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Innovation and High-Technology Policy, Policy-Making and Implementation in Central and Eastern European Countries: The Case of Estonia

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Declaration: Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any other degree or examination.

/Margit Suurna/

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CONTENTS

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APPENDIX

V Kattel, Rainer, Erik S. Reinert and **Margit Suurna**. 2009. "Industrial Restructuring and Innovation Policy in Central and Eastern Europe since 1990." *Working Papers in Technology Governance and Economic Dynamics* 23. The Other Canon Foundation and Tallinn University of Technology.

VI Suurna, Margit and Rainer Kattel. 2008. "The Development of eServices in an Enlarged EU: eLearning in Estonia." EUR 23367 EN/4 – Joint Research Centre – Institute for Prospective Technological Studies, European Commission. Luxembourg: Office for Official Publications of the European Communities.

INTRODUCTION

"Technology is much more than science and innovation involves much more than technology"
(Metcalfe 1995, 34)

Scope and aim

High technology is seen as highly important for economic growth and development in research-and-development and innovation strategies and that also in Central and Eastern European countries (CEE).[1] At the same time, the challenges to cope with are enormous. These challenges derive, firstly, from the complex (generic) nature and uncertainty prevailing in the areas (especially in science-based high-technology areas) and, secondly, from fundamental problems they are supposedly aimed to solve. The latter particularly refers to the notion that the most desired contribution of an industry or a technology should not only be in generating new products but, further, in increasing the general living standard of society (Singer 1950, 476). This means the designation of the development in high-technological areas as a top priority is not a cure in itself, but something which presumes the change of "*a common sense*" in the system to make the successful diffusion of the technology truly viable and a variety of national goals achievable (in particular Perez 2002, 15-19).

The emergence of innovation as a policy issue in CEE goes back to the end of the 1990s, whereas the focus in terms of priorities and policy measures has been, and still is, in favour of cutting-edge technologies such as information and communication technology (ICT), biotechnology, material technology (see here the INNO-Policy TrendChart annual country reports, available for CEE countries since 2000; Radosevic and Reid 2006; for general trends in the EU also the European Innovation Progress Report (EIPR) 2008; Reid and Peter 2008). While industrial restructuring and transition towards knowledge-based economy (in Schumpeterian terms, the process led by "*creative destruction*"; in general terms, see Schumpeter [1934] 1961, 66-67) in CEE has been seen by many in both academic and policy circles as a largely positive process, a closer and deeper look at the developments should make one precautious.

While CEE countries have experienced significant economic growth and convergence towards the level of developed EU member states (see e.g. European Commission 2009), there are severe structural problems that emerge from this "*statistical illusion*" (Srholec 2006, 65) and "*positive and robust economic convergence*" (Veugelers and Mrak 2009, 37). The question here

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[1] Central and Eastern European countries are the following ten most recent member states of the European Union (EU): Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.

concerns knowledge intensity and the development of innovation and technological capabilities besides production capabilities, of which, arguably, the latter are the dominant ones, and they do not go well together with the former (see here in particular the works by Radosevic and Kattel (for the latest insights see e.g. Radosevic 2011; Kravtsova and Radosevic 2009; Kattel 2010); also Tiits *et al*. 2008; for the overall Estonian context, see e.g. Varblane *et al*. 2008; Masso and Vahter 2008). The previous raises questions about: (1) the extent and sustainability of the restructuring and specialisation orientation in the region other than cost- (and tax-) related advantages, FDI- (foreign direct investment) reliance, etc. (for an overview see Reinert and Kattel 2007); and (2) the real essence of high-technology industries and the role they play for forming the basis for economic growth in terms of knowledge content and value-added (for a critical overview see Radosevic 2006; Kaderabkova 2006; Srholec 2006). In general terms, one can argue that while the rapid liberalisation of the 1990s made a significant contribution to the destruction of old, including the most advanced, industries in CEE (Kattel 2010, 54; also Drechsler *et al*. 2006; Kalvet and Kattel 2006; Tiits *et al.* 2008; Tiits 2006; see in general and positive terms Högselius 2006a, b respectively), the following decade brought "*myopia*" in the form of focusing on European policies and a subset of policy tools that has had considerable limits in its contribution to the building up of the creativeness of the local level, i.e. of the contextual innovation capabilities and knowledge-based economy (see in general terms Nauwelaers 2009, 31; Radosevic 2011).

The thesis aims to show what can be learnt from the experience of transition countries developing high-technology areas (from the feasibility of the chosen orientations to the preconditions necessary in the respective policies and policy-making mechanisms), relying hereby on the example of CEE countries and especially Estonia. As derived from the general goal of the thesis, the more specific research questions are outlined as follows:

1. What are the main factors and critical problems to explain the current state and evolvement of innovation policies (defined here as a set of public-sector efforts aimed at enabling the private sector to move into activities with higher value-added and feedback linkages) and the respective policy-making and implementation mechanisms in CEE countries, both on the general level (i.e. stylised region-specific contextual aspects related to the changes, derived from the pervasive and significant influence from the accession to the EU and Europeanisation *per se*), and on the case-study level (that is a sector- (even a project-) and country-specific analysis, in line with dynamic and context-specific thinking of evolutionary economy)?

2. What kind of public-management structures and institutions have been and are used for organising and managing high-technology policies and ventures by the countries in question, and what kind of critical problems

may these have caused in terms of the performance of different (selected) initiatives in the high-technology areas?

3. What has been the effect of the two previous aspects, that is, of the innovation policies and innovation policy-making mechanisms in place on the functioning of the innovation system and innovation environment in general? The latter concerns in particular the nature of prevalent business models in high-technology areas and possible future trends due to the conditions as set by the CEE-specific local and policy factors, next to the "*alignment*" with international industry trends.

The main body of arguments of the thesis have built upon the concept of a (national) system of innovation bringing together in a complementary way three aforementioned features (based on OECD 1999, 23; Carlsson *et al.* 2002): (1) policies for science, technology and industrial specialisation; (2) policy-making and implementation mechanisms referring to the organisational and institutional profiles and interaction structures of the system; (3) the relevance, efficiency and viability of the two previous aspects for the long-term and sustainable development of the system. The selected approach has been considered a useful tool for describing and explaining structural issues of transformation processes on all aforementioned levels in CEE.

In more detail and from a structural point of view, the thesis covers the following issues. First, a long-term and general overview of the evolution, current state and main challenges and problems in innovation policy and policy-making mechanisms in CEE countries (see article **I**; supported by article **V**). In these articles, besides the general methodological approach as described above, Europeanisation has been used as an attention-directing toolbox (Olsen 2002, 943) for evaluating the level of local contextual (read, policy and administrative) compliance with the objectives and developments as taken in the innovation policy issues on the EU level and the respective impact. Articles **III** and **IV** (supported by article **VI**) shed light on the changes and the complexity derived from the transformation processes on the policy-making and implementation level, in particular the (increasing) usage of agencies/quasi-autonomous non-governmental organisations and other market mechanisms with a supposed creative and specialised capacity that they are to bring to the governance of modern society (Goldsmith and Eggers 2004, generally). Although public policy as such is one of the core features in the literature of innovation systems, the attention given to the changes taking place in the public sector and the impact it has on innovation policy and the innovation system has remained limited (for a fundamental overview of these issues, see OECD 2005; for the latest coverage, see Drechsler *et al.* 2010). The final article (**II**) contributes to the issue of high technology from a business-centric approach, where Pisano's (2006, 80-81) proposed "*anatomy of the sector*" and the respective three variables in terms of participants of the industry, institutional arrangements and their governance, essentially resemble the basic core in the approach of a system of innovation.

The scope of argumentation of the thesis is limited due to its reliance on the case-study format in the selection of both countries and sectors while answering the research questions. Secondly, as the general background information and stylised facts in the topic-specific issue have been gathered in a systematic way for the group of CEE countries as such, it has to be acknowledged that an approach of this kind might not do every single country case justice.[2]

As a case study, one of the rather well-performing CEE countries, Estonia, has been selected (for the country's general performance in terms of innovation, see e.g. EIPR 2009, 3). The selection of different sectors has been derived from the seminal concept of techno-economic paradigms by Carlota Perez (2002). According to her, the economic growth and development is driven by a relatively small set of radically new technologies and industries ("*core technologies*") in different eras together with different basic principles for "*common sense*" in business models and the supporting socio-institutional context (Perez 2002, 15-19). Relying on the concept, the selection of the high-technology areas in the framework of this thesis has been twofold: on the one hand, ICT is regarded as a prevailing and ubiquitous technology which continuously broadens its scope by being embedded into traditional industrial and non-industrial sectors; on the other hand, biotechnology (together with nanotechnology, bio-electronics and new materials) is considered one of the possible new rising high-technological fields of the twenty-first century (e.g. Hegedus 2009, 12; Perez 2010a, 135; cf. Drechsler 2009a). The total "*breakthrough*" of biotechnology remains, however, questionable, and it may stay only a complementary technology in the framework of the ICT-based paradigm (Perez [1986] 2009; Freeman 2003; in general, see also Tiits *et al*. 2005, 17).

Estonia has been discussed in very positive terms in both areas, achieving the status of "*a well-developed e-country*" here, described by the current e-Government system, e-elections, Internet banking services, the submission of income tax returns over the Internet, etc. (for an overview, see Kalvet 2007), but also the status of being one of the leading countries in the area of biotechnology in comparison to the other new EU member states, a so-called "*poster child for successful transition to Western-style science*" (Aldridge 2010; Nature 2009a,

2 Innovation policy is a very specific area in the context of which the CEE countries are to share rather strong commonalities in their experience. The fundamental factor in the question is related the EU integration process, and the pressure on the part of the EU remains prevalent today. In general terms, the EU's influence concerns: (1) the transposition of the Acquis and the Lisbon Strategy/National Development Plans; (2) the EU pre-accession funds and structural funds; (3) integration into the European Single Market (see e.g. Veugelers and Mrak 2009, 9-13).

b). Both areas are stated as priority areas in the development process of catching up and building up the knowledge-based society in the Estonian research-and-development and innovation strategies *Knowledge-based Estonia 2002-2006* and *2007-2013*.

In the context of this thesis, the boundaries of the technological fields have been narrowed down and explored only in certain very specific fragments. Hence in the case of ICT, the focus has been on ICT-supported and paradigm-centred educational issues (labelled here as e-Learning). The reorientation in the educational sector has been argued to be relevant in order to take full advantage of the technological developments and at the same time to provide a strong enough basis for inputs in future innovations and technological breakthroughs (Perez 1992; Perez 2001, 125-126; also Kattel and Kalvet 2006). In the Estonian case, the e-Learning initiative can be regarded as an attempt to renew human resources for the available highly developed ICT infrastructure and e-services. As in Estonia, the main competence in the area of biotechnology, both in terms of science and entrepreneurship, is found in biomedicine or so-called "*red biotechnology*" (see here Ernst & Young 2010; the Estonian Biotechnology Strategy 2008-2013; Fraunhofer ISI 2002); research in this field is limited as well. In this context, the field of biomedicine, together with the attempt to create an Estonian "*Nokia*" in the form of the Estonian Genome Project, presents an initiative to make the most of the (possible) new emerging technological trend, supported by the pool of existing knowledge and competence in the area.

The aforementioned approach is particularly important in the context of CEE countries, where the policy-makers' attention has been on general and broad rather than on specific and differentiated policy schemes (Havas 2006, 270; see also article **V**, 25-26). This kind of practice, however, has limits not only in capturing the dynamics of technology-set affects in different industries (in general Pavitt 1984; also Bell and Pavitt 1993; Malerba 2004; Malerba 2005; for domestic structuralism in sectoral systems, see Malerba and Nelson 2010), but also in capturing the variety of different firms, organisational capabilities and routines belonging to the same statistical category (see also Havas 2006, 270).

