difference in IT industry profiles and concludes with the summary of the state's and market's role in shaping the trajectory of development of IT industry.

[17] Richard Heeks "International Perspectives: Software Strategies in Developing Countries" *Communications of the ACM* , vol.42, no.6, (1999): 11-13. http://portal.acm.org/citation.cfm?id=303849.303853

[18] Lisbon Objectives refer to the Lisbon Strategy, which strives to accelerate R&D expenditure, employment and growth so that EU becomes the most competitive region in the world by 2010.

CHAPTER 1: METHODOLOGY

To answer the question how the state via government policies and the market via FDI influenced and contributed to the trajectory of development of a particular industry via certain institutions, I will study a software segment of the IT industry[19] in Ukraine and Estonia. The industry observers and experts on knowledge-based economy agree that the software industry is desired for economies of CEE, as it human capital intensive and contains important "intra- and inter-industry effects on other sectors".[20] Additionally, the software industry directly or indirectly facilitates development and export of products and services that are competitive on an international scale.[21] In terms of industry performance in Europe, according to the European Commission's estimates, software and IT services have been enjoying the most robust growth with 5.9% for 2006-2007.[22]

Estonia and Ukraine were selected as case studies based on the three reasons, such as rapidly growing IT industry, comparatively similar starting point of development in the beginning of the 1990s, and different outcome in terms of IT industry profiles. Firstly, the two countries are regarded as favorable locations for software development. Estonia ranks the highest out of the CEEC, occupying the 25th place in terms of the global IT industry competitiveness assessment conducted by the Economist Intelligence Unit in 2007.[23] This Baltic country also tops the list among the CEEC in terms of e-readiness and diffusion of information and

[19] IT sector is consists of hardware, software and IT services.
[20] Slavo Radosevic. *Growth, Integration and Spillovers in the Central and East European Software Industry.* Economics Working Paper No.69 (2006): 27. http://www.ssees.ucl.ac.uk/economic.htm (accessed April 12, 2006)
[21] Tarmo Kalvet. *The Estonian ICT Manufacturing and Software Industry: Current State and Future Outlook.* PRAXIS Center for Policy Studies, Policy Analysis (2004). http://pdc.ceu.hu/archive/00002069/
[22] Europe's Information Society Thematic Portal. *ICT Drives 50% of EU Growth, Says Commission's Annual Report on the Digital Economy.* http://ec.europa.eu/information_society/newsroom/cf/itemlongdetail.cfm?item_id=3303 (accessed May 20, 2008)
[23] Economist Intelligence Unit. *IT Industry Competitiveness Index 2007.* http://www.eiuresources.com/mediadir/default.asp?PR=2007071101 (accessed May 2008)

communication technologies.[24] Furthermore, according to the Estonian Information Society Strategy, information and communication technologies contributed the estimated 9.2% of the country's GDP.[25] As far as Ukraine is concerned, the growth of IT industry exports reached 60%, while the industry growth remains dynamic and marked the rate of 23% in 2007 [26]. Additionally, Ukraine is on the top of the list of Western countries as an outsourcing direction for software development. Both Estonia and Ukraine are classified by Erran Carmel as emerging software exporting nations, located in the third tier, due to maturing software industries[27]

Secondly, at the outset of independence, which for both countries occurred in1991, the political economy was relatively on the similar level of development, facing the dilemma of simultaneity or triple transition – political, economic and cultural identity.[28] Despite the immense challenge to build free market economies with democratic norms, the two countries also obtained some positive legacies: significant scientific infrastructure, education system with strong emphasis on technical curriculum, and a large pool of ICT experts. With regard to Estonia, its scientific heritage stems back from 1936, when Tallinn Technical University was founded and evolved into a hub of all technical sciences.[29] In addition, the University of Tartu, Tallinn Polytechnic Institute and Institute of Cybernetics are also known for hosting the first computer centers, where shortly after their opening in 1950-60s education of IT specialists took place. Hence, research groups emerged, which developed various unique programming languages, used

[24] Economist Intelligence Unit.*E-readiness rankings 2007.* http://graphics.eiu.com/files/ad_pdfs/2007Ereadiness_Ranking_WP.pdf (accessed May 2008)
[25] Estonian Information Society Strategy 2013. *Ministry of Economic Affairs and Communications* (2006). http://www.riso.ee/en/files/IYA_ENGLISH_v1.pdf (accessed May 21, 2008).
[26] Outsourcing to Ukraine - 2006 Results and 2007 Expectations. NewswireToday. http://www.newswiretoday.com/news/12722/ (accessed May 2008).
[27] Erran Carmel, "Taxonomy of New Software Exporting Nations", Electronic Journal on Information Systems in Developing Countries, vol.13, no.2 (2003): p.3, http://www.ejisdc.org/ojs2/index.php/ejisdc/article/view/76/76
[28] The term has been introduced by Claus Offe and developed further in academia, as the one the best illustrates and summarizes the complexity of processed the post-soviet states are passing through.
[29] Estonian Institute. *Everchanging Science And A Small Country*. http://www.einst.ee/factsheets/factsheets_uus_kuju/everchanging_science_and_a_small_country.htm (accessed May 2008)

for different purposes, for instance, teaching and solving financial problems.[30] Thus, during the Soviet period, the Baltic States, and especially Estonia, were selected as a site for computer science and technical research. Estonian programmers worked on developing space program, apart from programming for the KGB. One of the most strategic artificial intelligence research centers was also established not far from Tallinn.[31] Therefore, Estonia had a comparative advantage of qualified IT experts employed by state institutions to develop new technologies. So when the republic became independent, this inherited factor helped to kick-start the IT development and penetration.

As for Ukraine, it also has impressive intellectual potential, educational and scientific infrastructure, which goes back to the communist period. As a part of the Soviet Union, Ukraine was a center of scientific research needed for the success of its space program. For example, Ukrainian National Academy of Sciences was responsible for about 40% of all Soviet research.[32] The country is divided into regions, and every region has at least a couple of universities specializing in technical fields. However, the capital city, Kyiv, has always been a leader of computing technologies with its prominent Glushkov Research Institute, one of the largest cybernetics schools in the world. Moreover, according to some researches, "the second computer in the world was created in Kyiv".[33] Thus, inherited competencies (higher education and R&D institutions, high literacy rate, etc) are important for explaining the potential for the development of innovative technologies, but, according to Michael Porter, they are not sufficient without

[30] Ahto Kalja and Jaan Oruaas. *An Overview of the SPI Activities in Estonia*. Institute of Cybernetics. http://www.iscn.at/select_newspaper/surveys/estonia.html (accessed May 2008)
[31] Joshua Levine, "If It Works, You Can Break It" Forbes. 20 December, 2004. http://www.forbes.com/global/2004/1220/016.html (accessed May 2008)
[32] Natasha Starkell.*Outsourcing Ukraine 2007: the Capital and the Provinces*. http://www.goaleurope.com/main?p=26&more=1&c=1 (accessed May 2008)
[33] American Chamber of Commerce in Ukraine. *White Paper on Offshore Software Development in Ukraine*. June 14, 2002. http://www.amcham.kiev.ua (accessed April 2008)

competitive advantages. The latter are purposefully created by strategic interaction among key actors, hence they are hard for other countries to duplicate.[34]

Thirdly, to make successful leverage and to sustain the given advantages, special institutions are needed that are directly related to IT, such as R&D, IPR, modernized education and training system, modern infrastructure (telecom, internet, PCs), well functioning capital market. At the beginning of the transition period, both countries experienced a considerable shock from the collapse of the Soviet Union, which resulted in weak institutional set-up: decrease of state expenditure on R&D; an absence of established IPR system; an education system providing thorough, yet too broad technical knowledge; undeveloped technical infrastructure and fledging capital market. As the neo-liberal wave swept across the CEE region, the role of the state was diminishing in sponsoring research and setting targets for production of innovative solutions.[35] The institutes that have generated a load of tacit knowledge, but linkages with industry and government were lost during when the union broke apart. Therefore, Estonia and Ukraine had to start from scratch in relation to building proper institutions and interdependencies between them.

To address this developmental challenge, the two countries came up with different solutions: Estonia stepped on vividly a neo-liberal path, while Ukraine evolved along the gradual lines, combining coordinated and liberal models in its institutional infrastructure. Hence, despite initial starting conditions, the outcome varies in terms of five institutional arrangements and activities of state and FDI in the two countries. Although one would expect that the Estonian liberal government would leave the task to the market to develop the most effective and efficient strategy for the successfulness of its IT industry, in reality it is the state in Estonia, not in

[34] Maryna Yaroshchuk "Drivers of IT industry in Bulgaria, Romania, and Ukraine" in *Central & Eastern Europe IT Outsourcing Review, 2007*. http://www.itonews.eu. (accessed May, 2008)
[35] Freeman "'Catching Up' and Innovation Systems", p. 16.

Ukraine, that performs the role of "industry promoter". In addition, Estonia managed to attract impressive share of FDI that must have contributed to the process of industry maturation, whereas in Ukraine FDI is less pronounced. Therefore, such a different composition and interaction between key players must have added to the variety of IT industry profiles and strategies, as there is no one single established way for developing the Central and Eastern European Silicon Valley.

Referring to different IT industry profiles, I suggest that there are different approaches to software production. I will use the classification of Richard Heeks, a distinguished scholar on the subject, who defined five software production strategies:

1) Export of software services, as successfully practiced by India.
2) Export of software packages, exemplified by Israel and Ireland.
3) Production of software packages for domestic market
4) Rendering IT/software services to domestic market
5) "Straddling the intersections" with specialization for niche markets.[36]

In my analysis, I will show why and how Estonia arrived at the foreign-led and predominantly product-based outcome (software packages and novel applications), while Ukrainian local firms developed service oriented model (IT services). Although this distinction is generalized, since many companies in their profile have both services and products, yet Ukraine has a more pronounced service segment targeted at foreign customers, compared to Estonia.

My study of the evolution of IT industry in the two countries will be based on industry reports, assessment of governmental policies, existing researches and conference materials on innovation related topics. The evaluation of key success factors will be complemented by personal interviews with businesspeople and authorities in the two countries. In this way it will be possible to identify strengths and weaknesses, as well as opportunities and threats facing the

[36] Heeks "International Perspectives: Software Strategies in Developing Countries".

IT industry in Estonia and Ukraine, and state and market responses to them via five chosen institutional factors.

CHAPTER 2: BRIEF IT INDUSTRY OVERVIEW

In order to better describe the role of the market in the following chapters, in this section I will briefly touch upon the key features of the IT industry in Ukraine and Estonia.

UKRAINE

Market Structure

The market is still dominated by small and medium local companies, while the big investors are still thinking and evaluating the potential risks due to political instability and weak functioning of relevant institutions.[37] Nevertheless, according to the President of the IT Ukraine Association, Igor Mendzybrovskiy, the Ukrainian IT industry is experiencing growth and is close to maturation, hence it is has high potential with the share of exports reaching 10%, or 1,5-2 billion USD. The sector is represented by 1,500 companies, employing about 30,000 people, yet the core of the industry consist of 70 companies with 8,000-10,000 employees.[38] In addition, research conducted by IDC, the leading consulting agency, shows that thanks to the IT industry in the period of 2005-2010 approximately 30,000 more new jobs will be created.[39].