The research is based on three sources of information: (1) extensive desk research to collect, analyse and assess the relevant qualitative and quantitative data from national and international sources; (2) semi-structured in-depth interviews with the main national stakeholders and experts of the relevant fields, mainly to validate the argumentation and main outcomes; and (3) presentations and discussions held in different seminars and conferences at the local as well as the European levels.

1. Overview and lessons of innovation and high-technology developments in the CEE countries during the 1990s-2000s

1.1. Critical aspects in policy-specific developments in CEE

In describing the evolution of innovation policies in CEE countries, two major trends can be brought out (articles **I**, **V**; for an overview see Table 1).

First, a fast transformation and restructuring of the economies could be observed, on the one hand inspired by the Washington Consensus and, on the other hand, relying on policies of macro-economic stability and attracting FDI during the 1990s (see Radosevic 2009 generally). The latter was favoured in turn by the simultaneous flourishing of the ICT-based techno-economic paradigm together with emerging geographical dispersion, de-agglomeration and outsourcing effects in the global environment of production (see article **V**, 5). In the circumstances as described above, it is argued that innovation policy remains secondary in comparison to transition-related concerns during this period (Radosevic 2002a, 354; Mickiewicz and Radosevic 2001, 10), the so-called period of "*no policy policy*" (article **V**, 20).

As for the policy aspect, it is important to highlight that the reliance on macro-economic competencies and management is limited to providing experience and a set of (differentiated) policy tools for the creation of long-term policy frameworks together with a focus on specific aspects such as sectoral upgrading, networking, etc. (see article **V**; Okimoto 1990, 19-20). At the same time, the structural and upgrading processes, which rely most of all on the productivity gains either from the painful adjustment processes in terms of employment and wage levels (especially in the first half of the 1990s) (e.g. Mickiewicz and Radosevic 2001, 10; Havlik 2007; Kravtsova and Radosevic 2009, 7-9) and/or from FDI-accounted mastery of production capabilities, remain limited in terms of the need for innovation policy and the building-up of the respective policy-making capacity as well (for an overview of structural transformation, see articles **I**, **V**; Radosevic 2006, 36-40; Radosevic 2011; Havlik 2007; Tiits 2006; Tiits *et al*. 2008; Kubielas 2009; Kattel 2010; Onaran 2010; for the divergent development and growth models in the region, see in particular Landesmann 2003; Hotopp *et al*. 2005; Landesmann 2010).

Second, integration into the EU has been pushing forward a considerable change in innovation policies in many CEE countries (articles **I**, **V**). The change has been embodied in the concentration of priorities on high-technology sectors, together with an over-emphasis on linear innovation as a heritage from the EU level (see here Tunzelmann and Nassehi 2004; for an overall overview of the evolution of priorities in the EU's innovation policies, see EIPR 2008, 29-30). Further, the change has come together with the introduction of new institutions and respective policy measures both on the public (implementation agencies) (article **I**; for field specific developments, see articles **III**, **IV**) and on the firm and industry levels (article **II**; see in general Radosevic 2002a; Radosevic 2002b; Nauwelaers and Reid 2002; Radosevic and Reid 2006), which, however, often due to their "*one-size-fits-all*" nature and their reliance on and imitation of the western developments have not been – and still are not – able to respond to the local specific problems and support the local-context-driven policy-making capacity, hence raising considerable limitations for the long-term sustainable development in the region, the so-called problem of the "*copying paradox*", (articles **I**, **II**, **III**, **IV**; see in particular Karo and Kattel 2010; Kattel and Primi 2010; Cimoli and Primi 2008; Varblane *et al.* 2007).

One can argue that the innovation policies emerging in CEE copy the "*European paradox*" thinking from the older member states (on the latter, see Dosi *et al.* 2005; 2006), but in a very specific format. The negative impact of the policy transfer has been further strengthened by the so-called "*Eastern European paradox*" – the geographical closeness to the highly developed industrialised European research and development (R&D), which has made possible "*development without local development*", but has also attracted highly skilled specialists to leave peripheral regions (Kranich 2008, 35-36).

Table 1. Evolution of organisational capabilities and national systems of innovation in CEE in the 1990s and 2000s

	Main features of organizational capabilities	Main features of national innovation system
1990s	- Productivity increases through slashing liabilities and employment; - Replacement of products and machinery; - Foreign ownership provides key access to management and marketing know-how and production networks; - Modularity in production enhanced by ICT paradigm and harmonization with the EU regulations	- Privatization programs and other measures to attract FDI; - Emphasis on macro-economic stability; - Erosion and partial disintegration of the previous R&D system; - Harmonization of legal environment with EU requirements; - Prevalence of macro-economic policy skills; - Policy initiatives assume symmetrical integration of CEE into global economy
2000s	- Contract work for European companies; - Process innovations prevail through cost-cutting initiatives, new machinery; - Marketing and brand creation for home markets in certain industries (media, food); - Speculative real-estate activities	- Increasing fragmentation of policy arena through agencies that results in strong coordination problems; - Growing mismatch between R&D system, high-tech biased innovation policy and actual industry needs; - Increasing foreign lending and consumption booms that result in financial fragility

Source: Article **V**, 34

This thesis relies on the argumentation that the accession to the EU has probably been the key variable influencing innovation-policy evolution in CEE economies since the late 1990s (articles **I**, **V**). Due to the Europeanisation that took place in the field, a considerable push was given to the formation of the first long-term strategies and policies related to innovation and R&D, e.g. Accession Partnerships, National Development Plans, the EU's Lisbon Strategy, etc. The change was further boosted by the introduction of innovation-policy measures from 2004 onwards (generally co-financed by the structural funds) (see here the INNO-Policy TrendChart annual country reports; EIPR 2006; 2008). Further, since joining the EU in, respectively, 2004 and 2007, and even already during the accession talks, there has been a strong change, which was almost not discussed publicly at all, in economic and particularly in innovation and industrial policies[3] in many CEE countries towards a more active role of the state (article **I**; also Török 2007). Hereby, the role is acknowledged that the adoption of the EU Acquis and the harmonisation with the European Single Market norms (in particular competition policy and safety, health, environmental and other standards, etc.) have had on the modernisation and restructuring on CEE industry as well (Havlik *et al*. 2001; Havlik 2005; Tiits *et al*. 2008, 76-77; for details also Kaiser and Kripp 2010, 11). However, as harmonisation made the outsourcing and relocation of production much easier and has been coupled with foreign financing and ownership, the effect of it should be seen in a favouring of encapsulation rather than an accumulation of innovative capabilities at the local level (consider here the issues of increased competition and cost-effectiveness, limited feedback linkages to national systems of business, education and R&D, etc.) (Cimoli *et al*. 2006 generally; Havlik 2005; Radosevic 2004; 2006; 2011; Tiits *et al*. 2008; for the opposite view see, e.g., European Commission 2009).

In the context of the aforementioned changes, and derived from the developments of high technology, the following is argued in the thesis:

[3] In order to have an outlook on innovation-policy issues more comprehensive than the fostering and diffusion of innovation, the thesis emphasises the perspectives of "industrial policy" and "sectoral policies", bringing together in a coherent way different policy domains of innovation, science, technology, competition policy, taxation, regulations, also employment and regional policies, strategy definition etc. (see for the definition of industrial policy and its change, Bianchi and Labory 2006, 13-14). Industrial policies are here to highlight the need for dynamic and structural adjustments of (specific) firms and sectors over time as conditions change, concerning here not only framework conditions but also (interventionist) measures for the development of different capabilities, etc. (see *Ibid*., 14). "*As such, industrial policy is not about industry per se*" (Rodrik 2008, 3). The sector-specific approach on the other hand has a deeper coverage of innovation-related dynamics and variety in different areas and of aspects related to system functioning (interdependencies, feedbacks, etc.) (based on Edquist *et al.* 2004, 443-444). In the text, due to certain similarities, the terms may not be used strictly in order.

- *High-technology policy and a gap of appropriability to structural composition of economy*

There is a lack of complexity in the way innovation policies in CEE are tailored to local circumstances. In general terms, this concerns the "*high-technology bias*", reflecting most profoundly the mismatch between the set priorities and their accordance to the existing economic structure and problems (see in general terms Piech and Radosevic 2006; articles **I**, **V**). Although the CEE countries have been in the process of turning their "*comparative advantage*" away from labour and low-skill intensive industrial branches together with a significant increase in medium-high and high-technology exports (see Landesmann and Richter 2003; for the trends since the accession to the EU, see European Commission 2009), the real essence of the restructuring remains questionable. Kattel (2010, 52) has claimed that "*... even if high technology exports have been growing in developing countries, this does not mean that we deal with similarly dynamic sectors with significant increasing returns*". There is a danger that the high-technology industries in CEE tend to concentrate on the low-value-added segment and serve the rest of the West as a popular outsourcing destination (see also article **II**). These cautions are supported by a number of studies that bring out a relatively low share of R&D intensity in the high-technology exports, a negative relationship between patents and high-technology exports, a negative relationship between ISO-900 certificates and patents, a low value of the quality intensity of the employment structure, etc. (for the latest overviews, see e.g. Radosevic 2006; Kaderabkova 2006; Srholec 2006; Kravtsova and Radosevic 2009).

At the same time, and as noted above, the innovation and industrial policies in CEE have heavily relied – and still do so – on the EU policy mix together with concentrating on R&D priorities (Radosevic and Reid 2006; Havas 2006; Radosevic 2011; for the latest overview of innovation measures in the EU-27, see EIPR 2009, 32-40, 71-72). The assumption behind the approach selected in CEE is a growing demand from industry for R&D, which, however, is not the case because of the structural changes that took place in the 1990s via the Washington Consensus policies and the specialisation in low-end production activities, virtually void of any research and with low demand for high skills as described above (see articles **I**, **V**). In his latest work, Radosevic (2011, 35) has argued that: "*... weak domestic demand for R&D coupled with a weak business enterprise sector, is likely to remain a major structural weakness of these countries' [CEE] R&D systems*." Looking at the example of biotechnology in Estonia, the practice prevalent here tends to confirm the problem of mismatch between the scientific and business activities, supported by the limited R&D capabilities and capacities available inside the local companies (article **II**; for the latter see also Mets 2006). In addition, a mismatch between different sectors in the CEE region has been found, according to which the science-intensive group is arguably least likely to support other sectors, and in particular most advanced sectors, at the local level (Kubielas 2009). The problem is compounded by the low level and structure of R&D expenditures (see article **II**; generally see also Eurostat 2008). In fact, the average share of government and industry in funding R&D has not increased but decreased between 1997 and 2007, compensated by an increasing share of funding from abroad (for the overview of R&D funding and funding system, see Radosevic and Lepori 2009, 661).

In their attempts to solve the situation, the CEE countries have relied too much on the narrow definition for systems of innovation[4] together with an emphasis on the right (borrowed) institutional set-up as the main recipe (read, policy measures that could play a considerable unifying role in terms of supporting cooperation between different actors of the field as well as enabling the creation of synergies between scientific and business activities and between different industrial fields to rise) (see here generally Lundvall 2010, 2; Johnson 2010; for the historical context of CEE, Freeman 2006). According to Perez (2001, 126; also Perez 2000, 47; Bell and Pavitt 1993, 167-168), the policy measures aiming to "*build a bridge*" between R&D institutions and the business sector are typical of (developing) countries where industries rely on (mature) technology together with little absorptive capacity to make use of R&D results at the local level. Further, if the introduction of new institutions such as innovation centres, networking partnerships, clusters, etc. is supported primarily by international assistance (as has been the case with CEE) (Radosevic 2002b, 93-94; Radosevic 2002a, 355-356; see also below), their embeddedness in the overall formal and informal environment at the local level may become problematic (broad approach to the systems of innovation, see also Lundvall *et al*. 2009).

For example, judging from the experience of the advancement of biotechnology in Estonia, it remains questionable whether and to what extent the (borrowed) institutional mechanisms and the respective innovation policy measures matter for the industry in a systemic way and have been able to facilitate cooperation mechanisms in the real practice. This concerns indications of the limited effect of competence centres, cluster formations, etc. in the field (see article **II**; Technopolis 2008; Kattel *et al.* 2007, 85-101).

It has also been argued that the respective policy measures are attractive to policymakers because of the relative ease of delivery and attached positive

[4] "*The narrow definition would include organisations and institutions involved in searching and exploring – such as R&D-departments, technological institutes and universities. The broad definition ... includes all parts and aspects of the economic structure and the institutional set up affecting learning as well as searching and exploring – the production system, the marketing system and the system of finance present themselves as sub-systems in which learning takes place*" (Lundvall 2010, 13). The latter refers in particular to the fact that "... *innovation must be rooted in the prevailing economic structure*" (*Ibid*, 10).

image rather than some more sophisticated taxation and regulatory policies (in terms of biotechnology, see Bagchi-Sen *et al*. 2004, 214).

Derived from the preconditions prevalent on the local level, there is not only a system-specific danger that high-technology is seen too much in linear terms (as a goal but not as a means for supporting economic development) (articles **I**, **V**), but also, that R&D-specific specialisation is too deeply influenced by general global trends instead of local specifics and possible demand conditions (article **II**). This is about the lack of an interdisciplinary and complementary perspective in policies (see Teece 1986), and especially about separating high technology from more traditional industries (according to e.g. Smith 1999; Robertson and Patel 2007, the respective separation should not and cannot be made in the first place).

Further, the dependence on foreign demand limits the creation of positive "*feedback loops*" and the diffusion at the local market (see Kline and Rosenberg 1986), meaning that there are not enough synergies created on the local level between high technology and traditional industrial sectors, but even more, that the respective gap due to the prevalent export orientation taken on the policy level may in fact be widening (see in particular article **II**). For example, a number of traditional fields which could play a considerable role in the Estonian economy are characterised by a limited awareness of the potential biotechnology applications, supported by the limited R&D in these areas in general. This in turn significantly prohibits the low-technology sectors from being considered a market for high-technology products and services (also the smallness of the market is another important factor) (for a more detailed overview of the case of biotechnology in Estonia, see the report by Ernst & Young 2010).

As was already highlighted by the European Commission's negotiation mandates,[5] there is a need for a shift in the CEE countries to a more complex and holistic understanding of innovation drivers in their economies (together with the administrative capacity to set concrete measures and to manage respective financial resources) (see article **I**). On the one hand, this refers to the need of coupling innovation policy to wider issues of development such as regional imbalances, labour-market, education, tax and other policies). On the other hand, and in its essence, the question concerns an active "*bottom up*" process concentrating on strengthening the domestic level as a precondition to make use and maximise the benefits of policies in a strategic way and in the long-term perspective (see Radosevic 2009; also in terms of Asian practice and lessons Hobday 2003; Hobday 2009).[6]

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[5] Positions adopted by the European Commission with regard to the National Development Plans (for the selected candidate countries).

[6] How relevant and effective the EU orientation and policy advice has been in this regard, is another question. For the limits of framework and horizontal policies in

- *High-technology policy and restrictions to the sector's move into activities with higher value-added and feedback linkages*

In light of the business models in the area of biotechnology as derived from the Estonian experience, the prevalence of an orientation towards the short-term returns and a specialisation in the lower value-added-creating activities (from the perspective of R&D intensity) can be detected (article **II**; see also EuropaBio and Venture Valuation 2009, for CEE experience in general). The trends related to the business models refer most profoundly to the fact that the innovation environment as well as the policy-making mechanism in CEE countries, and in Estonia in particular, do not provide long-term and strategic solutions for decreasing uncertainty in the area, especially when considering the current stage of infancy and critical arguments about the trends at the international level (see Pisano 2006; for criticism Glick 2008; for a wider overview of the issue, see here also Suurna 2010), but considerably deepen the current problems existing at the level of the innovation system and affect the relationships between different actors of the system putting them under more strain (article **II**; in general terms also article **I**). Arguably, the accurate estimates and decision-making process in the case of innovation projects is heavily dependent on the low level of uncertainty achievable "... *either by further research or by making a project less innovative*" (Freeman and Soete 1997, 246).

Further, instead of accumulating organisational routines, tacit knowledge and learning in the area of biotechnology in Estonia, we see an increasing specialisation and fragmentation at the industrial level, illustrated by the increasing number of newly established start-ups in R&D for biotechnology (article **II**). In a number of newly established enterprises, developments of this kind concern the reliance and dependency on the structural funding as provided by the Foundation of Enterprise Estonia (EEF),[7] coupled with the other pattern of development, where the rise of start-ups goes back to the already existing different groupings of biotechnology companies, hence reflecting an approach of narrow technological specialisation (article **II**; see also Kattel *et al*. 2007). The aforementioned general tendencies in turn raise questions about the reasoning for the kind of business models and their viability in a longer term than a programming period (article **II**; for similar problems in the issue at the

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contributing to the advancement of sectoral (specific) industrial policies in nation states (in general terms, see Pelkmans 2006) and critiques of the conceptual approach taken for economic growth on the EU level for forging ahead innovation, industrial and cohesion policies in general, see Reinert and Kattel 2007; also Havlik 2007; Barca 2009.

[7] EEF is one of the largest institutions within the national support system for entrepreneurship and one of the implementing units of the EU structural funds in Estonia, see also the organisation's web-site: http://www.eas.ee/index.php?setlang=en-GB).

European level, see Jones 2010). In this context, it is worth mentioning that according to the recent audit on the enterprise support measures by the National Audit Office of Estonia, 77 per cent of EEF's R&D-related support (79.25 mln EUR) from the years 2004-2009 has converged to the areas of bio- and materials technologies. Owing to the fragmentation prevalent in the support measures, as well as their marginal size, their impact in contributing to the enterprises' competitiveness is, however, believed to be limited (National Audit Office 2010).

It is argued that the innovation policy in CEE countries as well as in Estonia has been affected to a large degree by the EU structural funding and its administrative logic (see articles **I**, **II**, **IV**). The argumentation is supported by the INNO-Policy TrendChart country reports which reveal that the implementation of a wide range of innovation support measures in general has been relying strongly on the EU structural funding, resulting in the R&D and innovation policy set-up where structural funding is replacing rather than supplementing national funding in many CEE countries (see here e.g. country reports for 2006-2007; see also EIPR 2008, 39-40; EIPR 2009, 9; Technopolis 2006, 8, 29, 85). The other problems related to the EU structural funding concern the real effect of the support system: the extent of synergies created to deal with local development needs and the contribution to the endogenous policy-making and innovation capacity; a strong reliance on hard compared to soft measures; and incentives created with more focus on the funding being captured (financial absorption) than on its long-term effect (Barca 2009; Technopolis 2006; for an overview Radosevic 2011, 33-34). Next to the innovation policy issues, as described above, the reliance on structural funding and the respective administrative mechanism has made the structure of innovation policy more complex for beneficiaries (highlighted also in EIPR 2009, 15).

As a result, innovation policies in CEE are often poorly tailored to local circumstances and implemented in a way that only exasperates the situation. Many of the aforementioned issues have been highlighted in the EU strategic overviews since the very beginning, starting with the reviews of the implementation of the PHARE programme,[8] but remain crucial and unresolved until today (see article **I**). In this context, it is relevant to note that while, as brought out above, the EU accession foresaw a new regulatory role for the state, it still has supported innovation-policy implementation based on the market-failure rationale (competitive grant-based programming that relies on market

[8] PHARE was launched in 1989 as an EU financial instrument to assist the CEE countries (initially only Hungary and Poland) in their political and economic transition from a centralised communist system to a decentralised liberal democratic system. During the 1990s, PHARE became the EU's main financial instrument to assist the applicant countries of CEE in their preparations for joining the EU (see European Council 1989; 1999).

signals without being able to follow set priorities and goals) (article **I**; see also Radosevic 2002a, 353; for the Estonian context in research funding in general, Masso and Ukrainski 2009).

- *High-technology policy and a gap in terms of the stage in the technology lifecycle*

In addition to the problems highlighted in the framework of the area of biotechnology in Estonia above in terms of the business environment and the critical problems behind it, the case study of the Estonian Genome Project (EGP) serves to contribute to the field-specific overview from the perspective of the public-sector-management system.

In details, the case illustrates how it was tried to achieve the long-term goal, oriented towards frontier research (the largest population-based genetic databases with 100,000 gene donors in Europe) and the improvement of public health,[9] through a market-based organisational-institutional set-up and private means (usually with considerably short-term orientations) (see here Table 2). In circumstances described by high uncertainty, learning intensity and a need for steady investments together with a long lead time as specific to the initial stage of scientific and R&D activities in the area of biotechnology (gene technology, in particular), the selected set-up was not able to satisfy the desires of either the public or the private side (article **III**). The other important aspect the state missed in its innovation policy is the creation of interconnections and synergies between the main actors of the systems of innovation in a way that the initiative would not only have served the interest of a few actors (consider here the limits of the exclusive licence in the hand of *EGeen Ltd*) (article **III**).

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[9] *Human Genes Research Act*, approved by Riigikogu 13 December 2000. RTI 2000, 104, 685, in particular § 3.

Table 2. A brief chronology and ownership structure of the Estonian Genome Project

2000	2001	2001	2002	2004	2004-2007	2007
Enactment of the *Human Genes Research Act* for coordinating the establishment and retention of the gene bank, and for gathering, processing and disseminating the information related to it.	Foundation of a special non-profit organisation, the *Estonian Genome Project Foundation* (EGPF), to carry out the EGP.	Foundation of a profit organisation called *EGeen Ltd* by EGPF to finance and commercialise the results of the EGP (for 25 years).	Gathering the first tissue samples from gene donors.	Termination of the contract with the main financer *EGeen*. This meant that the EGP was released of the previously valid exclusive rights of *EGeen* and that *EGeen* was no longer obliged to finance the activities of the EGP.	Strong political debate over the future of the project. Activity of the project practically terminated with the main emphasis given to the maintenance of DNA samples. Information on only 10,319 gene donors.	Amendment of *Human Genes Research Act,* the EGP continues as a scientific establishment under the *University of Tartu*. A database with 100,000 gene donors by 2010.

Source: based on article **III**

The usage of the highly fashionable organisational-institutional set-up, arguably in accordance with the economic rationality of efficiency (see Samier 2005, 77-88, generally) and a dynamic technology-driven economy (Goldsmith and Eggers 2004), provided in its essence a "*window of opportunity*" for altering the original policy programme, due to which the accountability and responsibility problems together with a "*resource-squeeze*" (for criticism in general terms, see Drechsler 2005, 101; Drechsler 2009b) were to rise. Hence, next to technology issues, the EGP case highlights the need for high administrative capacity in the public sector as a precondition to manage complex R&D and innovation-policy initiatives (article **III**). The aforementioned managerial problems led to the transformation of EGP into a structural unit of the University of Tartu and turned it (back) to a scientific venture in 2007 (article **III**).[10] Though there seems to be no correlation between the ownership structure and the success of the gene banks, as every bank is dependent on its own specific institutional framework and its initial goals (see Austin *et al*. 2003), we can detect quite a clear tendency towards more and direct public-sector involvement in genetic databases during the last half of the decade (article **III**).[11]

In general terms, the case of the EGP is a good example of how the decentralised set-up, the lack of democratic control from above and the lack of market control from below may give a monopoly over the provision of the service to a certain actor (article **III**; Greve *et al*. 1999, 140; Peters and Savoie 1994, 422). Similar problems, though in a somewhat "*softer*" format, can also be detected in the developments of e-Learning in Estonia.