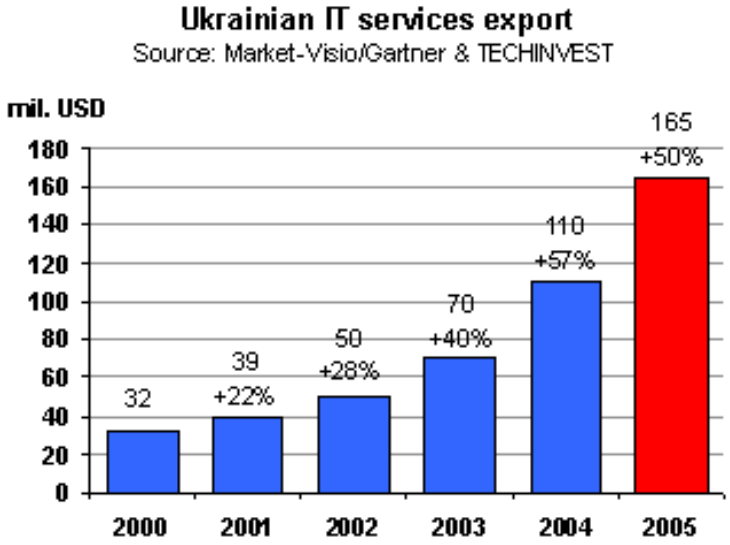
Market orientation

According to the first independent market research, conducted by Techinvest, the market is primarily order-oriented, as the product[40] ("off the shelf") model represents only 10%.[41] About 70% of the surveyed companies offer service of coding to their foreign customers, which is followed by such services as

[37] "Outsourcing to Ukraine: 2006 results and 2007 expectations" *Softarea51*, January 17, 2007. http://www.softarea51.com/press-release/Outsourcing_to_Ukraine_2006_results_and_2007_expectations.html (accessed May 1, 2008)
[38] Igor Mendzybrovskiy, telephone interview with Maryna Yaroshchuk on May 19, 2008.
[39] "IDC IT Economic Impact Study" IDC, 2006, msdb.com.ua/Downloads/Ukraine/Partner/IntelliRights/idc_study_ukr.pdf (accessed April 7, 2008).
[40] A detailed segmentation of IT industry into software and IT services segments is provided in the conclusion and appendix.
[41] "Ukrainian IT-Export Industry Market Research" *Techinvest.* http://www.techinvest.com.ua/main.php?lang=en&page=23 (May 1, 2008).

application integration, software testing, IT consulting, and re-engineering services.[42] In addition, 95% is software development is done for global palyers.

The graph below shows the dynamic growth of IT services, which have become pronounced especially in the last years.



Professional Organizations:

Ukrainian Association of Software Developers, the U.S.-Ukraine Digital Alliance, IT Ukraine and Hi-Tech Initiative.

ESTONIA

Market structure

Based on 2001 report, there were 380 companies officially registered in Estonia, yet the number of active SMEs is about 200.[43] Another interesting characteristic of Estonian software industry is that the largest software firms are actually IT departments of telecommunication companies and of the two largest Estonian banks, Estonian Union and Bank Hansabank, which are foreign-owned, and employ respectively

[42] ibid
[43] ibid

over 100 and 250 programmers.[44] Along with the other banks, Sampo, Societe Generale, and Ühispank, the banking sector is not just an employer, but is an additional source of software solutions delivered to the entire banking industry.[45] As for the biggest "pure" software firms, these are Skype, MicroLink, Webmedia, AlnaGroup, IT Alise, and Regio, which are communication oriented or produce software for telecom sector.[46] Therefore, software industry in Estonia is integrated into ICT cluster and is inextricably linked with FDI related industries.

Market Orientation

Although the majority of these SMEs have a diversified profile of activities, according to industry experts the larger share of software firms are developing software solutions for local needs or for export abroad.[47] The driving sectors are banking, telecommunications and government structures. Furthermore, start-up companies are likely to concentrate on niche products or business models, such like Skype's or Kazaa's, whose feature is a launch from a small base and then rapid expansion.[48]

European Information Technology Observatory (EITO) studies further what constitutes software products and IT services, and breaks these two segments into the following categories:

Software: systems software and application software, and tools;

IT services: hardware maintenance, project services, outsourcing services, as well as software consulting, implementation, operations management and support services.[49]

[44] Alec Snetkov. *Information Technology lansdscape in Estonia*. http://www.american.edu/carmel/os2237a/software.htm (accessed May, 2008)
[45] Marek Tiits and Pihl Tarmo. *IST R&D and Innovation in Estonia*. Virtual Center of Excellence for IST RTD in Estonia. Working Paper, 2002. http://esis.ee/eVickings/evaluation /eVickings_RTD_in_ICT_final.pdf (accessed May 26, 2008).
[46] John Garratt and Auri Aittokallio."Baltics: Skills Will Make the Maarket Difference" IT EUROPA October 14, 2007.http://www.exigenservices.lv/?m_id=35&i_id=1&pub_id=697 (accessed May 16, 2008).
[47] Linnar Viik, ICT expert in Estonia, telephone interview, May 19, 2008.
[48] Mark Landler "Hot Technology for Chilly Streets in Estonia" The New York Times, December 13, 2005. http://www.nytimes.com/2005/12/13/technology/13skype.html?pagewanted=print (accessed May 5, 2008).
[49] EITO. *Market Value Details.* http://www.eito.com/marketsegmentsdetail.htm (accessed June 4, 2008)

Therefore, the Estonian software development business model can now be presented with the finest detail and data[50]:

Table 1
Structure of revenues by type of products and services (in%)[51]

	Application SW	System Infrastructure SW	Application tools	Total SW Products	Operation Mngmt	Implementation	Consulting	Support services	Total SW services	Non SW
Estonia	44	8	3	**55**	5	11	11	8	**35**	9

Professional Organizations:

Estonian Association of Information Technology and Telecommunications, Estonian Information Technology Foundation.

[50] The data for Ukraine is available only in general values, because a detailed survey of firms was not conducted, and eve if it took place, it would it would not be representative, due to high rate of software sold on the "black market".
[51] The data is derived from the study of 224 firms in CEE region (excluding Ukraine) by Slavo Radosevic, "Growth, Integration and Spillovers in the Central and East European Software Industry", December 2006. http://www.ssees.ucl.ac.uk/economic.htm

CHAPTER 3: SKILLED LABOR

Skilled labor is the critical mean of production for innovation industry, hence quality and quantity of the workforce is *sine qua none* for the success of the IT industry in Estonia and Ukraine. The availability of a large pool of competent labor is one of the critical deciding factors not only for local firms, but also for foreign companies, which consider investing in opening software development centers or outsourcing IT related tasks abroad. As indicated by the Global Outsourcing Report 2007, the driving rationale behind the IT outsourcing market is "quality and speed to the market, not just cost of services".[52] Thus, having cheap labor is good, but access to high skilled employees, combined with a suitable geographical location provides the basis for a more sustainable growth of the IT industry in CEE region.

At first glance, educated and technically savvy workforce is one of the competitive advantages of Estonia and Ukraine, which is due to one of the few positive legacies of the previous regime. However, at the closer look, presence of traditionally strong technical schools producing thousands of IT graduates does not necessarily mean that the industry is satisfied with their quality. At the moment, the CEE countries are experiencing shortage of skilled labor that specifically meets IT industry's requirements. The deficit of qualified workforce is generally explained by the fact that the system of education inherited from the past is not able to follow the speed of technological revolution, and which is more important, industry-specific skills call for somewhat different institutional guarantees.[53] Therefore, on one hand, the state can play considerable role as a source of educational programs that are relevant to software development

[52] Mark Minevich, "The Global Outsourcing Report: Opportunities, Costs and Risks" The CIO Insight http://www.hoa.hu/download/upload/67/html/Global_outsourcing_report_CIO_Insight.pdf

[53] Margarita Estevez, Torben Iversen, David Soskice. "Social Protection and the Formation of Skills: a Reinterpretation of the Welfare State" in *Varieties of Capitalism: The institutional foundations of competitiveness*., eds Peter Hall and David Soskice (Oxford: Oxford University Press, 2001).

industry. Just like in some leading software countries, state can choose a function of an "educator". Alternatively, market can also actively participate in the skill-training system via employers' contribution to the vocation training arrangements and certification of skills.[54] As inferred from the experience of first-tier software nations, the practice of international accreditation and certification schemes helps to solve the problem of poor training or quality deficit.[55] Thus, I will discuss if the shortage of competent employees exists in Ukraine and Estonia, and what are the state's and the market's responses to the IT industry's requirements.

3.1. Ukraine

3.1.1 Role of the Market

In 2005 during the meeting of President Yushchenko with Bill Gates at the World Economic Summit in Davos, the business leader complimented the high intellectual ability of Ukrainian people and encouraged investment to Ukraine.[56] Mainly for this reason foreign companies are eyeing Ukraine as a suitable place for software development and other IT related operations, because the abundant supply of talented human resources is one of the largest in Europe and is also a low cost one. Each year about 30,000 students graduate from well-established universities and technical colleges with specialization in computer science, while overall the number of students in technical field reached 670,000 as of 2007.[57] As for low-cost base, the average monthly salary of IT professional working in Kyiv ranges from 500 USD to

[54] ibid
[55] Heeks "Software Strategies in Developing Countries", p. 11
[56] Ulad Radkevich and Natasha Starkell **"**Ukraine: Will the Orange Revolution Boost the IT Outsourcing Industry?" *Outsourcing Journal.* October 3, 2005. http://www.goaleurope.com/main.php?p=52&more=1&c=1 (accessed May 2008)
[57] Natasha Starkell "Outsourcing in Ukraine in 2007" Market Study for GOAL Europe, June 2007. http://www.goaleurope.com/main?cat=6 (accessed May 1, 2008)

1000 USD.[58] Hence, these factors show why Ukraine is becoming a spot for offshore software development.

Although Ukraine is not a *terra incognita* for foreign investors interested in outsourcing their business processes abroad, the global IT players are not in a hurry to establish their presence in Ukraine. One of the ways to compete and establish a better image of Ukraine is to promote not only the cheap labor advantage, but also quality of the workforce. As corroborated by Taras Vervega, marketing and business development director of SoftServ, Ukrainian developers possess critical technological capacity to create complex solutions.[59] IT industry representatives see benefits from positioning Ukraine as a "high-quality labor country", according to Larisa Rudak, Co-Director of SaM Solutions in Kiev.[60]

One of the key challenges that IT industry faces in Ukraine in building the image of a hi-tech nation, is connected with the supply of skilled human resources. Employers are not satisfied, because young professionals do not meet the IT industry requirements. Their knowledge of English language is not high enough, management skills are underdeveloped and awareness of the specificities of the software development processes is low, too. The reason is that the system of education is focused on fundamental preparation, systemic approach to problem solving and logic thinking skills, but does not meet the modern demands of the industry. Hence, business representatives draw attention of the state to the need to reform the curriculum, so that it is more industry oriented. Another issue, brought up by business community in connection to education, is that universities lack industry practitioners necessary to teach computer courses and new developments in the field of management of information systems. Consequently, more and more student leave for education or training courses abroad, while the job brain-drain is less

[58] ibid
[59] Taras Vervega, telephone interview with M.Yaroshchuk on May 20, 2008.
[60] Radkevich and Starkell, "Ukraine: Will the Orange Revolution Boost the IT Outsourcing Industry?"

conspicuous in the recent years. According to Viktor Maznyuk, a President of Ukrainian Hi-Tech Initiative, approximately 5% leave for training, whereas only 1-2% leaves to work in foreign countries.[61] The response from education authorities is that the market, not the state, should invest into skill formation, due to the dynamic development of industry and inability of the education curriculum to change so rapidly.