Here the loose connections (see Figure 1) to the central government have made it possible to create favourable conditions for the involvement of the private sector in the provision of e-Learning services, serving as a catalyst for many public policy actions in ICT and the e-Learning area as well in the late 1990s (articles **IV**, **VI**; see also Kalvet 2007). On the other hand, the set-up of the field has evolved in accordance to the increasing reliance on EU structural funding.[12] Though EU structural funds provide an opportunity for the CEE countries in

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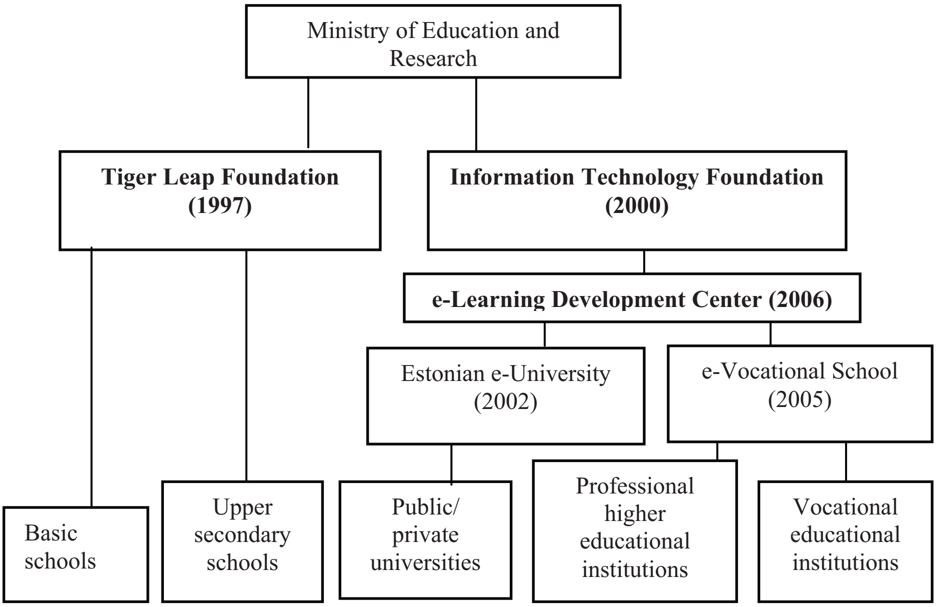
[10] The change relies on the amendment of *Human Genes Research Act*, approved by Riigikogu 14 February 2007. RTI 2007, 22, 111.

[11] By today, information for 51,515 gene donors has been gathered (as of February 2011). Also we can see a considerable increase in publications (basically only 1/5 of published articles in relation to the EGP belongs to the era of private ownership), twice the amount of participation in international research projects, regular scientific seminars taking place and no striking news in the media for the closedown of the project, freezing its finance flows, etc. (see the web-site of the Estonian Genome Centre, University of Tartu: http://www.geenivaramu.ee/index.php?lang=eng).

[12] See here for information on EU structural funds in Estonia, the web-site http://www.struktuurifondid.ee/implementation-of-structural-support/index.-php?id=13841; and the web-site of Innove (the unit is to promote, among other things, the initiatives and activities through the EU programmes in the area of human-resource development in Estonia), http://www.innove.ee.

terms of investments in both ICT and human resources, the limits of the system should be acknowledged as well, e.g. the project-based approach (see in particular article **VI**), combined with the general prevalence of one-off initiatives in the field (articles **IV**, **VI**).[13]

Figure 1. Management plan for developing e-Learning



Source: largely based on the Strategy of the Estonian e-Learning Development Centre 2007-2012; for more details, see article **VI**

Though the developments in the field of e-Learning have been highly positive in creating the respective infrastructure and the e-Learning services (in particular the web-based grade-book e-School in general education and the usage of ICT for administrative purposes in education, e.g. enrolment systems for courses, university admission systems and different learning management systems in higher education, influenced rather strongly by the progress of e-Government services), the progress has been limited to creating linkages between the new and ICT-centred and current learning processes (for the global trends in this respect, see in particular Hakkarainen *et al*. 2006; article **IV**). In the framework of the ICT paradigm, and as argued by Perez (2001, 125-126), the essence of the educational reform is particularly important: "*In reforming education, it is*

[13] For instance, the Estonian e-Vocational School held the biggest project called *eKey*, financed under the ESF measure during the last programming period (1.68 mln EUR). During the current period, the biggest allocations are foreseen for programmes such as *BeSt* in high education for the creation of web-based learning content and the e-Learning support and quality system (6.81 mln EUR), also *VANKer* in vocational education (1.86 mln EUR) and *Learning Tiger* in general education (1.16 mln EUR), all administred by the foundations active in the area.

essential to update and upgrade the technical contents of programmes and – perhaps even more importantly – to make radical changes in the methods, objectives and instruments of training ... This reform must induce students to take responsibility for their own training processes; it must place emphasis on 'learning to learn' and 'learning to change'; it must foster creative teamwork, teaching students to formulate problems and evaluate alternative solutions; it must find ways of providing access to computers and the Internet; and it must create the necessary conditions for giving students not so much the capacity to provide answers as the capacity to ask questions and process information." Also the most recent survey on ICT development trends in Estonia highlights the biggest challenge to be in updating the educational system (Arengufond 2009, 34-35).

Due to the policy-making mechanisms for e-Learning in place in Estonia, restrained by the role of the government (the Ministry of Education and Research, in particular), there is no overall consensus over the role of ICT in education together with supporting teaching methods/materials, the legal basis and necessary financial footing and monitoring systems (articles **IV**, **VI**). The adoption of the *E-memorandum* in September 2006 and its orientation towards students and teachers rather than policy-makers expressed most explicitly the attitudes towards ICT education and its development. This conforms to a line of argument that caught up with the EU that the state's aspiration for continuous improvement through ICT (together with a focus on infrastructural change and the private sector) has diminished and rather put forward an individual goal (Runnel *et al*. 2009, 34, 44-45). In terms of activities, the area of e-Learning is rather fragmented with respect to the multiple actors engaged in the area (next to foundations and consortiums also the local "*grass-roots*" level); in addition there are a number of single strategies and programmes undertaken in the field, which, however, do not share common goals and have not been able to create synergy and functional coherency (article **IV**).

Based on the recent developments, a need for a changed role of ICT in education to move towards individualised and interactive learning and "*learning to learn*" approaches is also recognised at the state level (see here Arengufond 2010). The real activity according to these development propositions is still to be seen.

1.2. Critical aspects in policy-making and implementation mechanisms in CEE

According to the concept of Utterback (1996) on interlinkages between the organisational set-up (among other aspects) and the stage in a product/technology cycle, the development of high technology, due to the prevailing technological uncertainty, presumes an organisational structure that is rather organic and open for frequent adjustments. In terms of policy-making mechanisms, this refers to the need of engagement and cooperation between different stakeholders, raising considerable challenges for policy-making and implementation from the aspect of horizontal and vertical coordination and of public-sector accountability in general. Here it is important to note that the effective coordination and cooperation systems have been highlighted in particular in the latest surveys, e.g. in the area of biotechnology (BioPolis 2007). The core lies in the exchange of information and knowledge, a well-considered choice of different policies and feedback mechanisms in place between engaged parties, which makes it possible to design a common understanding in field-specific issues and policy-making of constant adaptation and learning.

- *Lack of inter-linkages and cooperation at the ministerial level and between different stakeholders involved in innovation-related activities*

While it is argued by Lundvall *et al*. (2009, 15) that: "*'innovation policy' needs to be anchored not in one single ministry but rather at the very top of the government and in strategic bodies aiming at building sustained learning at all levels of the economy*," almost all problems in the area of innovation policy in CEE go back to weak and disorganised actors and the fragmented policy-making system, resulting in considerable coordination problems in policy design and implementation together with insufficient policy appraisal, evaluation, monitoring and policy-learning systems (article **I**; INNO-Policy TrendChart country reports for 2006-2007; see also Radosevic 2002a, 355).

There are serious obstacles to the information flow in the preparation and implementation of different innovation programmes and measures on the ministerial level, while the expected synergies are not being created. On the one hand, this is due to the lacking tradition of partnership and inter-institutional coordination and cooperation between administrative levels and, on the other hand, it is caused by the separation of policy responsibility between education/science and innovation/industry on the ministerial level and its delivery system (article **I**; see also Nauwelaers and Reid 2002, 365; for the Estonian context in general, Sarapuu 2010). The problem has been exacerbated by the compartmentalised and structured nature of the EU support (see e.g. European Commission 2007). Though arguably interministerial coordination and advisory bodies are created in all EU member-states (EIPR 2009, 4), in the recent literature, a new challenge for interministerial coordination has been raised in terms of cooperation not only between ministries involved in R&D and innovation, but also to the engagement of ministries responsible for non-R&D policy domains such as health, environment, transport, energy, etc. (Nauwelaers 2009, 34). Further, the issue goes deeper than the mere creation of a set of formal organisational ties, but instead concerns long-term processes that form the basis for cohesion and coordination (Rueschemeyer and Evans 1985, 59; for the different levels and aspects of coordination from administrative (avoidance of overlapping and duplication) to policy and strategic ones (comprehensive agreements on future development plans), see also Braun 2008).

This kind of fragmented policy-making system has in turn resulted in a lack of cooperation between different innovation-related activities and actors in general such as research organisations, government and industry (article **I**; based on INNO-Policy TrendChart country Reports 2006-2007).

- *Separation of responsibility for innovation and high-technology policy-making and implementation*

In the late 1990s, due to the progressive decentralisation of the PHARE management structures as well as the EU requirement for the creation of regional and local institutions to administer the EU funds after the accession, a system of implementation agencies was created and pursued in CEE (in particular local agents paid from the operational costs of the PHARE budget) (see European Council 1989; 1999; European Commission 2003; Bailey and de Propris 2004; Grabbe 2006, 82). The trend initiated during the harmonisation period intensified with the structural funding and mostly emerged in the mid-2000s with the actual accession. Due to the emerging trends both on the side of innovation-policy measures as discussed above and institutional changes as derived from the EU-provided assistance in the form of structural funds, the basis was also created for the first implementation agencies in the innovation-policy era (article **I**; for an overview of the usage of independent agencies in the area of innovation and R&D together with the coordination mechanism in place (or the lack of it), see also Technopolis 2006, 13). While the creation and role of agencies in the area of innovation policy was seen in very positive terms by the EIPR (2006, 65) at that time, mainly as agencies were to create a division of labour between ministries and agencies (policy design being the responsibility of a ministry following political decisions taken by the government, and policy implementation being dealt with by agencies), a more critical perspective has been taken in the latest report by EIPR (2009). The report brings out, e.g., concerns for clarity in the system, the necessary coordination at hand, possible overlapping and/or fragmentation of priorities and responsibilities. (*Ibid.*). In the context of CEE, the transfer of modern trends mean in its essence that the increasing usage of independent agencies in an already weak administrative environment lacking policy skills for networking and long-term planning often only deepened and exacerbated the existing problems of policy-making and implementation in the field (articles **I**, **III**, **IV**). It is also acknowledged here that further research is needed for an evaluation of the innovation governance system in CEE.

In general terms, and according to Pollitt *et al*. (2004), the reasons for and the outcomes of using agencies in policy implementation are subject to great variety in different areas and countries. While a rather narrow investigation has been carried out in the selected areas in Estonia, two distinctive aspects emerge for agencies in the innovation-policy area. The first aspect refers to the usage of quasi-autonomous non-governmental organisations (e.g. in the form of foundations)[14] as a rather common organisational-institutional set-up in the management of innovative initiatives in high technology. Based on the cases of EGP and e-Learning, as explored in the framework of the thesis, it is argued that this kind of decentralised organisational-institutional set-up may enhance some kind of flexibility, but it does not automatically guarantee the effective implementation of policy in terms of interaction and close relationships, which are considered to be at the core of the innovation process. This kind of policy-making set-up may in fact cause serious problems, especially if used as a tool by the government to shift accountability and responsibility (including the financial sort) away from itself (articles **III**, **IV**).

The second aspect of exploration concerns the increasing usage of implementation agencies in the policy-making system in CEE. The role of innovation-policy-management agencies in CEE has taken a very specific format (e.g. consider here the example of EEF in the Estonian context), overwhelmingly charged with structural-funds management and funded through the same (see articles **I**, **II**). While the established agencies are mostly for managing external funding and hence detached from the policy creation and respective capacity-building, it can be asked what the input is that this kind of decentralised state structure has for an effective intervention in the innovation-policy area (i.e. organisational capacity for information gathering, situational decision-making and appropriate capacities for action converged to the specific entity, insulated from the control of the central bureaucracy as well as enjoying enough autonomy for a very specific reason: i.e. to formulate collective goals), as foreseen, e.g., by Rueschemeyer and Evans (1985) in general terms. The implementation agencies in CEE can be seen as organisational structures presenting administrative differentiation which, however, "*tend to mesh with specific sets of policy instruments and form a fairly stable amalgam*" (Rueschemeyer and Evans 1985, 52, generally), and hence can be treated as an element to cause serious problems of collaboration and coordination in the policy-making mechanism.

[14] The list of the organisations which belong under this concept is long and varied: (1) contract agencies; (2) public bodies (e.g., Non-Departmental Public Bodies, Para- and Extra-Governmental Organisations, the Dutch *Zelfstandige Bestuursorganen*); (3) voluntary or charity organisations; (4) state-owned enterprises and private-sector organisations (van Thiel 2004, 176; Greve *et al*. 1999, 144; Bertelli 2006, 241-242); (5) foundations (Huber 2009, 9, in addition to the aforementioned layers).

1.3. Lessons from the CEE countries' experience

The analysis on CEE countries' experience in developing innovation policy and high-technology areas refers to a lack of certain prerequisites and background preconditions for development that are, however, central in the concept of systems of innovation (economy as a learning and dynamic system which should evolve according to local needs and specifics, centred in its turn by policy learning (Lundvall 2007, in particular)). The general guidelines for describing the essence of these prerequisites are derived from the phrases of the field-specific literature:

1. "*... the analysis of industrial policy needs to focus **not on the policy outcomes** – which are inherently unknowable ex-ante – but on **getting the policy process** right*" (Radosevic 2009, 39);
2. "*... building an effective system involves much more **than having a plausible plan** ... while national systems clearly are shaped by policies, it is a mistake to see these systems as having been **'planned'** in any detail. Rather, they **'evolved'***" (Nelson 2006a, 15);
3. "*... long time effective recipes become powerless ... [Even more] ... **recipes should be avoided**. A successful strategy in one country cannot be transferred to another*" (Perez [1986] 2009, 16, 42);
4. "*To derive optimal outcomes, the **visible hand of the state** must work in conjunction with the **invisible hand of the market***" (Okimoto 1990, 12);
5. "*Policy learning ... implies that **policy making itself is a process of learning**. The goals, the instruments, the models, the data, the competence of the bureaucracy, the organizations and the institutions develop over time in interaction with each other and not least with the experience and feed-back from implementing specific policies.*" (Lundvall 2007, 39).

In line with the argument raised for developing countries and in very general terms, it can be said that the transition in the CEE countries has been led by a visible simplicity of how development occurs: "*... understood as a cumulative unidirectional process ...*", reflected in "*... a race along a fixed track, where catching-up will be merely a question of relative speed*" (Perez and Soete 1988, 460), supported in turn by organisational-institutional structures of a very simple kind (Nelson 2006a, 13). The first half of the argumentation refers to a neoclassical belief regarding the extent that the investments in productive capabilities would have on the enhancement of innovation capabilities (see generally, Abramovitz 1986; Nelson 2006a, 10-11; Bell and Pavitt 1993, 158); and the second half of the acknowledgement, already there in 1960s (Gerschenkron 1962;[15] for a theoretical overview, see also Hobday 2003;

[15] "*... in a number of important historical instances industrialization processes, when launched at length in a backward country, showed considerable differences, as compared with more advanced countries, not only with regard to the speed of the development ... but also with regard to the productive and organizational structures of industry which emerged from those processes. Furthermore, these differences in the speed and character of industrial development were to a considerable extent the result*

Hobday 2009), though still prevalent today, is that the institutional arrangements and tools for success are context-specific and differ a lot from general Western ideals (Lundvall *et al*. 2009). The endowment of the scientific and educational system is seen here as an unconditionally vital feature to exploit the existing technology potentiality and capacities to change (Reinert 1999; Nelson 2006a; also Perez and Soete 1988; Perez 2001; Verspagen 1991).

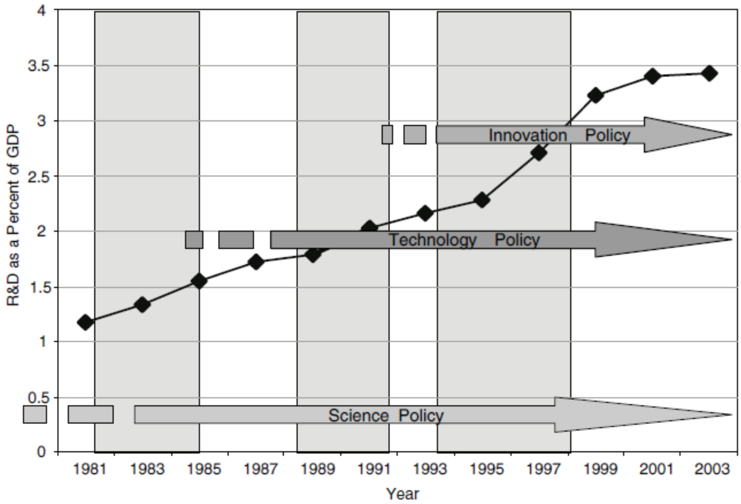
The development of CEE countries has been limited too strongly to the outcome-based framework of the policy-making mechanism (see Radosevic 2009): consider here a stage-centred process as derived from the EU accession, the achievement of a set of measurable criteria (see also Kalvet and Kattel 2006, 9-10) but also annual reporting to the EU and priorities strongly tied to structural funds' programming context referring to an emerged need to have a set of specific targets for the development, including in issues such as research, innovation and competitiveness (for the latest details in this respect see here also EIPR 2009, 18, 39). As the previous has come along with the Europeanisation of the national logic of science, technology and innovation policies in CEE and the rather mechanical transfer of policy models not relevant for the local level, the logic of the kind has led to considerable problems in the strategic dimension of policy-making (see in particular Radosevic 2011, 36). The main hypothesis which arises is that this kind of "*centralized*" policy-making mechanism lacks the inputs and elements relevant for field-specific economic and innovation policies, but also cuts through the basis for feedback channels and interaction mechanisms to interconnect the policy-making to the development needs of the private sector at the local level (see for the latter Lundvall 2010, 2; Okimoto 1990, 33-34).

Further, the concept of systems of innovation has emerged as a standard feature in forming and evaluating innovation policies in CEE, especially since the 2000s (see here INNO-Policy Trendchart country reports), putting into motion a shift of focus from industrial policies to (high-technology) innovation policy together with a more systemic policy view (Soete 2007). In terms of policy intervention, the systemic perspective and concentration on a wide range of various structural aspects and externalities has made the potentiality for state intervention broader in scope, but entrenched in its directedness in achieving the stated objectives than was the case with traditional industrial policy (Dobrinsky 2009).

In a way, the aforementioned transformation has become a paradox for transition countries, because while a number of studies both in a large cross-section of countries in general (Fagerberg, Srholec and Knell 2007) but also covering the CEE countries (Fagerberg and Srholec 2008; Veugelers 2010; Veugelers and Mrak 2009) have found technological capacity, and in broad

of the application of institutional instruments for which there was little or no counterpart in an established industrial country." (Gerschenkron 1962, 7) terms the benefits of industrial policy, to be related to growth in significant terms, the concept has basically disappeared from the official policy language of advanced countries (though in practice continues to play its role) (Soete 2007, 282-283; *The Economist* 2010). For example, it is not only the fact that policies were supported by the "*system of national innovation*" thinking during the 1990s, but also the reliance on Japan's MITI example to make science and technology policies increasingly target-oriented and systematic, pursued one decade earlier by TEKES (that is before the introduction of a system of innovation), that is at the core in the case of the Finnish success story (Ylä-Anttila and Lemola 2006, 91-92; Figure 2).

Figure 2. R&D in per cent of GDP in Finland, 1981-2003



Source: Kotilainen 2007, 78

In other words, there is a gap between the general trends and different contextual needs in developed and developing countries, whereas while the first group is to pursue the broader organisational, economic and social embedding of new technologies, the second group appears to be challenged by more traditional industrial science and technology policies (Freeman and Soete 2009, 588). The situation in the latter group (including CEE countries) is suppressed by the limited experience in utilising different industrial policy tools (in turn tied to the increasingly EU-centred focus) (see Török 2007).

While the industrial landscape is becoming increasingly complex and dynamic due to the generic nature of (arising) innovative technologies, affecting in turn the emergence of a wide set of new perceived spaces for innovation, business models, industries, etc., the approach of systems of innovation is not sufficient in providing (practical) guidelines for context-specific policy-making. This concerns not only the attention to be given to variations as derived from the technological change within different sectors and industrial fields, but also the notion that "*industrial policy may change over time and across individual* *companies*" (Okimoto 1990, 3). Secondly, as a system of innovation relies to a great extent on institutions of an informal and broad economy-wide context, these foundations are more difficult to direct and control than those of technology or industry specific ones (Nelson 2006b; Nelson 2009, 279-283). In fact, the set of relevant institutions ("*social technologies*") such as norms, rules, expectations, governance structures and mechanisms, customary modes of organising and transacting, should be seen as necessary preconditions for new technologies to be exploited and developed effectively (Nelson 2009, 271, commenting on Perez's work).

The deepest insights devoted to a systemic overview of technical change (explained in a stylised way by an S-curve-like technology life cycle) combined with economic as well as socio-institutional aspects can be found in the work by Carlota Perez (see here in particular 2002; 2004; 2010b; supported strongly by the works of Freeman, Dosi, Nelson, Soete, Louçã, and others). According to her, first, "*there are no magic formulas for achieving development without mastering technology*" (Perez 2001, 125); second, "*windows of opportunity*" (see in particular Perez and Soete 1988) derived from advances in technology should be seen as a "*moving target*" (Perez 2001), occurring in different forms in different countries and periods. As the latter presumes an understanding of the nature and causes of technological change, this serves as a basis for further exploration. *Hence, this thesis aims in its final stage to analyse the CEE-specific developments from a technology-centred angle.* The reasoning arises from the need to go further and to shed light on the appropriateness of different policy measures with respect to specific technology fields, technology development stages and the organisational-institutional context (the classification of this kind has also been suggested for the formation of technology policies and policy-making by Metcalfe 1995, 38) and in doing so to open up the problem of context-specific policy-making in CEE in more fundamental terms.

While the technology-cycle-based development was originally proposed for newly industrialising countries to open up the essence of possible entry points and "*windows of opportunity*" along a technology life cycle to leapfrog (see Perez and Soete 1988; Perez 2001; also Andersen and Lundvall 1988, 21-22), the approach has been considered valuable for strategic development and as a basis for public policy in the recent topical literature (e.g. Phaal *et al*. 2011; Bergek *et al*. 2008, 419-420; in terms of CEE countries, Radosevic 2011; see also Kattel 2009). According to Kattel *et al*. (2009, 15), the understanding of the technological development and its dependency on the policy framework and interlinkages to socio-institutional conditions is becoming a central methodological issue in the future. The extreme dynamics the approach is to cover is also the reason why in the framework of this thesis, the discussion is not limited to the concept of sectoral systems of innovation as proposed by Malerba (2004), which in essence has strong roots going back to the specificity in different industrial areas (in particular to Pavitt 1984 taxonomy), but remains general in terms of attention given to the development stages and the respective changes (see here also Malerba 2007).