To capitalize on the solid technical potential of Ukrainian graduates and to meet the demands of rapidly growing market with increased number of vendors and clients, IT companies and professional associations decided to facilitate the situation by establishing direct linkages with universities and with project management organizations. As a result, local software development companies started to support financially certain university departments, and also set up training academies and certification processes. However, as pointed out by Taras Vervega, only large firms can afford such activities, as well as those multinational companies (MNC) that have commercial offices in Ukraine.[62] For example, Kyiv Polytechnic University has HP, Microsoft, Cisco, and other MNCs among its partners.[63] These market leaders also sponsor computer labs or special equipment, where students can apply their skills.

To render software development and especially oriented at serving foreign clients, Ukrainian programmers should possess good project management skills, too. Developing a complex solution according to customer's specifications entails meeting the deadlines, ability to prioritize and to manage budgets accordingly. According to the Ukrainian Association of Software Developers (UASWD), although time is needed to engrain project management and communication skills into work culture of Ukrainian developers, special classes and training can

[61] Yaroshchuk, "Drivers of IT industry in Bulgaria, Romania, and Ukraine", p.2
[62] Vervega, interview
[63] Emmy Gengler, "Ukraine and Success Criteria for the Software Exports Industry." Electronic Journal of Information Systems in Developing Countries, no. 13 (2003): 5 www.ejisdc.org/ojs2/index.php/ejisdc/article/view/82/82 (accessed May, 2008)

be useful. For instance, the UASWD agreed with the project management organizations to collaborate with software development teams, so that the latter can learn the successful methods of work.[64]. As explained by Viktor Maznyuk, Ukrainian business community cannot afford to wait longer for support from the state in creating special hi-tech zones or centers, thus the companies are taking action in their own hands[65].

Another way in which foreign and local software companies can influence the availability of employees with desired profile is to control and coordinate head-hunting practices and to source the skilled workers from regions (provinces). After western companies started to look further east in search for cheap software service providers, the competition on the Ukrainian labor market intensified. The reason for choosing Ukraine, for example, over Hungary or Poland, according to the global consulting firm A.T. Kearney, is increasing living standards, wages and corresponding costs in the new MSs.[66] However, closer attention from the western clients puts pressure on the local labor market, and one of the means of attracting the skilled workforce is to offer higher compensation. To prevent unreasonable jumps in remuneration, anti-hunting lawbook is expected to be issued soon, as stated by Technopark company.[67] Furthermore, facing skyrocketing prices for the real estate in the capital city Kyiv, many foreign and local IT firms have started to seek and train employees in the regions of Ukraine. According to the findings of GoalEurope, a market research company, 53% of development resources were located in Kyiv, whereas other cities as Lviv and Kharkiv are runner-ups with respective share of 18% and 13%

[64]Ibid, p.9
[65] Maznyuk, interview
[66] "Global Services Location Index", A.T. Kearney.http://www.atkearney.com/shared_res/pdf/GSLI_Figures.pdf (accessed April 15, 2008).
[67] Victoria Malinovskaya "Outsourcing to Ukraine: What to Expect?" *Technopark Corporation.* http://technoparkcorp.com/about/news/year2006/news18

of development workforce[68], and have cheaper facilities. Therefore, by expanding into the country's regions companies can maintain the price-quality ratio and industry growth.

3.1.2 State

The state should attend to the needs of IT industry, because this industry is export oriented and apart from generating foreign currency inflows, it also creates new jobs, restrains brain-drain, diversifies export portfolio of the country, and attracts foreign investors that develop telecommunication and computer infrastructure. Considering all the available success factors and potential benefits that IT can bring to the economy, Ukrainian government has made a range of declarations confirming its support for the country's transition from industrial to information society.[69] Ukrainian authorities have placed information society among priorities of their policy agenda and expressed intention to support this industry in various speeches and documents, since the adoption of the National Program on Informatization in 1998.[70] The government states that the development of information technologies will allow Ukraine to build a democratic society and to integrate into European community. However, resolutions and speeches in support the industry are not enough, and judging by the examples of the first-tier software countries, concrete programs are needed, especially in the field of education, where state has the most likely leverage and possibility of intervention.

The Ukrainian state has not yet created a consistent approach to solve the emerging problems in the education domain. Among the main reasons for worsening of quality of education are outdated teaching approaches and low salaries of teaching staff. In response, the Ministry of Education plans to increase expenditure on the education from 4% of the GDP spent

[68] Starkell "Outsourcing in Ukraine in 2007" http://www.goaleurope.com/main?cat=6
[69] Access to relevant speeches, interviews, and publications related to the innovations topic is available at the website of the State Agency for Investments and Innovations http://www.in.gov.ua/index.php?lang=en&get=141
[70] Cabinet of Ministers of Ukraine. *The List of Legal Acts.* http://www.kmu.gov.ua/control/en/publish/article?&art_id=10280806&cat_id=10280794 (accessed May, 2008)

7 years ago, to 6.52% of the GDP. The former minister, Stanislav Nikolayenko, has also recognized in his speech that hi-tech industries are important for economic growth and innovation-based model is the right path, since the country does not have global resources of oil or gas.[71] Yet, I should underlines that exactly thanks to serving as an intermediary for transporting natural gas to EU countries, supplied by Russian Gazprom, the Ukrainian state is making a lucrative business, as it re-exports the purchased gas at much higher prices.[72] Thus, being caught up in the gas trade "wars" and other commercial matters, the top officials seem to be less consistent with following-up on their proclaimed action plans with regard to other industries with high potential economic impact.

Only most recently Ministry of Education and Ministry of Transport and Communication have turned their attention to the demands of ICT industry by organizing conferences, during which possible solutions to the problems of teaching ICT disciplines. As a result, plenty proposals were made, among which such measures were outlined: "to create a mechanism allowing operational changes in the educational program and in the content of the discipline once in two years; to increase the number of hours for IT classes to 15 credits; to establish a system of monitoring demands and needs of ICT labor market, as well as direct connection with the interested enterprises (potential employers); to engage ICT companies in practical training of students and ensure provision of modern equipment for higher education institutions."[73] At any rate, at least the problems are now publicly discussed and alternatives approaches are evaluated.

[71] Starkell, "Outsourcing in Ukraine in 2007"
[72] "Ukraine's Gas Sector" Oxford Institute for Energy Studies., June 2007. http://www.oxfordenergy.org/pdfs/NG21.pdf (accessed April 21, 2008).
[73] Yaroshchuk, "Drivers of IT Industry in Bulgaria, Romania, and Ukraine", p.3

The state interest in IT may be boosted by the actions of international community. For example, on May 2008, Microsoft Corporation signed a memorandum of understanding (MOU) with Ministry of Education of Ukraine, Ministry of Interior and State Service of Special Communication. This is an important event, as it starts cooperation in the field of education via certain measures that will help to upgrade teaching methods and quality of curriculum. The MOU was signed by the Chief Executive Officer of Microsoft Corporation, Steve Ballmer, Minister of Education of Ukraine, Ivan Vakarchuk, and Premier-Minister, Yulia Tymoshenko, which indicates that the top authorities have started on the right track.

3.1.3 Summary

While the Ukrainian state is slowly starting to address the issue of provision of public goods, such as modernization of education in conformity with knowledge-based economy, the local companies, have emerged as major source of training of the vast talent pool. The majority of IT companies establish linkages with the universities, through which they provide practical training to the students, set up computer labs, engage in joint research projects, and also employ the best performers. In addition, project management skills can be improved by programs and courses arranged by the professional IT associations. Such industry-specific skills and project management abilities are essential for the development of customized software for foreign clients. Although only a few big name companies have opened full-cycle software development centers in Ukraine, those who are present or have commercial representations are also providing sponsorship and promoting knowledge-transfer. Furthermore, the international demand for software development activities helps to explore human capital potential in the provinces of Ukraine and to develop specific skills there, too.

3. 2. Estonia

3.2.1 Market

Estonian private and public sector is in agreement that the present and future of the country's economy depends to the large extent on the knowledge of its citizens. The country strives to develop innovative-driven economy, where highly educated people, vibrant linkages with more developed Scandinavian neighboring countries, and solid educational institutions definitely provide a positive leverage.[74] In addition, shifting to quality-based instead of the low-cost strategy is desirable for Estonia, since after its accession to the EU the labor costs have risen.[75] For example, according to the World Bank an average annual wage increase in the period from 2004 to 2006 was 7.9%, and most recently the rate climbed to 15% according to unofficial data.[76] Hence, the key to competitiveness of the Estonian economy is availability of a critical mass of skilled labor, which will enable IT and other sectors to produce higher value-added goods.[77] At the same time, although the number of computer science students in higher education grew impressively from 552 to 4,046 in the period of 1994-2004[78], the preferred goal to move higher in the value chain with more intellect intensive processes still remains a challenge. The software companies have found the ways how to do well even in this situation when the competitive advantage of cheaper resources is deteriorating and the skilled labor shortage is pressing.

According to the independent survey conducted in 2001 among 75 and 99 ICT firm, the major problem voiced by business representatives was insufficient number of qualified employees. 63% of the surveyed enterprises answered that they have difficulties in finding the

[74] Ministry of Economy and Communications. *Access of Enterprises to Venture Financing in Estonia: Freasibility Study of Government Support Scheme*, 2004. http://www.eas.ee/vfs/2129/Riskikapitali_eeluuring.pdf
[75] Tarmo Kalvet. *Analysis of the Estonian ICT Sector Innovation System. ICT, Innovations and Innovation policy: The Case of Estonia*, Tartu: SA Archimedes, 2002.
http://www.esis.ee/eVikings/evaluation/eVikings_WP_Tarmo_Kalvet.pdf. (accessed May 3, 2008)
[76] Drew Wilson, „East European Jobs Chase a Work Force on the Move". *EE Times Europe*, 19 November 2007. http://www.eetimes.eu/203102898 (accessed May, 2008)
[77] Kalvet. "The Estonian ICT Manufacturing and Software Industry: Current State and Future Outlook".
[78] Statistics Estonia, http://www.stat.ee (accessed May 16, 2008)

suitable workforce for their sector.[79] One more observation made by Estonian researchers in 2001 is that few subjects were incorporating application of ICT in business and accentuated more theoretical issues, not practical ones. In addition, interdisciplinary methods are important, because novel IT products or services are not just about writing a code or installing a system, but they rather involve integrated approach to problem solving and ensuring customer satisfaction. Analysts also pointed out that at the time of the research, such major universities, such as Tallinn Technical University and University of Tartu offered a limited number of internship and practical joint projects.[80]

Hence, facing such a situation, companies were eager to invest into human resource development themselves. As demonstrated by the project, eVickings poll, 86% of companies confirmed that they invested in training of their personnel. In this way companies would be able to move faster into higher value added niches.[81] Naturally, the bigger the company, the more it invested into training of its employees, and here foreign-owned enterprises had financial leverage over domestic ones. Estonian experts estimated that generally the most successful firms spend around 10% of the annual salary fund on development of human resources.[82] However, a positive attitude of employers towards spending money on educating workers was not a given in the end of 1990 and the beginning of 2000s, but rather developed virtue, because already in 2006 the