2. Technology-centred approach as a complementary tool for describing the essence of basic problems in the development of high technology in CEE countries

2.1. Stylised features of technology-centred development: compounding context-specifics with technology-cycle and techno-economic-paradigm-based approaches

The technical change and its evolution is subject to extreme complexity and dynamic processes.[16] The extreme complexity of the issue could explain why the treatment of technology has remained somewhat narrow-minded in the mainstream non-evolutionary literature both on the policy-making level and in theoretical literature. Reflections of this kind can be found in ideas on how technological change has been treated, e.g., as something "*freely available*" (see for criticism e.g. Kattel *et al*. 2009, 9; Reinert 2008, 139), "*an artefact which can be bought off the shelf*" (for criticism see e.g. Sharp and Pavitt 1993, 147), "*aggregate growth of the GDP*" (see for criticism e.g. Freeman and Louçã 2001, 143), "*exogenous manna from heaven*" (see for criticism e.g. Reinert 2008, 139; Freeman and Soete 1997, 429; Freeman 1994, 463; also Sharp and Pavitt 1993, 130), "*black box*" phenomena (see for criticism e.g. Kline and Rosenberg 1986, 278; Freeman 1994, 463), etc. These points make a rather implicit remark on the separation of economic policy from that related to technology and inability to cover the technology-specific features in growth and development respectively (for an overview of the role of technology in economic growth and development, see chapters 13 and 19 in Freeman and Soete 1997; for the theoretical essence of the issue, see Pavitt 1987; Pavitt 1996; also Freeman 1994; for the advancement of policy issues Mytelka and Smith 2002; etc.).[17]

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[16] For the dependency of the state of the supporting technologies at the time, see in particular Hughes 1992; for the dependency on complementary assets derived from upstream and downstream activities and sectors, see Teece 1986; for the complementarities between incremental and radical innovation and between research-derived and market-derived incentives for innovation, see Kline and Rosenberg 1986; for the externalities of the system due to increasing returns and path-dependency, see Arthur 1994, making in turn location as such together with concentration of certain intangible assets a viable factor not only in the nation-state but also on the international level, see for brief insights here e.g. Porter 2000; Dunning 2002, etc.

[17] It has to be acknowledged that the term "*technology*" has a wide range of definitions. According to one of the core theorists of the field, W. Brian Arthur (2011, 5), the range of the major different definitions is estimated to be at least half a dozen,

In the evolutionary school of thought, the expression of technological change is strongly related to the certain paths of cumulativeness and not (totally) random opportunities and regularities in the advancement of technology.[18]

It has been acknowledged here and in the topical research as well that the concept of technology and/or product life cycle (as is generally the case when using models) holds widely for developing generalisations, which, however, have limits, for instance in terms of universality, straightforwardness (e.g. in terms of the identification of different phases and boundaries for the effect) and the sufficiency of variables used and, respectively, their role and focus (in general, see here Nelson 1994; also e.g. Malerba 2007; Suarez 2004). It can also be questioned how viable the life-cycle approach is by itself, reflecting the possible need of complementarities with other toolboxes derived from evolutionary theory, such as, e.g., the "*market features*" approach, concerned with analysing market functioning and critical aspects for state intervention respectively (Burlamaqui 2006, 9-10).

The goal of this thesis is not to carry out a survey on the literature on industrial and innovation dynamics and evolution and to explore the model's adequacy, but instead to use it as an "*illuminating [tool applicable] in a wide range of industries*" (Nelson 1994, 52; see also Freeman 1994) and as a "*natural unit of analysis for the technology policy maker*" (Metcalfe 1994, 935) to disclose the fundamental challenges in the current state of high-technology policies and policy-making mechanisms in CEE countries. Hence, the concept of the life cycle is dealt with here as a set of certain stylised and sequential patterns for attempting to describe technological change in its complexity and dynamics. The core of the approach taken in the framework of this thesis is composed by two different layers as follows:

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from which several conflict with each other. In the framework of this work, the term technology and technological innovation are used to emphasise advantages made in both theoretical and practical knowledge (see here in particular Dosi 1982, 151-152; Freeman and Soete 1997, 24). Arthur (2011, 28-30) has emphasised here the aspect of functionality, derived from which the term should be seen from three different independent categories in total: "*a means to fulfil a human purpose*", "*an assemblage of practice and components*", and "*collection of devices and engineering practices available to a culture*".

18 Consider here the historical overview of (modern) stage theories since the 19th century (see Reinert 2009); technological trajectory and paradigm as introduced by Dosi 1982 (in line with Kuhn's scientific paradigm [1962] 2003); a product lifecycle model by Utterback and Abernathy 1975; or natural trajectory, referring in turn to organisational routines and core organisational capabilities relevant for the exploitation of (new) technological opportunities next to a systematic application of science-based knowledge (see in particular Chandler 1992, 86; Nelson and Winter 1982, 255-262; also Sharp and Pavitt 1993, 130-131).

I Changing character of technological evolution as something which starts with radical innovation/improvement is followed by the phase of incremental and exploratory improvements together with the emergence of the so-called "*dominant design*" and eventually ends with maturity.[19]

The concept of the life cycle involves a wide set of diverse features to illustrate the aforementioned change, though seemingly simple and plain: (a) variations in nature, focuses and incentives in the innovation process along the development stages due to the product-process confrontation (see here Utterback and Abernathy 1975; Utterback 1996; also Ayres 1987; Perez and Soete 1988; Freeman and Soete 1997, 278-279, 358; Andersen and Lundvall 1988, 21-22; for the different phases and focuses in industrial emergence, see Phaal *et al*. 2011); (b) the changing focus of scientific knowledge, the effect of which is likely to be much more direct at the early stage, and giving way to possibilities to use unskilled labour in the later stages (see in particular Perez and Soete 1988; Perez 2001; also Freeman and Soete 1997, 278-279, 358); (c) the changing nature of learning curves being steep in the early phases of the technological development and secondly being extremely activity-specific, pointing in turn to the notion that it is wise to produce where the learning curves are steeper (Reinert 2008, 125-164), but also that in most high-technology industries, which belong to this category, the product cycle itself tends to be much shorter (Okimoto 1990, 28); (d) changing organisational structures from organic to hierarchical and bureaucratic ones, hence considerably changing the receptivity for innovation opportunities (Utterback 1996; Strebel 1987); (e) changing market conditions in terms of firms involved, potential for market growth, returns, demand structure, competition, etc. (see Utterback 1996; Klepper 1997; also Perez and Soete 1988; Freeman and Soete 1997, 278-279, 358); (f) changes in uncertainty/risks, profitability and different sources of financing over the development stages, together with possible profit loss in the early stages (see Siemon 2010, 19-20); (g) different aspects and stages in innovation and technological diffusion (see Rogers [1962] 1995, 1-37); (h) changes in the relative importance of locational advantages from dynamic advantages and external economies to static advantages, tending to favour

[19] "*Every radically new product, when it is first introduced, is relatively primitive. In the initial period there is much experimenting in the product and in its process of production, in the market and among the initial users. Gradually, it consolidates a position in the market and the main trends of its trajectory are identified. From then on, there is a sort of take-off for a period of successive incremental improvements in quality, efficiency, cost-effectiveness and other variables, which eventually confronts limits. At that point, the technology reaches maturity. It has lost its dynamism and its profitability. Depending on the type of product, this cycle can last months, years or decades; it can involve a single firm, dozens of firms or thousands. As the technology approaches maturity, there is often a shakeout, leaving only a few producers. There is also a high likelihood that, at maturity, the product will be replaced by another or the technology will be sold to weaker producers with lower factor costs.*" (Perez 2004, 220-221; see here for schematic illustration, e.g. Perez 2010b, 187).

developing countries in the later phases respectively (Perez and Soete 1998; Freeman and Soete 1997, 279; for the international movements, see in particular Vernon 1966; also Nurse 2009); (i) changes in different features of a nation's institutional environment together with the role of organisations such as universities, government agencies, legislature, etc. (Nelson 1994; for examples of different technologies and respective emerging institutions, see also Nelson 2006a, 7-9; 2006b, 24-25, 38-44; Murmann and Landau 1998), etc.

II Socio-institutional changes as derived from the technological revolutions and the respective surges every 40-60 years. According to the concept, the techno-economic paradigm determines a "*best-practice model*" for the most effective use of the new technologies within and beyond the new industries, meaning that the concept also involves the change of organisational forms, business models, finance systems etc. that are conducive to innovations and the types of technological capabilities and skills that are needed (e.g. Perez [1986] 2009, 14-15; 2002; 2004; 2010b). As a result, the state's role in building the system is categorised in much wider terms than just the replacement of older infrastructure or the introduction of new institutions – this is about the creation of externalities in the system to facilitate the processes of change and adaptation in the flourishing of the new technologies (Perez 2004, 224; see here also Freeman and Louçã 2001, 145):

1. "*The development of surrounding services (required infrastructure, specialized suppliers, distributors, maintenance services and so on);*
2. *The 'cultural' adaptation to the logic of the interconnected technologies involved (among engineers, managers, sales and service people, consumers and so on);*
3. *The setting-up of the institutional facilitators (rules and regulations, specialized training and education and so on).*"

The structural adjustment between the new technology and the respective policy-making framework in terms of an appropriate set of organisational structures and institutions for key technologies and industries of different areas and times has arguably been related to the changing pattern of international technological leadership (see Perez and Freeman 1988; also Perez 2002; 2010b; Freeman and Louçã 2001). The policy question here is whether the new technology employs the same kind of understanding and skills as the old one and how institutions should support the adaptation and shift needed. It is of utmost importance to note here that technology should be seen as something embedded in the system and affected and determined by its historical, cultural and socio-institutional context together with economic patterns of the system (Tunzelmann 1997; for the historical co-evolution of industrial governance structures and the nature of technology, see also Kitschelt 1991). The latter also explains why some "*radically innovative*" industries have been clustering within particular countries (Casper and Kettler 2001, 7) or why specific sectors tend to fail in some countries due to the "*mismatch*" of governance structures needed and the path-dependency of national institutionalised learning capabilities (Kitschelt 1991, 469; for examples of that kind of lock-in situations, see Edquist and Hommen 2008, 1-28). The previous is compounded by the need to deal with the issue of technological development not only according to its particular local conditions, but also to the changing external circumstances and international comparative advantage: "*The issue of policy making is to be aware of how different technologies are promoted by different accumulation systems, and the extent to which these systems are connected internationally*" (Metcalfe 1995, 42; also Hobday 2003, 309; Okimoto 1990, 31).

Accordingly, as derived from the technological progress and level of maturity, the strategic basis for state intervention in specific industrial fields and development stages is different and highly context-specific. Okimoto (1990, 50-51) has suggested that the state involvement should be greater in the sectors belonging either to the early phases of the industry life cycle when demand is small or to the later stages when the industry faces the loss of its comparative advantage and confronts the respective restructuring problems. Basically, the same kind of approach (but V-curve-like) has been proposed by Drechsler (2009a, 100; for the comments, see Hajnal 2010, 123-124) for the state involvement with the focus on supporting and establishing new technologies and supporting the phasing-out of the old and leading ones. In one of his latest works concentrating on the CEE countries, Radosevic (2011, 26) has suggested that policies in transition countries should be in line with the prevalent stage in techno-economic paradigms (in addition to the gap prevalent in the comparison to the technology frontier). Respectively, the policies in the installation phase should be focused on innovation and structural change and in the deployment phase on the issues of diffusion and demand for technology uptake and absorption. In its essence, the emphasis here is on how different capabilities and dynamics influence innovation along the life cycle, which move from competence-building and supply dynamics towards wider social, economic, environmental, political and technological drivers and market-demand dynamics in the later stages (see Phaal *et al*. 2011, 222-223). As no strict line between different phases of the technology and/or product life cycle can be drawn in reality and each stage should be seen rather as a combination of different firm- and environmental-level factors (Suarez 2004), it has been suggested in the business literature that not the effectiveness of the usage of life-cycle theory in business-strategy building but instead the input it may have for the development of firm capabilities that shape the structure of competitive interaction is what matters and should be explored in depth (see for an overview, McGahan *et al*. 2004, 8). The taxonomy of knowledge governance regimes throughout the technology and/or product cycle by Kattel (2009) makes the closest attempt of this kind on the policy-making level.