[79] Rainer Kattel and Tarmo Kalvet. *Knowledge-based economy and ICT-related education in Estonia: overview of the current situation and challenges for the educational system.* PRAXIS Center for Policy Studies, Policy Analysis, p. 54. http://pdc.ceu.hu/archive/00003205/ (accessed May 16, 2008).
[80] Ibid, p.57
[81] Ibid, p.55
[82] UNESCO *National Report of Estonia.* http://www.unesco.org/uil/en/UILPDF/nesico/confintea/Estonian.pdf (accessed May 16, 2008).

share of companies willing to pay for the training of their people reached 70%, compared to 45% in 2001.[83]

One of such illustrations of profit and non-profit sector cooperation is Estonian Information Technology Foundation (EITF), which is a founder and administrator of the Estonian IT College and a national program "Tiger University". The representatives of the Estonian government, Tartu University, Tallinn Technical University, Eesti Telekom and the Association of Estonian Information Technology and Telecommunications Companies are on the Executive Board and Council.[84] The remarkable feature of IT College is that it operates in close contact with the ICT industry while providing applied courses on IT and telecom subjects for 250 students per year. Although in the start-up period of this private institution Ministry of Education donated a significant amount, the number of private partners is impressive and is increasing, as IT companies are sponsoring specific courses.[85] Apart from major foreign companies (Hansapank, Hewlett-Packard, IBM, Microsoft, Nokia, and Oracle), large local ICT industry players have also provided scholarships for students (Elion, EMT, Eesti Ühispank, Microlink, Santa Monica Networks, Starman, and Tele2), but Swedish owned Hansapank and Telia along with the Swedish Agency for Economic and Regional Growth have been recognized as the largest donors.[86]

3.2.2 State

Right after obtaining independence, Estonia stepped on the road of radical liberalization in order to break the stereotypes associated with the country in transition. Its second objective was to

[83] Ibid, p. 32-34.
[84] IT College. *IT Foundation.* http://www.itcollege.ee/?url=eits (accessed May 2008).
[85] IT College. *Cooperation.* http://www.itcollege.ee/?url=cooperation (accessed May 2008).
[86] IT College. *Status and Facts.* http://www.itcollege.ee/?url=status_and_facts. (accessed May 2008).

position itself in the world as an *innovative country*.[87] Just like Ukraine adopted its National *Program on Informatization* in 1998, the Estonian Parliament approved the *Principles of Estonian Information Policy* also in 1998. However, the policy in case of the Baltic country was coupled with the National Development Plans and projects that will be highlighted hereafter, as well as with corresponding state committees and agencies responsible for coordination of the IT development. With regard to education, the most known and far-reaching initiatives of the Estonian state are Tiger Leap project (1997-2000), Tiger Leap Plus development program (2001-2005), as well as such endeavors, carried out by the state agency Enterprise Estonia, as Business Training program and Program for retraining of employees.[88] Thus, private-public partnership was formed to gradually tackle the barriers on the way to the real information society.

The two Tiger Leap projects are considered to be the best-practice in improving the quality of education in schools and higher education establishments, by providing them with up to date ICT infrastructure and access to internet, and assuring ICT competency by all teachers and students. In addition, the program, financed by state budget, supported innovative proposals of educational institutions as to e-learning activities.[89] Hence, the goal was not just to increase internet usage for its own sake, but to create a learning environment conducive to innovation and client base that would be receptive to new e-services and technologies, and thus attend to the requirements of the ICT industry.

While in the beginning of 2000s the state was concerned with ICT infrastructure development and creation of the necessary institutions and frameworks necessary for

[87] Alasdair Reid. "Evaluation of the Design and Implementation of Estonian RTDI Policy: Implications for Policy Planning", *Technopolis Consulting Group Belgium*, 2006. http://www.technopolis-group.com/downloads/reports/585_Evaluation_Estonian_RTDI_2006.pdf
[88] Ministry of Economy and Communications http://www.mkm.ee/index.php?id=8419 (accessed May, 2008), Enterprise Estonia http://www.esis.ee/ist2004/385.html (accessed May, 2008)
[89] UNESCO *National Report of Estonia.* http://www.unesco.org/uil/en/UILPDF/nesico/confintea/Estonian.pdf

implementing policies, later the government tailored its strategies with the ones of the EU (Lisbon Strategy'2000, eEurope 2005) to meet accession requirements. Along these lines an updated IT policy, "Principles of the Estonian Information Policy for 2004-2006", was adopted, which designated certain priority areas, such as "introduction of *e*Services[90] in all state agencies together with respective training and awareness-raising activities for the whole society", and "increasing the export capacity of the IT sector".[91]

The most recent document related to the information technology and IT education is Estonian Information Society 2013. Among its numerous measures dealing with the development of knowledge-based economy, the strategy aims at creating favorable conditions for the superior competitiveness and internationalization of the ICT sector. Additional the objectives of the Ministry of Education and Research are modernization of national curricula, introduction of e-courses and electronic study materials and their dissemination throughout all educational levels.[92] Furthermore, the Ministry also realized the urgent task to bring IT education in sync with the requirements of the ICT sector and set out to improve the apprenticeship system, attract IT lecturers to vocational and higher education level institutions, and devise a mechanism to increase motivation among post-graduate students.[93]

3.2.3 Summary

The state policies of Estonia demonstrate substantial emphasis on human capital development and attention to information technology that pervade all aspects of the Estonian competitive strategy. The approach is not to promote industry champions, but rather to build all-inclusive information society. Public-private initiatives were initiated in the field of education and were

[90] E-Services: e-Police, electronic ID Cards for all citizens, e-voting at parliament elections, etc.
[91] ICT Development in the Public Administration of Estonia. *RISO*. http://www.riso.ee/en/pub/2004it/p11_s.htm (accessed, May 2008)
[92] "Estonian Information Society Strategy 2013" *RISO*. http://www.riso.ee/en/node/84
[93] ibid

supported by the state funds and by major donations from FDI, mainly of Scandinavian origin. As a result of their cooperation, the pool of internet users expanded, technology awareness increased, and possibility to improve commercial skills appeared. Hence, the learning entrepreneurial environment was created thanks to the initiatives of the state and funding of firms, which indirectly helps to meet the human resource related needs of the ICT-embedded software industry in Estonia.

CHAPTER 4: RESEARCH AND DEVELOPMENT

Research and Development (R&D) is popularly defined as a process of "discovering new knowledge about products, processes, and services, and then applying that knowledge to create new and improved products, processes, and services that fill market needs."[94] Hence, R&D is one of the crucial sources of knowledge that in its turn can be codified and tacit, but both types are equally important for innovation. A relationship between research, technological development and innovation (RTDI) has become mutually beneficial and with positive implications for socio-economic development, too.[95] Perhaps the first policy advisor who propagated and linked scientific research with economic competitiveness was Vannevar Bush[96], science adviser to President Franklin Roosevelt. In his seminal report to the president "Science - the Endless Frontier", he stated that "a nation which depends upon others for its new basic scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade, regardless of its mechanical skill."[97] As mentioned by the Economist, Bush promoted state sponsored science and engineering and had a vision of united academia, industry and military (during the wartime). This roadmap became a key to the US success in information technology industry in the next decades.[98] According to his advice, universities conducted scientific researches, which were further developed by industry and then the products were brought to the market.

[94] "R&D" InvestorWords.com. WebFinance, Inc. May 28, 2008 http://www.investorwords.com/4028/RD.html.
[95] This area has been researched by such economists, as Freeman, Lundvall, Nelson, and mentioned by Attila Havas "Knowledge-intensive Activities versus High-tech Sectors: Learning Options and Traps for Central European Policy-makers" in Knowledge-based Economy in Central and Eastern Europe, p. 259-261.
[96] Vannevar's Bush is not related with the current president George.W. Bush.
[97] Vannevar Bush "Science - the Endless Frontier". Chapter 3, Science and the Public Welfare. http://www1.umn.edu/scitech/assign/vb/VBush1945.html (accessed May 28, 2008).
[98] "The rise and fall of corporate R&D" *The Economist.* March 1, 2007. www.economist.com/science/displaystory.cfm?story_id=8769863 (accessed May 28,2008).

As for the Soviet Union (SU) countries, its regime invested highly into science and technical education with the goal to increase military production, and as a result, according to Chris Freeman, "militarization of Soviet R&D" suppressed the one of the US.[99] After the shift happened towards information technology in 1970s and 1980s, the negative consequences of such excessive militarization in SU became evident, because SU was not capable to transform its RTDI system into decentralized enterprise-level one, as it was inconsistent with the command system and ideology.[100] So, while the West moved to enterprise-financed R&D, coupled with the stronger role of universities, the research institutes of the USSR continued concentration on fundamental research without the connection with industry and teaching.

Another important aspect worth mentioning, when discussing R&D in hi-tech industries, is a phenomenon of clusters. The concept of clusters was proposed by Harvard professor Michael Porter, who noticed that clusters are formed in one place of linked prestigious universities, research centers, industries and government agencies, whose critical mass and spin-offs to the market induce innovation, productivity and new businesses. Such conglomeration of knowledge, relationships and motivation allows for labor specialization, capital accumulation and other advantages to appear that are hard to gain from a distance, even in the time of open global economy and instant communication. Additionally, clusters permit conceptualizing of the role of a state and market in a new way. [101]

Having experienced Soviet approach to R&D, both Estonia and Ukraine are trying to find their way of integration into worldwide IT industry by looking at the best practices of leading hi-tech nations. Hence, in this chapter I will discuss how Ukraine made use of its previous scientific

[99] Freeman, "'Catching Up' and Innovation Systems", p. 19
[100] Ibid, p. 22
[101] Michael Porter, "Clusters and the New Economics of Competition", *Harvard Business Review,* November-December 1998, cited on Institute for Strategy and Competitiveness. http://www.isc.hbs.edu/econ-clusters.htm (accessed on May 28, 2008).

superiority, cases of collaboration among firms and universities, and external factors driving offshore product development, while the government talks about Silicon Valley projects. With regard to Estonia, I will study whether its grand strategies were matched with the concrete projects aimed at increasing R&D expenditure, and a possible contribution of FDI.

4.1 Ukraine

During the Soviet period in the history of Ukraine, such industries as aircraft, ship-building, nuclear physics, missile and tank engineering, communication and telecommunication massively employed Ukrainian scientists, mathematicians and engineers.[102] Although these branches of economy were not software development *per se*, a significant portion of software R&D was necessary to run the applications used by those industries. As discussed by Gengler, the famous Paton Institute designed a Soviet type of a cruise missile, which needed a precise programmed model of the surface of the earth.[103] However, after the collapse of the SU, there was not much domestic demand for R&D. Moreover, state expenditures on R&D drastically decreased, and in addition a closure of the majority of the factories and companies necessitated the technical workforce to find new ways of applying their skills and of commercializing their technologies. So, they pursued career in software development, where they could make use of their scientific and technological adroitness in IT related projects.

In recent years there is more activity coming from the side of the firms when it comes to establishing partnerships or cooperating with universities. For examples, it is common when IT companies reach out to universities to hire students for certain projects in a form in internship with potential further employment. Telesens Ukraine, a subsidiary of German company,

[102] American Chamber of Commerce in Ukraine. *White Paper on Offshore Software Development in Ukraine*, June 14, 2002. http://www.e-ukraine.org/e-ukraine/fullnews?item_id=80412 (accessed May 12, 2008)
[103] Gengler, p. 13

achieved even more by establishing a software development center on the basis of Kharkiv Polytechnic University. This joint endeavor involves 15 departments of the university, 30 PhDs, 30 professors, 100 doctors of science[104], and 2,000 students, who are all engaged in software development projects.[105] Thus, the IT companies have realized advantages of horizontal clustering, as it facilitates access to R&D and human resources, whereas universities benefit from investment into infrastructure and technology. However, there is no yet a case when the related companies share the same working space, with an exception of a joint agreement between Kvazar-Micro and Telesens Ukraine.[106] Another bright example of firms' initiative is the Ukrainian Software Consortium project, started by the Ukrainian company Techinvest in 2003, which brought 30 leading software and IT companies under one umbrella.[107] In this fashion, the industry representatives were able to get attention of international software and venture capital community at such fairs as CeBit, organize US-Ukraine IT forum in Ukraine, and open lines of communication with the global bands, such as IBM.[108] The member firms specialize in different areas, such as banking, education, SAP, etc, which means that they complement each other and not rival.

As for the Ukrainian government, the first time when President Yushchenko mentioned a specific intention to develop an analogue of Silicon Valley in Ukraine was October 2007, after approving the initiative of the Association of Ukrainian Entrepreneurs. According to this announcement, the plan is to create international hi-tech clusters together with universities and research institutes in 5 oblasts of Ukraine. The estimated return on investment of this large-scale

[104] A degree one level higher than PhD.
[105] Elena Teslya "Ukrainian Silicon Valley" (in Russian), Computerworld, http://www.osp.ru/cw/2006/13/1154262/ (accessed May, 2008).
[106] Gengler, p.12.
[107] "Hi-Tech Market Development. Ukrainian Software Consortium". TechInvest. http://www.techinvest.com.ua/main.php?lang=en&page=8 (accessed May 28, 2008).
[108] ibid

project is 100 million USD, and 1500 new jobs are expected to be created, too. While the detailed plan of this project is not ratified yet, a good foundation was laid for such an ambition by the State Agency for Investment and Innovations and National Technical University Kyiv Polytechnic Institute, which opened the scientific park *Kyiv Polytechnic*, legitimized by the law on December 2007. The purpose of the newly created institution is to unite academia, industry, research institutes for fostering innovation processes and launching innovative products.[109]

As an emerging market with innovation potential, Ukraine is potentially attractive as an offshore R&D destination. The Economist Intelligence Unit argues that the race for R&D talent is taking place now due to globalization of R&D, as claimed by the 70% of surveyed top managers. According to Daniel Franklin, editorial director of the Economist Intelligence Unit, corporate R&D is going to be more transnationalized, as different players will undertake different tasks in the innovation chain.[110] However, global corporations also recognize risks involved, especially worrisome is the state of intellectual property rights in the developing countries. Ukraine can benefit from such global trends, if IPR protection is reinforced, because Ukrainian companies have definitely capacity for such activities, unlike Indian counterparts, who are mostly engaged in routine coding.[111] The R&D outsourcing is one step above the ordinary outsourced activities, hence it entails larger budgets, more complex analytical and programming tasks and stronger emphasis on quality. So, this can be a viable alternative to the simple IT outsourcing, which is dominating the market at the moment.

[109] "Scientific park "Kyiv polytechnic" The State Agency of Ukraine for Investments and Innovations. http://www.in.gov.ua/index.php?lang=en&get=113 (accessed May 28, 2008).
[110] Joanne McKenna "Companies plan to increase overseas investment in R&D, says a new report from the Economist Intelligence Unit" The Economist, 2004, http://www.eiuresources.com/mediadir/default.asp?PR=680000768 (accessed May 28, 2008).
[111] AmCham, *White Paper*, 2002

To make a step from outsourcing to R&D services, and then to product development is not easy. Only a few companies in Ukraine can afford changing their focus, and United Software Corporation is one of the successful examples. The company has managed to switch from offering man-hours to innovation sourcing and eventually developed product-oriented model.[112] The company succeeded in product-based business model, because it received necessary investment from Techinvest, understood the needs and wants of clients, and obtained a large network of diverse specialists. As for the rest of the market, they develop customized solutions for the western companies, and the latter sell them under their own trademark. Therefore, as estimated by Anatoliy Zayets, the First Deputy Head of the State Agency of Ukraine on Investment and Innovations, 80-90% of Ukrainian products are not recognized as originated in Ukraine by western customers.[113]

Clearly, there is a need in an innovation policy that addresses the problems experienced by innovative companies and offers them incentives and tools for successful functioning. Reorganization of state R&D system is also necessary for increased involvement of private sector into R&D, which is evident from the data, provided by STEPS, National Academy of Sciences of Ukraine: the ratio of public expenditure on R&D/GDP in Ukraine is less than 60% of the EU25 average, and ratio for private sector expenditure on R&D is even lower with only 31%.[114]

[112] "USC shows the benefits of its business strategy to Ukrainian software developers". USC, November 5, 2007. http://www.uscglobal.com/index.php?option=com_content&task=view&id=70&Itemid=32 (accessed May, 2008).
[113] Anatoliy Zayets "Information Technology is a Priority of National Development" *Commerce*, no.16 (2007): p. 8, http://www.chamber.ua/publications/commerce/26
[114] "Innovation in Russia and Ukraine in need of performance improvement". Innovations Report, July 10, 2007. http://www.innovations-report.de/html/berichte/wirtschaft_finanzen/bericht-87127.html (accessed May, 2008).

4.1.1 Summary

Until now, the state has not played any valuable role in supporting or reorganizing R&D institutions. The demand for hi-tech solutions is still weak on the domestic market, whereas systemic approach to international technology transfer or commercialization is still missing, hence the share of R&D investment by private sector remains small. A positive sign is coming from the side of IT firms, because they cooperate with each other, reach out to international clients and universities, which ensures access to R&D, human resources and international capital. This can be interpreted as survival strategy in the light of institutional inertia in 1990s and beginning of 2000s. The government attention on the top level to the issue of the economy's international competitiveness via hi-tech became noticeable only after the Orange Coalition came into power in 2005. In the meantime, globalization of R&D offers opportunity for Ukraine to move up from simple IT outsourcing to a more complex R&D outsourcing.

4.2 Estonia

As a result of a path dependency, weak enterprise R&D was still characteristic for Estonia in the 1990s. Research conducted by the Estonian Archimedes foundation points out that at the Estonian IT companies were developing specific applications, which did not include systematic research and development activities. The surveyed firms mentioned the lack of financing of R&D and the need in incubating their new products. This problem, expressed by 30% firms, can be solved by passing on some parts or stages to pertinent universities or research institutes or by cooperation with other companies. However, as indicated in the research, IT companies were selling their developed applications predominantly to domestic buyers, hence they were inclined to look at each other as competitors. In addition, familiarity of private sector about the activities of academia and research institutes was minimal at that time, as shown by 35% of companies,

which knew something about the local institutes and only 10-15% collaborated with them. Yet, they were more aware (56%) of the supporting institutions, such as Estonian Technology Agency, Tartu Science Park and TTU Innovation Centre.[115]

In 2004, when another study was conducted on this matter, it became already noticeable that the private sector's investment into R&D increased and had a larger share, compared to the public one. According to the Estonian R&D Strategy document for 2007-2013, in 1999 the investment made by business into R&D was 23.9%, while in 2004 it reached 39% of the total R&D investment.[116] The authors explain this change by a low starting base of enterprise-level R&D and also by state support, as well as by better cooperation with research institutes. Thus, in 2000 such state agencies as Estonian Science Foundation and Estonian Technology Agency contributed a considerable 11 million kroons for IT related R&D.[117] Still, the strategy document acknowledges that the ratio of business sector investment in R&D is still below the one of the western countries, for instance, the EU average is 55,5%.[118]

Another view on addressing R&D problem focuses on the role of FDI, which under certain conditions brings in technological know-how into the host country. A lot depends on the capability of a state to "anchor" FDI, so that it establishes links with local universities, suppliers, engages in high-end activities, ensuing in well-paid jobs.[119] In this respect, Estonia managed to transform from factor-driven to investment-driven type of economy, because it ensured significant inflow of FDI.[120] Invest Estonia agency explains this success by favorable business environment, liberal economic policy and low taxes.[121] As a result, in 2006 this Baltic country

[115] Marek Tiits and Pihl Tarmo *IST R&D and Innovation in Estonia.*
[116] "Knowledge-based Estonia 2007-2013" RISO http://www.riso.ee/en/node/84 (accessed May 25, 2008)
[117] Tiits, 2002, p.10
[118] Ibid, p. 12
[119] Attila Havas, "Knowledge-intensive Activities vs. High-tech Sectors", p. 271.
[120] Kalvet. *Analysis of the Estonian ICT Sector Innovation System*, 2002
[121] Invest Estonia. http://www.investestonia.com (accessed May, 2008)

has become one of the leaders in CEE region with account to FDI investment per capita reached 986 Euro and the stock of FDI rose to 9214 EUR per capita.[122] The foreign investment, the country secured, came mainly from Nordic countries, bringing their more advanced IT culture to Estonia, hence contributing to the rapid implementation and diffusion of ICT. More specifically, investment of foreign companies into R&D accounted for 13-17% of total R&D investment, whereas average in the EU countries is 7-8%.[123]

As mentioned in the previously, IT sector is embedded into ICT cluster with strong links to banking and telecommunications sectors. This is not a coincidence, because the majority of the foreign investment went into banks and telecoms. According to the 2004 report prepared by the Institute for Prospective Technological Studies, out of eight ICT firms which account for 80% of the market in Estonia, seven are Swedish and Finnish, and only Microlink AS is Estonian.[124] Kalvet explains that the robust development of banking sector and technological solutions developed by the banks' IT departments have strengthened the need in high quality software, credible and secure products, which facilitated the appearance of innovative solutions on the market.[125] Moreover, their products have wider implications for electronic commerce, language technologies, and data communications security. Also, RTD subcontracting is done by the foreign banks and telecoms, where smaller domestic software companies carry out certain tasks, since comparing to the foreign enterprises, local ones are undercapitalized.[126] Therefore, considering foreign-led linkages and competition between local ICT firms, there is vertical cooperation in the ICT cluster of Estonia.