Based on the discussion above, it is rather straightforward to assume that the life-cycle approach leads the focus of attention away from a mere dichotomy of state *versus* market and from individual innovations to a more systemic understanding that innovation possibilities are firm/industry/techno-economic-paradigm specific, local-context specific and vary systematically over time (Metcalfe 1995, 31-33; e.g. Perez 2005). As a result and in terms of policy-making, we have to speak about, first, high-level "*intelligence-gathering capacity*" (term derived from Walsh 1988, 53) for awareness about the phase of the evolution of the specific technology, technological revolution and the broader context of the paradigm (Perez 2001, 120), which in turn, arguably calls for closer state-society relationships in policy-making and particularly those that connect the state to entrepreneurial groups, "*'embedded' in society than insulated from it*" (Evans 1995, 30; for a wider overview see also Skocpol 1985); second, capacities to deal with more systemic problems, such as uncertainty and high risks, networking and learning problems, compared to mere attention to lower risk and the provision of a stable environment (Evans 1995; Chaminade and Edquist 2006); and third, capacities to be able to address and adapt to the diverse and changing conditions over time, sometimes even to the conflicting needs of a broad range of industries at different points in time. In essence, all of the above leads to a "*vicious*" circle of deepening the governmental involvement once the step has been made. As examples of core prerequisites for this kind of policy-making system, the presence of a dynamic coordination mechanism (Okimoto 1990, 8; Rueschemeyer and Evans 1985), the reemphasis of Weberian structures and values in policy-making (see e.g. classical work by Evans and Rauch 1999; also Burlamaqui 2006, etc.)[20] and the need to accept mistakes in policy-making could be named here (see Okimoto 1990; Chaminade and Edquist 2006).

Fundamental in the framework of this thesis is the question about the focuses in policy-making most likely to complement the approach of context-specificity. As it is concluded in the more generic circumstances that "*the general policy issues do not tell a policy maker exactly what to do in order to improve the functioning of the system*" (Edquist *et al*. 2004, 438), the same applies to the CEE conditions where, by definition, the policies to fulfil the content of local innovation policies have been worked out on the EU level, and respectively, the focuses in policies concern framework matters and are horizontal in nature. In order to pursue context-specific policy in CEE, and as discussed above, the specific industrial fields (sectors) and industrial policies are the ones which need to be reemphasised. In its essence, the sectoral focus is also most likely to bring along a decrease in dependency on the general, macroeconomic and "*one-size-fits-all*" policies that are currently highly prevalent.

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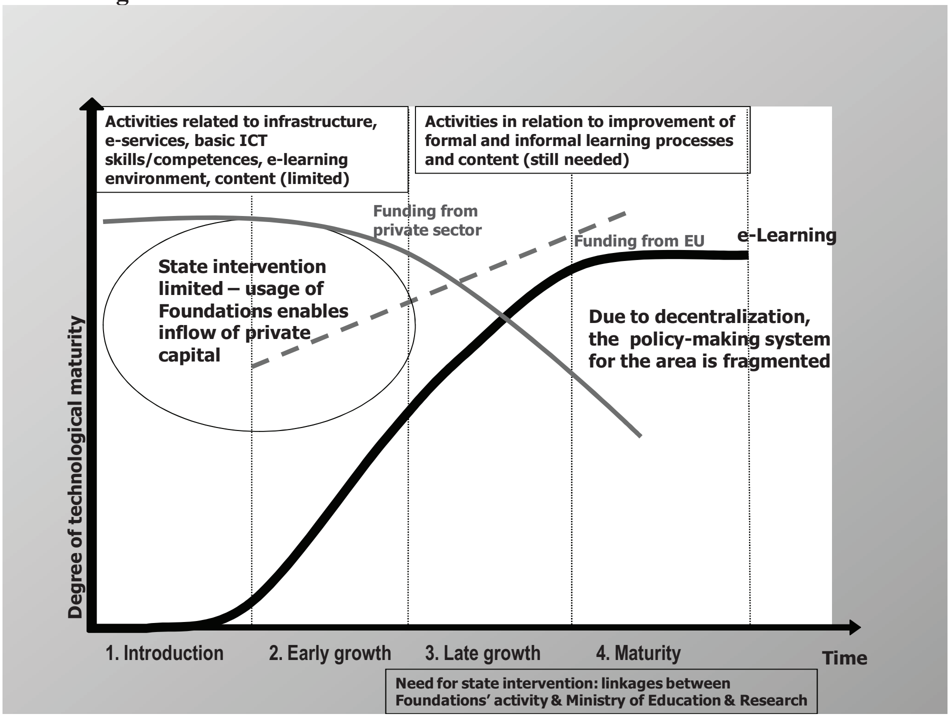
[20] Such as autonomy, competence, honesty and the political strength of policy-makers to avoid the "*hijacking*" of policies by entrenched interests (Evans 1995; Lall 1992, 183; see also Edquist and Hommen 2008; Chaminade and Edquist 2006).

It can be argued that this kind of the approach, as it has been prevalent in CEE so far, is suitable for the reorientation to be made in the transition period and in a short-term perspective, but does not have the inputs sufficient for the long-term policy-making. In a paradox way (following Karo and Kattel 2010; Karo 2011), the current practice may have considerably hampered the latter and not on the level of innovation policies in general, but also building the capacities for "*modern*" industrial and technology policies which, as argued above, have become more complex in terms of the technological content but also in terms for the direct role and means the state is allowed and able to use.

2.2. Lessons from the case studies

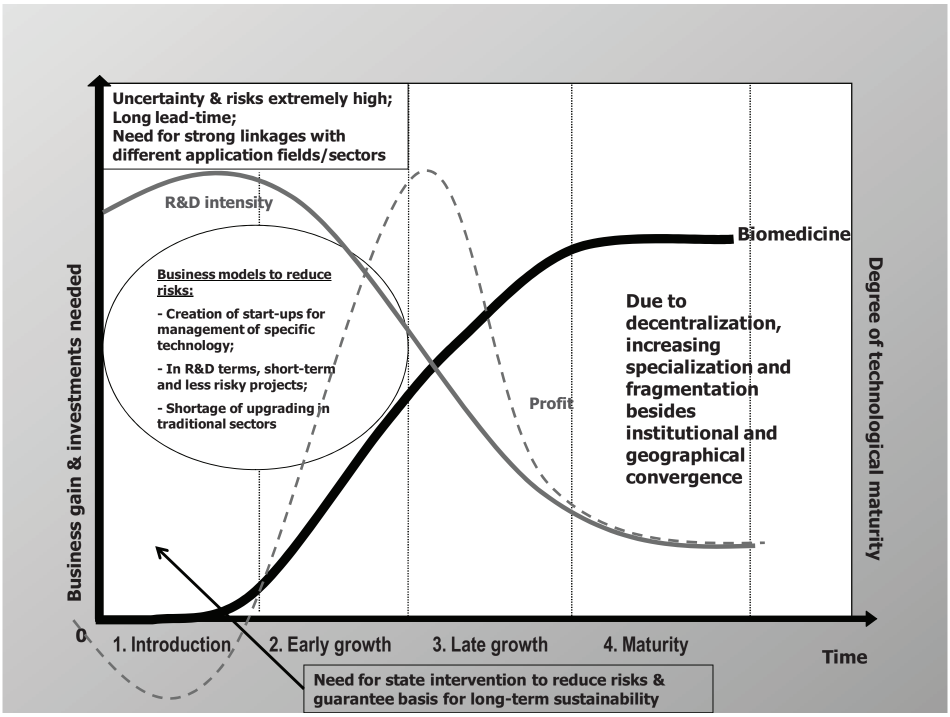
In this sub-chapter, the Estonian government's initiatives in the co-called "*core technologies*" of the current techno-economic paradigm of ICT and of the possible future paradigm of biotechnology are presented from the perspective of the technology cycle (see here Figures 3 and 4). These figures serve as illustrative case studies to shed light on the problems which derive from generic (i.e. not sector-specific) and macroeconomic stability-oriented policies, on the one hand, and, on the other hand, from the policy-making mechanisms (decentralisation in terms of reliance on the foundations and implementation agencies) that have not been able to create a connection to the local context-specific and certain technology-driven problems. Instead, the system in use has considerably deepened the (CEE-specific) problems in terms of coordination, cooperation and collaboration, has not been able to react to the technology-specific problems and challenges in the selected innovation policies areas, and has paved the way for decreased governmental accountability in the respective frontline innovation matters (articles **II**, **III**, **IV**, **VI**; in general terms article **I**).

Figure 3. Stylised features of the current state and basic challenges in the era of e-Learning in Estonia



Source: based on Perez 2002; Perez 1992; Perez 2001; articles **IV** and **VI**

Figure 4. Stylised features of the current state and basic challenges in the era of biomedicine in Estonia



Source: based on Perez 2002; Perez and Soete 1988; Siemon 2010; articles **II** and **III**

The previous shows that the considerably different high-technology areas representing arguably different "*best model*" approaches in terms of favourable business models, organisational structures, socio-institutional conditions, etc. share distinguishable commonalities in basic policy focuses and policy-making mechanisms, a back-up role for the state, the role of (implementation) agencies, a reliance on structural funding (as a basic support mechanism for innovation) and a rather strong reliance on the private initiative in the early phases of technology development. Interestingly enough, as argued above, both areas have also ended up with rather similar problems for both policy-making and the innovation environment in general, which is about increasing the fragmentation of innovation actors and policies within the high-technology areas as well as between the different high-technology and relevant traditional areas (see articles **II**, **III**, **IV**, **VI**; and article **I** in general terms). This, however, refers most explicitly to the fact that the approaches taken in these different specific policy areas have not been able to tackle the different technology-specific, stage-specific but also country specific problems, needs and challenges in fundamental terms. The major problem here has been the lack of externalities and complementarities at the local level, which, however, the generic innovation policies in essence do not reach.