[122] Estonia Ministry of Foreign Affairs http://www.vm.ee/eng/kat_131/3364.html
[123] "Knowledge-based Estonia 2007-2013"
[124] Puss, Tiia, Tiit Rajasalu, Urve Venesaar and Mare Viies. "Factors and Impacts in the Information Society: A Prospective Analysis in the Candidate Countries: Report on Estonia. Institute for Prospective Technological Studies, Spain: European Communities, 2004.
[125] Kalvet, 2002
[126] Tiits, 2002

Besides foreign owned ICT companies, there is an unusual (for CEE region) connection between local ICT companies and government. The remarkable feature of the Estonian state is that apart from public initiatives and building of innovation related institutions, it also performs a role of procurer of IT solutions from the domestically-owned firms since 1998. The examples of projects commission by the state are e-government, electronic ID card for all citizens, X-road project (government information exchange mechanism), digital signature, and e-voting (one of the first in the world).[127] This finding is supported by survey of firms, done by Kalvet, which states that Estonian product development companies found niche in information society and sell e-business and e-government production to the domestic market.[128] Furthermore, in addition to positive attitude of the state to application of novelties, the small size of the country can also be beneficial, as suggested by Vaho Klaaman, Managing Director of Skyline, as it is "a perfect test site for new "killer applications"".[129]

Tracking the developments of policies in relation to R&D, I have noticed a high degree of learning of state authorities and institutions in terms of formulation of policies and building support structures with a help of the EU. The state issued a number of strategic documents in the domain of knowledge-based economy, out of which the cornerstones are "Knowledge-Based Estonia: Research and Development Strategy 2002–2006" and the most recent R&D Strategy "Knowledge-based Estonia 2007-2013", proclaiming the goal to achieve expenditure on R&D of 1.9% of GDP by 2010 and 3% of GDP by 2014.[130] In the latter strategy it is explicitly stated that "research and development, and innovation (RTDI) are at the core of the knowledge-based society model in developed countries". No wonder that the document mentioned example of

[127] Kalvet 2002; and State Information System http://www.riso.ee/en/node/76
[128] Kalvet, 2002
[129] Ibid.
[130] "Knowledge-Based Estonia 2007-2013" www.akadeemia.ee/_repository/File/ALUSDOKUD/Knowledge-based%20Estonia%20II.pdf

advanced countries, as the very nature of this strategy is taken from the best examples of Finland and Sweden. The positive outcome of the deployed policy tools is that they managed to increase public funding for R&D, among which such programs as Competence Centre and the SPINNO program, oriented at research institutes, universities, and innovation centers, received positive international appraisals. The total financing of these programs accounted for 13 million euros for the period of three years, which is quite a sum for the size of Estonia.[131] As for concrete results, SPINNO program helped to match industry with universities in the form of projects, thanks to which technology transfer and commercialization started, 35 spin-offs were registered, as well as 26 trade-marks, patents and industrial designs.[132]

However, there are certain weaknesses of RTDI policies pointed out by the Review Report, compiled by the DG Research. For instance, the objectives related to the rate of R&D expenditures have not yet been met for 2002-2006, so setting even more ambitious goals without turning attention to the needs of enterprises is not an effective approach. In addition, the "coordination gap" and "implementation gap" by state and public authorities should be addressed.[133] Furthermore, the challenge of Estonian NIS to bring together industry and university representatives still persists. Nevertheless, the presence and improvement of a strategically important and detailed R&D policy is a unique case among CEE countries.[134]

[131] Wolfgang Polt "Evaluation of RTDI Mix. Country Report for Estonia 2007" http://www.fteval.at/home/en/evaluierungsstudien_4.php (accessed May 17, 2008)
[132] Reid., "Evaluation of the Design and Implementation of Estonian RTDI Policy
[133] Polt "Evaluation of RTDI Mix. Country Report for Estonia 2007"
[134] Carine Dartiguepeyrou "A Prospective Analysis of the New Member States' Contribution to a Knowledge-Based Europe". http://www.idate.fr/fic/revue_telech/179/C&S56_DARTIGUEPEYROU.pdf (accessed May 3, 2008)

4.2.1 Summary

Estonia is going through a fast catching-up process in achieving innovation-driven stage. Firstly, the country received an increased inflow of Nordic FDI in banking and telecom sectors, which became the drivers of software development in the country (with novelties, such as internet banking, digital signature, m-banking, m-parking, etc) due to superior capital resources and know-how. The linkages in the ICT cluster are predominantly foreign-led, as domestic firms are relatively small and compete with each other. Secondly, the state assumed a role of a user of novel technologies, procured from domestic firms. This state's drive for innovations resulted in high ranking for e-readiness and responsiveness to the EU goals to increase R&D expenditures. The established targets have not been met yet, but the specific programs and innovation centers, initiated by the Estonian state and facilitated by EU funds, were established to stimulate R&D activities chiefly in the public sector. Moreover, Estonia is so far the only CEE country which has designed and implemented two R&D related strategies (in 2002-2006 and 2007-2013). Therefore, the combination of FDI investment and state's activeness gained Estonia a status of an e-country.

CHAPTER 5: INFRASTRUCTURE AND CAPITAL NEEDS

The ICT sector is one of the most capital-intensive sectors that requires developed infrastructure and simultaneously also provides a basis for information technology diffusion in society. The quality of broadband connection, internet access, and PC use are necessary for creating demand for IT applications and for strengthening information society. Hence, the state of infrastructure speaks about the country's economic condition and offers a chance for government and foreign investment to make a contribution. Furthermore, capital is needed for financing early stage innovations and intermediary phases of product development, start-up companies and marketing of new products, as ICT sector is known for spillovers and spin-offs that appear as a result of R&D activity or due to the perfectioning of the existing technologies. As for the software segment, it belongs to the one of the most entrepreneurial areas. Thus, support of entrepreneurial ventures, which can come from the state or venture capital organizations, is also important for the overall success of the industry. A developmental state provides grants, loans or creates public venture funds to meet the needs of innovative industries. In its turn, a developed capitalist market is nurtures venture capital (VC) organizations, which not only finance new enterprises, but also take part in formulating company strategy and development of local innovations. Therefore, access to state funds or VC is essential for maintaining high performance of IT industry.

In the CEE region VC is growing, albeit from a very low base, as it took off almost from scratch due to the bank-centered nature of a previous regime's financial system. European Private Equity and Venture Capital Association (EVCA) reports that the total VC investment into CEE was 508.3 million Euro[135], whereas the average amount for the EU was 27 billion

[135] Central and Eastern European Statistics 2005. *An EVCA Special Paper.* http://www.cvca.cz/miranda2/export/sites/www.cvca.cz/cs/sys/galerie-download/CEE-Statistics-2005.pdf (accessed May 31, 2008)

Euro. According to soecialist on this topic, Ilian Petkov Iliev, there is a lack of investment into early-stage in contrast to late-stage companies.[136] The author also argues that the difference in financial systems translates into funding different types of innovations, and hence leads to variety of NISs. Therefore, in prescribing policy treatment, the structural difference of VC in NISs should be considered. So, in this chapter, I will describe how Ukraine and Estonia are addressing the challenge of attracting VC in hi-tech, as well as the quality of infrastructure (telecom and internet coverage), provide the examples of government programs and their potential impact on IT industry.

5.1 Ukraine

Presently, technological infrastructure in Ukraine is underdeveloped and the number of telecommunications networks does not yet correspond to the requirements of informational society. Moreover, according to business analysts, it restraints industry's growth. In detail, as of January 2007, in Ukraine there were 26.4 fixed phones per 100 citizens, while Estonia had 35.4, and France - 57.3.[137] One of the major challenges of the telecommunications industry has been a privatization of the national telephone company Ukrtelecom, the monopoly position of which inspired a debate between state and business, continuing now for more than a decade. Although the situation with fixed phone lines is not advantageous, the mobile communication looks more prospective, because the amount of services rendered by operators rose by three times and investment into telecom networks increased, 80% of which was covered by mobile operators themselves.[138] Thus, as the more foreign mobile communication operators are entering Ukraine,

[136] Ilian Petkov Iliev "Barriers to Venture Capital Investment" in *The Knowledge-based Economy in Central and Eastern Europe* (New York: Palgrave McMillan, 2006): p.129
[137] Oleksndr Bakalinsky and Valetyna Vertel "The Innovative Development of Ukraine's Competitiveness". *Commerce*, no.16 (2007): 9. Available also at http://www.chamber.ua/publications/commerce/26
[138] Bakalinsky and Vertel, p.11

the more investment into infrastructure will increase, in turn so will the competition, and the prices will go down as a result. In terms of internet access, the number of users is still low by European standards.

Table 2

The Development of Telecommunication System in Ukraine			
Number per 100 residents	January 1, 1999	January 1, 2007	January 1, 2010 (forecast)
Fixed phone lines	18.3	26.4	30.9
SIM card penetration	0.63	104	126.9
Internet users	0.39	10.3	27

Source: State Statistics Committee of Ukraine and *Commerce* publication of American Chamber of Commerce.

As for the state efforts in this domain, the Supreme Council of Ukraine has adopted the law "On the Foundations of the Development of Ukrainian Information Society in 2007-15" and a subsequent Action Plan, where the goal "to develop national information infrastructure and integrate it into international infrastructure" is stated.[139] Additionally, Oleksandr Bakalinskiy mentions that such support institutions as "National Investment Fund, the Innovation Fund of Ukraine, the Bank of Ukraine's Development" are envisioned by the strategy, too.[140] At the same time, international venture capital organizations and international funds are few, whose list is limited to Western NIS Fund, EuroVentures, ABRT Russian Venture fund, and Techinvest.

The intentions to attract international investment have been expressed by the former president Leonid Kuchma in 2001 in a decree "Program on Development of Investment Activity in Ukraine in 2002-2010", which contains a chapter on drawing in investment for building

[139] Zayets "Information Technology is a Priority of National Development" *Commerce*, no.16 (2007): p. 8
[140] Bakalinsky and Vertel, p.11

innovation infrastructure.[141] However, in retrospect, it has become obvious that Ukraine is lagging behind CEE countries in FDI in total and per capital. Hryhoriy Nemyria, a new Deputy Prime Minister, is optimistic about future and predicts that 2008-2012 will be decisive for Ukraine in receiving foreign investment in the light of its recent acceptance to WTO and hosting the upcoming European football championship-2012.[142] Yet, when it comes to the software segment, due to high taxes and risks, according to Gengler, only 10-15% of firms have received foreign investment.[143]

In this circumstance, IT companies realized that they have to promote their software development services themselves, to set up representation offices abroad, because the latter gives more credibility and a wider selection of services offered to the foreign clients. Furthermore, software development companies participate in the road shows of Ukrainian technologies in Silicon Valley since 2003, thanks to which the finalists get funding from venture investors. Naturally, it is easier to establish such contacts, if diaspora is present in the target markets. In case of Ukraine, contact between home country and diaspora is strong, which domestic companies used for initiating first sales or partnerships. Still, when it comes to marketing and top-level sales, substantial funding and positive image of the country is decisive.

5.1.1 Summary

The problems of attracting foreign investment, creating local venture capital organizations and developing appropriate infrastructure needed for thriving of information society can be traced back to the imperfection of the national economy's condition, represented by red tape, high taxes

[141] Emmy Gengler, "Ukraine and Success Criteria for the Software Exports Industry." Electronic Journal of Information Systems in Developing Countries, no. 13 (2003): 5 www.ejisdc.org/ojs2/index.php/ejisdc/article/view/82/82 (accessed May 28, 2008)
[142] "The all CEE-ing eye markets" *World Finance*, *Magazine*, February 12, 2008. http://www.worldfinance.com/news/135/ARTICLE/1201/2008-02-12.html (accessed May, 2008).
[143] Gengler, p.13

and absence of investor-friendly institutional systems. Nevertheless, telecommunications infrastructure is the one that is receiving most of the investment by the foreign operators at the moment due to the untapped market. As for software developers, they have found a way out by reaching the potential clients via international linkage, the latter, however, is not enough to market effectively the firm's offerings. Should Ukrainian IT industry decide to expand into the product-based model, the appropriate framework for VC growth is even more imperative, as it helps to direct investment into start-up ventures, intermediary phases of product development, as well as provides a feasible exit option for investors. Finally, financial support from the state and positive country branding on the international level is is desirable for any production market strategy of IT industry.

5.2 Estonia

Estonia ranks high in terms of developing technological and information infrastructure. For example, in 2005, the country was recognized to be in the "Top 10 Who Are Changing the World of Internet and Politics", as its information infrastructure is the most advanced in the CEE region. To reach such impressive results Estonia had to undertake a profound privatization and deregulation to ensure competitiveness of information and communication technologies. In the beginning of 1990s the sector was monopolized and underdeveloped, so the Concession Agreement had to be signed to remove the obstacles. Consequently, in 2001 the telecommunications market was completely and thoroughly liberalized. Kalvet elaborates on the success of privatization and adds that it has been partially responsible for the early internet use for research, fast development of much needed technological infrastructure and attraction of foreign investment into ICT.[144] The competition between telecom providers pushed prices down,

[144] Kalvet, , 2002.

and moreover, thanks to the Telecommunications Act adopted in 2000, providers render universal services throughout Estonia for the similar prices.[145] As a result, ICT industry performed extremely well, gaining cell phone penetration of about 90% and the digitization level of main lines of 82%.[146] Additionally, it is quit peculiar for Estonians to use innovations in communications in all spheres of public life. For example, in 2004, 80% of those young people who wrote state exams received results in a form of SMS.[147] Another illustration of coordinated firm activity is Look@World project, started in 2002 by ten large companies, which committed 40 million Estonian kroons (2.6 million Euros). Their mission was to disseminate internet connection throughout the entire country, as well as to provide free computer classes to elderly people, because in this way the pool and profile of users would be increased.[148] Accordingly, thanks to demonopolization policies and extensive private sector investment, including Nordic investors, into hi-tech and communications infrastructure, Estonia managed to transform its ICT industry, which positively influenced internet diffusion and connectivity, and served as a foundation for innovative solutions.

Dynamic activity is observed in the public sector, too, as Internet and government in Estonia have complemented and reinforced each other. Besides promotional policies, the state was one of the first in the world to actually introduce e-government, which enables cutting lead time by basing all the paper work and related legislature on the web format and by arranging ministerial meetings online.[149] Accenture, the global management consulting company, pinpointed correctly that such "citizen-centred perspective" reduces red tape, increases efficiency

[145] Snetkov , http://www.american.edu/carmel/os2237a/privatization.htm
[146] RISO State Information System. *IT in Public Administration of Estonia. Yearbook 2004* www.riso.ee/en/pub/2004it/p42_s.htm (accessed May, 2008).
[147] ibid
[148] UNESCO. *National Report on Estonia*. http://www.unesco.org/uil/en/UILPDF/nesico/confintea/Estonian.pdf
[149] Snetkov, http://www.american.edu/carmel/os2237a/internetactivity.htm

and effectiveness of customer service, and saves taxpayers' money,[150] hence I believe all these reduces barriers to the development of modern hi-tech society.

There is no doubt that entrepreneurial activity is highly correlated with finance: access to financial resources for conducting R&D or launching new product is a very expensive and risky business. To hedge their risks, entrepreneurs in Estonia can get funding from different sources: government, VC and foreign investors. Firstly, the government designates 1% of the state budget for IT needs in public sector.[151] This share is not high, but can be treated as a step towards appreciation of IT use in public structures. In addition, there are funding bodies, created by the state and co-funded by the EU, that tangibly support private sector. For example, Enterprise Estonia is one of the major players, providing assistance to SMEs, consisted initially of seven independently operating public agencies (among which the largest were Estonian Technology Agency, Estonian Innovation Fund) that merged in 2000 and formed a new large-scale organization. Among the specific programs run by this agency, the most impactful ones can be named, such as Product Development Program, Feasibility Study Grants, Applied Research and Loan Grant, and Start-up Aid Program, all of them launched in 2001. Most of the proposed financial tools cover 75% of expenses in a loan form, or up to 50% in a grant for the enterprises innovation related matters. According to Technopolis Group, which prepared an overview and evaluation of RTDI policies, it is too early to measure numerically the outcomes of such programs.[152] As for certainly successful initiatives, the evaluators name Kredex Program, run by Ministry of Economic Affairs, which has created 1000 new jobs.[153] The program is targeted at

[150] "The good, the bad and the inevitable" *The Economist,* February 14, 2008. http://www.economist.com/surveys/displaystory.cfm?STORY_ID=10638105 (accessed May, 2008).
[151] Snetkov, http://www.american.edu/carmel/os2237a/itfinancing.htm
[152] Reid. "Evaluation of the Design and Implementation of Estonian RTDI Policy" http://www.technopolis-group.com/downloads/reports/585_Evaluation_Estonian_RTDI_2006.pdf
[153] ibid

micro and small-size companies, but I find this to be rather an advantage, because in CEE it is especially problematic to finance small ventures. Finally, the state has long planned to establish an Estonian Development Fund, and seems like this idea will be realized soon, as the necessary act was adopted by the Parliament in 2006. The core objective of this institution is to provide venture capital and management consulting for fledging companies, and also "technology foresight and monitoring on behalf of respective ministries", with total budget of 32 million Euro.[154]

Secondly, as the state funding mechanisms are considered by entrepreneurs to be modest, VC is needed to fill in the financial gap. VC organizations and state are supplementing each other, because VC providers are not excited about financing the first stages of innovation development, because this entails very high risks. Thus, it is necessary to have state programs that back up investors' spending in the later phases, which suggests that the state plays a role of a catalyst of money for the early periods.[155] The existing research on IT Landscape in Estonia names the following investment funds that provide their services to Estonian enterprises: The Baltic-American Enterprise Fund (BalAEF), Baltic Small Equity Fund, Estinvest, Stantion Capital Corporation, Baltic Fund 1, Inc, Nordic Investment Bank, the majority of which prefer to look at Estonia as a part of a Baltic cluster, encompassing Lithuania and Latvia.[156] In comparative perspective with the other CEE countries, the Baltic Tigers do not look the best in terms of total availability of start-up capital, replacement and buy-outs, but demonstrate 58.6% increase from year 2004 to year 2005.

Table 3

[154] ibid
[155] Ministry of Economy and Communications. *Access of Enterprises to Venture Financing in Estonia: Freasibility Study of Government Support Scheme*, 2004. http://www.eas.ee/vfs/2129/Riskikapitali_eeluuring.pdf
[156] Snetkov, http://www.american.edu/carmel/os2237a/itfinancing.htm (accessed May, 2008)

Type of Investment by CEE Country, 2005. Amounts in Euro, thousands.							
Type of investment	CZ	HU	PL	RO	SK	Baltics	Others*
Seed	-	-	-	-	-	-	-
Start-up	408	1,865	667	3,751	-	1,110	1,203
Expansion	10,621	62,349	2,196	11,358	1,430	25,789	17,902
Replacement capital	31,331	18,495	55,283	-	18,037	2,690	-
Buyout	66,593	64,538	49,761	54,890	-	6,151	-
Total 2005	108,593	147,247	107,818	70,000	19,467	**35,730**	19,105
Total 2004	16,074	121,562	134,437	32,543	7,059	**14,808**	219,997
* Bulgaria, Slovenia, Croatia, Bosnia&Herzegovina							

Source: EVCA[157]

5.2.1 Summary

The capacity of Estonian state to liberalize its telecommunications sector, to attract FDI, and to address the problem of lack of VC seems to suggest that it has played a driving force in advancement of ICT sector. The coordination of public initiatives with private sector led to implementation of a series of internet penetration promoting projects. The government is a good example of a user of internet technologies, which has positive implication for the "citizen-centred perspective" to the country's development. Although multiple financing programs were initiated by the state, their impact has yet to be seen. Meanwhile, the role of FDI investment into infrastructure and new innovative businesses is more visible and tangible.

[157] Central and Eastern European Statistics 2005. *An EVCA Special Paper.* http://www.cvca.cz/miranda2/export/sites/www.cvca.cz/cs/sys/galerie-download/CEE-Statistics-2005.pdf (accessed May 31, 2008)

CHAPTER 6: INTELLECTUAL PROPERTY RIGHTS PROTECTION

Competitiveness of nations depends not only on the abundance of material capabilities, but also on the intangible assets and their protection. Back in 1841 Friedrich List remarked that Adam Smith forgot about the intellectual dimension of capital and wrongly considered that "the revenues of the nation are dependent only on the sum of its material capital".[158] This line of thought is shared and further elaborated by Hernando de Soto, who claims that the Western countries enjoy superior economic performance thanks to legal property that enabled to gain "surplus value over and above its physical assets."[159] Therefore, property protection mechanisms are necessary for turning immaterial capital into profit. Precisely such attuned property regulations are lacking in developing countries, which poses a hurdle for unleashing their economic potential. Moreover, intellectual property (IP) is a very sensitive kind of property, as it "refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce."[160] Software products are information products that are very easy to duplicate, therefore, they need IP rights protection in order to stimulate innovators and reward them for their inventions. The countries in transition realize this, and are now trying to combat high piracy rates and implement necessary IP laws. Therefore, in this chapter I will briefly discuss regulations in Ukraine and Estonia and efforts of the respective governments to fight piracy in the software sector.

6.1 Ukraine

[158] Friedrich List. The National System of Political Economy. English edition London: Longman, 1904, in Chris Freeman "The 'National System of Innovation' in Historical Perspective". *Cambridge Journal of Economics*, no.19 (1995): 5-24.
[159] International Monetary Fund. *The Mystery of Capital. Chapter 3.* http://www.imf.org/external/pubs/ft/fandd/2001/03/desoto.htm (accessed May 2008).
[160] World Intellectual Property Organization. *What is Intellectual Property?* http://www.wipo.int/about-ip/en/

There are different methods of protecting IP, but when it comes to software, the two ways are distinguished: patents and copyrights. Ukraine chose the copyright method. The main law that governs software protection is the Law on Copyright and Neighboring rights. The other laws that are helpful are Law of Ukraine on the Protection of Information in Automated Systems, Law of Ukraine on Information, and Law of Ukraine on Protection against Unfair Competition.[161] Despite existence of such laws, Ukraine is still in the list of top 20 countries with the highest piracy rates. High piracy rate is a feature of global concern, which is supported by the survey conducted by the Economist Intelligence Unit, which states that 84% of top managers interviewed name IP protection as a great challenge.[162] Nevertheless, 84% piracy rate of Ukraine signifies how severe the problem is, because in 2007 it was on the ninth place of the worst offenders of IPR.[163] The improvement from the past year was just 1%, but comparing to the indicators in 2004, the piracy rate dropped by 7%. So, some activity in the very recent years has been going in the field of IP enforcement. However, the "black market" still hurts the industry and Ukrainian entire economy, because entrepreneurs are reluctant, as their profits will be diluted by the shadow market, and state budget is not receiving a major part of revenues from taxes. According to the global technology market watch IDC, if the share of illegally used software were pushed down by 10%, then the economy of Ukraine could receive 1,5 billion USD.[164]

The two recent events stimulating revision of IPR related legislature are the European Football Championship that Ukraine and Poland are hosting in 2012, and Ukraine's long expected entry

[161] AmCham, *White Paper on Offshore Software Development in Ukraine*
[162] Economist Intelligence Unit. *Companies plan to increase overseas investment in R&D, says a new report from the Economist Intelligence Unit*. September 28, 2004. http://www.eiuresources.com/mediadir/default.asp?PR=680000768 (accessed, May, 2008)
[163] Business Software Alliance and IDC. *Fourth Annual Global Software Piracy Study, 2007*. http://w3.bsa.org/globalstudy/upload/2007-Piracy-Study-Findings.pdf
[164] Yevgeniy Kulikov "Software Market as an Indicator of IT Industry Development" (in Russian) *Computer Observer*, February 7, 2007. http://ko-online.com.ua/node/27078 (accessed June 2, 2008).

into WTO. Firstly, the 2007 Annual Report of the State Department of Intellectual Property mentions the participation of the Department in the amendment of the legislative acts, in the adoption of new laws and activities for protection of UEFA intellectual property rights. Secondly, considerable adjustment has been made to meet the requirement of TRIPS Agreement. Thus, Verkhovna Rada of Ukraine (Supreme Council) on March 31, 2007, adopted the law "On Amendements of Certain Legislative Acts of Ukraine Related to the Intellectual Property Rights Protection with Regard to the Requirements Connected with Ukraine's Accession to WTO".[165] Finally, Ukraine joined WTO on May 16, 2008, after 14 years of negotiations.[166] Therefore, it can be inferred that improvements in IPR protection were externally driven.

As for the market players, the most active in lobbying government to fight software piracy are Microsoft, Intel, Oracle and Lucent.[167] In addition, international firms recognize that the issue of pirated software is a social issue, hence awareness activities are organized, too.

6.1.1 Summary

Respect for IP right comes with time, but the damage from illegal software sales is felt instantly by the industry and the country's economy. Entrepreneurs and SMEs do not have a loud voice to influence the state to pay more attention to the issue, but MNCs, like Microsoft, can lobby government more successfully. Still, the biggest driver for change comes from the international community, in the form of WTO entry or foreign investment possibilities.

6.2 Estonia

Software piracy in Estonia is a major problem, even thought the piracy rate is lower, than in Ukraine. As reported by IDC, the share of unlicensed software in Estonia in 2007 was 51%.[168]

[165] State Department of Intellectual Property. *Annual Report 2007*. http://www.sdip.gov.ua/eng/
[166] World Trade Organization. *Accessions – Ukraine.* http://www.wto.org/english/thewto_e/acc_e/a1_ukraine_e.htm (accessed June 2, 2008).
[167] Gangler, p. 5

The half of illegal software on the market definitely translates into huge losses incurred by companies or missed revenues for state. The government is aware of the situation, in the words of Juri Pihl, the Minister of Interior, testifies that "the software privacy is the crime of the IT era and the software piracy may endanger innovative economy."[169]

In terms of legislature, in includes "Trademark Act (1992), Copyright Act (1992), Patent Act, and Utility Models Act (1994), Protection of Geographical Indications Act (1999)", as well as various international treaties.[170] Moreover, a police unit was designated to fight piracy. However, as stated by the IP Alliance, this task is not a top priority for Estonian police or customs. The pace of tackling IP related crime is slow, because police units lack resources and training.[171] Furthermore, Nordic neighbors are only exacerbating the problem, because they purchase pirated software. The threat is coming from another neighbor, Russia, which produces massively pirated optic discs that find their way to Estonia.[172] Therefore, companies have to come up with additional measures how to protect their IP and to lobby government for allocating more resources to address the problem. In context of the size of Estonia and pro-EU oriented policy making, measurable results can be expected soon.

6.2.1 Summary

Despite governmental attention to violation of IPR in software industry, the problem of pirated software persists. IP related legislature was passed and special police units were devised to fight IP crime, but no impressive results were achieved. The piracy rates are decreasing, but too slow,

[168] Juhan Tere, "51% of Software Used in Estonia is not Licenced", *The Baltic Course*, May 20, 2008. http://www.baltic-course.com/eng/analytics/?doc=1761 (accessed June 2, 2008).
[169] Toomas Hõbemägi. "Minister of Interior: Software Piracy Endangers Innovation". *Estonia Business News Channel BBN*. http://bbn.ee/Default2.aspx?ArticleID=447a750c-4eae-47ff-8487-51750695c415 (accessed June 2, 2008).
[170] Snetkov, http://www.american.edu/carmel/os2237a/legal.htm
[171] International Intellectual Property *Alliance. Special Mention. Estonia* www.iipa.com/rbc/2006/2006SPEC301ESTONIA.pdf (accessed June 2, 2008).
[172] ibid

while demand for counterfeited software is still high, mainly coming from domestic and Nordic users. Nevertheless, comparing to Ukraine, the IPR protection regime is more favorable for entrepreneurial activity and piracy rate is relatively lower.

CONCLUSION

In this thesis, the role of the *state* (via governmental policies and programs) and the *market* (via FDI) in shaping the five institutions, that are indispensable for the success of the national innovation system, has been analyzed for the IT industry of Ukraine and Estonia. To trace the evolution of the IT industry in the two countries, such institutional arrangements as skill formation, R&D, capital provision, infrastructure and intellectual property rights protection were selected, as they allow for a major contribution on behalf of state and/or market. The objective of the analysis was to establish how the composition and interaction between these key players influenced the development of different IT industry profiles. As a result of the evaluation, it has been shown that IT industry in Estonia has embarked on the innovation-driven path and product-based model due to beneficial involvement of FDI and the increased government intervention into the national innovation framework, whereas in Ukraine the lack of the two has prompted local software developers to find the solution in the form of IT outsourcing, as it best "fits" the existing institutional environment.

To reach this conclusion, the actions of the state and the market with regard to five institutions were described from the beginning of the transition period and until the present day. The *general finding* is that the state's support is particularly desired for the rapidly developing IT industry in Ukraine and Estonia, as companies' strategies and tactics are not sufficient by themselves to wrestle with the legacies of the past and to overcome the modern challenges, such as skilled labor shortage, high piracy rates, and underdeveloped venture capital market. More *specifically*, I will sum up how the different approaches to the same problems led to the different IT industry profiles in the two countries.

Firstly, in Ukraine in the skilled labor formation area the state played minimum role, as the system of education has been left unreformed, producing thousands of graduates whose skills

do not meet industry's requirements. Hence, the local and foreign IT companies played the main role in training the labor force, thanks to which graduates and young professionals can enhance their programming and project management skills. Such competencies are high valued by foreign clients that outsource IT related projects to Ukraine. At the same time, in Estonia both government and FDI representatives addressed the problem in a way of public-private programs, called out to improve the technology awareness and computer skills of the entire society. This helped to stimulate entrepreneurial drive and local demand for innovative IT solutions. Therefore, it is logical that Skype and other breakthrough communication applications were developed in Estonia.

Secondly, in Ukraine the state has been detached from supporting R&D institutions and the RTDI system has not been reinvigorated yet. As noted earlier, Ukrainian IT companies realized the benefits of clustering horizontally and with universities and research institutes, which might be helpful in catching the wave of R&D globalization that has started to move eastwards. Yet, it is still difficult to cover the high R&D costs and risks. As for Estonia, the state provided capital, established supporting R&D structures, as envisioned in its numerous R&D strategies and programs, as well as performed a role of procurer of complex solutions, requiring R&D. Moreover, Nordic FDI, extensively present in telecom and banking sectors, possessed material means and know-how for the development of products that also have wider implications for electronic commerce, language technologies, and data communications security. Furthermore, the foreign-led linkages with local academia, SMEs, and government are significant in Estonia.

Thirdly, technological, institutional and information infrastructure in Estonia is much more developed than in Ukraine, and is actually one of the best in the CEE region. Such a result

is attributed to the ability of the Estonian state to attract and retain FDI in telecom and banking sectors, which in its turn made considerable investment into ICT sector. The state also accommodates the financial needs of entrepreneurs via different grants, loans and credit programs, yet their results are still to be seen. As discussed previously, for these matters Ukrainian firms do not rely on the state, but on international linkage.

The governments in both countries have to work hard on IPR protection, as the piracy rates are very high and cause damage to the industry. For Estonia, whose piracy rate is lower than in Ukraine, it is especially important matter, as in a product-based model the vendor is the one who own the code, and hence has incentive to protect it, whereas in an outsourcing model it is the customer who owns the code. Therefore, IPR protection is crucial for local and foreign IT companies.

These discussed findings lead to the generalized typology of IT industry profiles:[173]

Criteria	**Software Products (Estonia)**	**IT Services (Ukraine)**
Business model	Specific market needs; Revenue per item; Products have release cycles; Proactive, market and technology driven activity	Customer-oriented; Revenue per project or man/hour basis; Customer usually determines deadline and requirements.
Skilled labor	Highly skilled labor, but low firm-specific knowledge	Highly skilled labor, but with high firm-specific knowledge
R&D requirements	High costs and risks	Lower
Capital needs and Infrastructure	High initial investment needed, high marketing costs	No initial downpayment
IPR protection	Source code owned by the vendor	Source code owned by the customer

The practical implication of the above-mentioned differences is that IT firms, choosing product market specialization, should be aware of different benefits and trade-offs the two business

[173] To derive this table I consulted such sources: Steven Casper, Mark Lehrer, and David Soskice "Can High-technology Industries Prosper in Germany? Institutional Frameworks and the Evolution of the German Software and Biotechnology Industries" *Industry and Innovations*, vol.6, no.1, June 1999; Punkaj Jalote "Management Software Product Development – Key Differences From Service Projects", *Indian Institute of Technology Kanpur*, http://www.cse.iitk.ac.in/users/jalote/GenArticles/NasscomQForum05.pdf

models entail, and that the transition from service business to software products one is not a matter of choice, but also of possibility. The state should maintain its motivation and capacity to control and support the reforms in education, RTDI system and capital market, and implement strategies encouraging and stimulating increased value-added and innovation potential of the IT industry, because the success of the IT industry serves well national interests and long-term competitiveness of the economy.

Appendix

Elaboration on Market Segmentation

The explanation provided is based on the research project, conducted by Fassbinder, which was co-funded by the European Commission within the Sixth Framework Program (2002-2006)[174]

SOFTWARE:

Software is divided into application software (programs that do what users are directly interested in) and infrastructure or system software (which allows someone to build, run and manage systems) and any program that supports application software.

1. Infrastructure software
a. Application development
b. Application integration and middleware
c. Business intelligence tools
d. Database management systems
e. Data integration tools
f. IT operations
g. Security software
h. Operating-system software

2. Enterprise application software
a. Customer relationship management
b. Enterprise resource planning
c. Supply chain management
d. Project portfolio management
e. Content, communication and collaboration
f. E-learning

IT SERVICES

IT services refer to the application of business and technical expertise to enable organizations in the creation, management, optimization of or access to information and business processes.

3. Product support

[174] Future Actions on Software and Services Based on Market Analysis of Market Evolution, Effects of International Factors, and Return on European Research Investment
http://www.fassbinder-project.eu/documents/Fassbinder-Outline.pdf

a. Hardware Support Services
b. Software support services
c. Operating system software services

4. Professional Services
a. Consulting
b. Development and integration
c. IT management
d. Process management

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