Table 3. Stylised features for the description of developments in the innovation area in CEE

Characteristics of intervention	Context-specific ideal-type developments	Developments in CEE
Reasoning	In a systemic way to intervene and support changes and adjustments at the micro-economic level	To guarantee macro-economic conditions in terms of stability, openness and competition, that is factors for the inducement of change
Aim	"*Substitution of missing prerequisites*" – reliance on local/regional specificities (externalities) and needs while considering technological opportunities in the international context	"*Substitution of missing policies and institutions*" – reliance on international (including EU-level) induced "*best practice models*" and trends in design policies and institutions
Focus	Sector-specific policies: dependency on the sector and its development stage together with acknowledging differences among firms in the same statistical sector: a) Early phase: emphasis on R&D capabilities and positive feedback linkages that decreases the level of uncertainty and risks b) Maturity: emphasis on creation of synergies and complementarities and rejuvenation	Framework and horizontal policies: policy measures do not specify sectors but are open to all sectors; are broad and generic in essence
Policies	R&D and innovation policies as instruments for a wide range of policy objectives → treated as something depending on the specifics of certain areas together with different purposes and different sorts of innovation systems Policy mix of direct and indirect focus on R&D Innovation formation and diffusion of innovation treated in an inseparable way; includes policies to stimulate demand for locally generated innovation	R&D and innovation policies as important arenas of action R&D priorities and policy measures limited to the focus on cutting-edge technologies Policies to stimulate the supply of innovation, its commercialisation and transfer and the respective institutions
Nature	Immeasurability Interactions in innovation processes Institution-building that supports the production and reproduction of human and social capital	Measurability (compounded by the limits in indicators in use for the analysis and evaluation of the innovation (system) policies) Allocation of resources, supported in turn by a reliance on structural funds Threat: lack of interconnection

		between higher technology intensity of production and innovation capacities
Effect	Process – policy fine-tuning – based on policy learning and incremental policy accretion Need for constant changes in institutional setting for policy management and implementation	Outcome – the result of conscious and deliberate efforts to construct complementary sets of policies
	PRESUMES:	**IS BASED ON:**
Characteristics of policy-making	Bottom-up approach and "*microindustrial management*": a) Constant monitoring and information gathering of development trends b) Embedded autonomy c) Search networks → scaling-up and linkages between macro- and micro-level developments Threat: lock-in, rent-seeking and lobbying	Top-down and centralised approach → policies of "*one size fits all*" Threat: mechanical policy transfer not relevant but "*legitimate*" Threat: the upward flow of information from lower and middle levels to be choked off
Structure of policy-making	Decentralisation Built-in high-level communication and coordination mechanisms	Policy formulation deprived from the implementation (agencies) Coordination through a set of formal organisational ties
Capacities of policy-makers	Autonomy attained through (high) meritocratic policy-making capacity	Autonomy through distance-based policy-making → inside capabilities in high-technology-specific questions limited

Source: Theoretical framework derived from Radosevic 2009; Nelson 2006a; Mytelka and Smith 2002, 1467; Lundvall 2007; Jensen *et al*. 2007; Chaminade and Edquist 2006, 8-9; Patarapong and Chaminade 2007, 7-8; Evans 1995; Hobday 2003; Perez and Soete 1988; Okimoto 1990; Burlamaqui 2006; Soete 2007; Metcalfe 1994; Nauwelaers 2009; Rueschemeyer and Evans 1985.
For CEE: Original articles of the thesis and appendices; supported by Radosevic 2009; Radosevic 2011; Radosevic and Reid 2006; Havas 2006; Kattel and Primi 2010; Reid and Peter 2008; Török 2007; Tiits 2006; Kalvet and Kattel 2006; EIPR 2008; 2009, etc.

As discussed above, the question about context-specific policy-making and policy learning is highly bound to the sector-specific approach in innovation policies. Hence, the preconditions for effective policy-making are not only dependent on the socio-institutional environment prevalent on the local level (especially if one considers the issue of technological and socio-economic path-dependencies and the developed "*core*" and learning capacities respectively), but are strongly related to the dynamics of technology-derived developments together with the specific nature of technology progress in selected areas.

The keen following of the trends in the innovation area as introduced on the level of the EU, however, has had a rather contradictory effect on the response of local-context and technology-specific problems (see articles **I**, **II**). This has been compounded by the high relevance given to the outside (and often international) consultation/expertise knowledge in the policy-making. Both explain why the lack of capacities related to innovation governance in the majority of CEE countries has remained a crucial issue till today (see here EIPR 2008, 52). Due to the above-described capacity problems, the real practice in CEE is faced here with another setback, a lack of embeddedness in the state and society relationships that, however, could serve as an important channel for exercising the bottom-up orientation in policy-making. The policy-making mechanism in place has had a wider impact on the functioning of the system, where severe problems of cooperation and collaboration between different stakeholders can be detected, reflecting in this way also the general innovation climate in the context of which the development of high technology should take place (see here article **II**; also **III**). The latter is particularly important in the framework of the argument according to which networking is less hampered by the initial density of trust and ties at the micro level than by the difficulties of "*scaling up*" e.g. bringing together different stakeholders of the process (Evans 1997; see also Radosevic 2009). The basic presumption for the focus of change in innovation and industrial policies in CEE would concern the strengthening of the local-level policy-making capacity together with specialised knowledge-equipped entities and working policy-making structures in terms of coordination and collaboration and that not only between R&D but also between R&D and non-R&D entities and between the state and the business area.

Summary and conclusions

The aim of this thesis was to bring out the main lessons from the experience of CEE countries and of Estonia in particular while developing high-technology areas. The discussion covered the main trends in the evolution of innovation policies and policy-making mechanisms in CEE in general and also explored the very same aspects in the context of certain high-technology fragments based on the example of Estonia. Hence, the conclusions are limited in making generalisations in country, technology and sector perspectives. At the same time, the approach taken has made it possible to go deep into the selected matters and to take advantage of the toolbox of the evolutionary school while exploring the different nuances of technology-centred and context-specific developments. On the other hand, the spectrum of issues which was aimed to cover is wide in its essence, showing in turn that the approach taken is appropriate for indicating the fundamental and critical problems and challenges in the areas of innovation policy and specific high-technology fields rather than being adequate for forming the basis for the evaluation of causal factors and impacts on the functioning of a system in a profound way.

In policy issues, it has been proposed that innovation and high-technology policies need to be:

1) *Nation-state specific*
2) *Sector-specific together with deeper interdependencies between different relevant policy areas*

Innovation policy in CEE countries has been keen on following "*fashionable trends*" in the international area, and on the EU level in particular, and not as much on context-specificity in needs and capabilities as prevalent at the local level (for the general trends, see article **I**; biotechnology-specific developments in Estonia, article **II**). While policy-making has been derived from theoretically desirable ideas (e.g. importance of high-technology), the market structures and their impact on R&D intensity in practical terms has not been under consideration (articles **I**, **II**). As a result, innovation policy has not been able to tackle the current structural problems in CEE countries and, as a matter of fact, considerably deepens the existing problems and capacities to solve them (articles **I**, **V**).

The Europeanisation of innovation policy has come along with a very specific dichotomy between innovation and industrial/sector-specific policies, out of balance in favour of developed countries. As a result, the preliminary focus in innovation policies has increasingly been given on the one hand to horizontal and generic policy measures and on the other hand to systemic issues, the presumptions of which have been limited to several aspects in the context of CEE (for the examples, see e.g. article **II**). In its essence, the systemic problem-solving orientation, which has become prevalent in innovation-policy discourse, is bound to the question of how to create synergies and complementarities between front-line new technologies and the existing stock of the technological basis varying in different countries. In developed countries, the fundamental basis for this has been the practicing of technology, science and industrial policies decades earlier. In the CEE context, what is needed is, first, a set of capacities and capabilities to understand the essence of different sectors, the role different technologies play in these together with changes as derived from the technological development stage, but also the socio-institutional factors that the progress is to be supported by, etc., and, second, the ability to evaluate the desirability and feasibility of the development of certain specific sectors in the local context. The examples of biomedicine and e-Learning in Estonia have shown that there are considerable problems of fulfilling both aspects in the current policy-making, as a result of which the spill-over effect and complementarities that both sectors would presumably have on the rejuvenation of other (industrial) fields and the general economic development in Estonia is restrained and concentrated in the hands of certain players (articles **III**, **IV**).

In terms of policy-making and implementation issues, the positive impact of the prevailing trend of implementation agencies as well as the usage of quasi-autonomous non-governmental organisations has been questioned:

Although a decentralised organisational set-up may enhance some kind of flexibility, the selected case studies in Estonia have shown that the set-up by itself does not automatically guarantee the effective formation and implementation of high-technology policy. In particular, this concerns the creation of interaction and feedback loops between the state and relevant stakeholders, favourable conditions for the selected strategic areas such as a certain level of stability and shared common goals, the creation of interconnections, synergies and functional coherence between the main actors and relevant activities of the system of innovation, etc. (articles **III**, **IV**, **VI**).

The previous is linked to another effect of Europeanisation, the effect it has had on the policy-making mechanism present for innovation-policy issues. The essence of the "*copying paradox*" in this case resembles the typical problem of policy/technology transfer, where the institutions and aspects distinguishable have been taken over, though in overall terms not completely (e.g. what belongs under the decentralisation of policy-making and what is a part that the implementation agency is able to fulfil) and are not able to guarantee the system's effectiveness – the fundamental problems of policy-making and administrative capabilities, not transferable and highly context-specific. In this respect, the example of the EGP is profound in highlighting the importance of high administrative capacity in the public sector as a precondition to manage complex R&D and innovation-policy initiatives (article **III**). The encapsulation of the policy-making system from the local context and society has been supported by the availability of structural funds, and the respective implementation mechanism paved the way for another set of changes that the local level has not been able to deal with strategically together with its market-led focus (articles **II**, **I**). Here the fundamental role is played by the fact that implementation of a wide range of innovation support measures has been relying strongly on EU structural funding, resulting in the R&D- and innovation-policy set-up where structural funding is replacing rather than supplementing national funding in many CEE countries (see article **I**).

The main hypothesis which arises in the context of CEE countries in general is that the EU-centrism which has influenced the set of favourable policies as well as of policy-making mechanisms lacks the inputs and elements relevant for field-specific economic and innovation policies, but also cuts through the basis for feedback channels and interaction mechanisms to interconnect the policy-making to the development needs of the business society at the local level. The approach of the kind is particularly troublesome in the case of high-technology fields, generic in nature, referring to the fundamental change in how the areas should be treated: as means rather than goals by themselves (see in particular article **VI**).

In terms of functioning of a system as derived from one selected high-technology area, it has been argued that fragmentation in the area considerably deepens the systemic problems if not dealt with strategically:

The exploration of business models in the area of biotechnology in Estonia has confirmed the "*alignment*" to the international trends, i.e. an orientation towards less risky and faster payback models, threatening in turn the emergence of outsourcing in the economy where a supply and service orientation is already prevailing and hence encapsulation at the lower value-added end may occur (article **II**). The governance of high-technology areas creates considerable (strategic) challenges for the transition countries. On the one hand, the trends as described in the case of Estonia reflect that it is possible to avoid dealing with the profound problems related to cooperation and synergies, etc. prevalent in the general environment for R&D and innovation, but that only in the short-term perspective. In the circumstances of increasing specialisation and fragmentation in the area of biotechnology in Estonia (though supported by geographical and institutional convergence), one can argue how sustainable the prevalent trends are in the long run, and even more, how strongly they will affect the sectoral structural set-up in a way from which it will be hard to escape, especially in the context of continuous international developments (article **II**).

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SUMMARY IN ESTONIAN

Innovatsiooni- ja kõrgtehnoloogiapoliitika, selle kujundamine ja elluviimine Kesk- ja Ida-Euroopa riikides Eesti näitel

Kõrgtehnoloogiliste valdkondade eelisarendus ning selle rõhutamine teadus-, arendus- ja innovatsioonistrateegiates on viimaste aastakümnete olulisemaid arengusuundi Kesk- ja Ida-Euroopa (KIE) riikides, sh Eestis. Samal ajal on arusaam nende riikide valmisolekust, võimalustest ja konteksti-spetsiifilistest vajadustest rakendada majanduse toetamiseks kõrgtehnoloogilisi arenguid jäänud suhteliselt ebamääraseks. Käesoleva väitekirja eesmärk on välja tuua kriitilised probleemid ja õppetunnid innovatsioonipoliitika ja (valitud) kõrgtehnoloogiliste valdkondade arendamisel KIE riikides, eelkõige Eestis. Töös analüüsitakse vastavate poliitikate ning nende kujundamis- ja elluviimismehhanismidega seonduvat, sidudes omavahel üleminekuriikide poliitikate orientatsioonis siiani prevaleerivad ja tehnoloogilise arengu dünaamika mittemõistmisest tulenevad piirangud poliitikate kujundamise võimekusega.

Selleks on teoreetilisel tasandil kokku viidud innovatsioonisüsteemide, euroopastumise, avaliku halduse, ärimudelite ning tehnoloogia elutsükli ja tehnoloogilis-majanduslike paradigmade põhised käsitlused. Oluliseks taustinformatsiooniks kõrgtehnoloogiliste valdkondade arendamisega seonduva uurimisel on innovatsioonipoliitika üldised arengutrendid ja nende KIE eripära, mis tuleneb 1990-ndatel aset leidnud majanduse ümberstruktureerimisest ja 2000-ndatel Euroopa Liiduga (EL) liitumisega omaks võetud uutest rõhuasetustest nii poliitikate kui seda toetavate organisatoorsete ja institutsionaalsete lahenduste ülevõtmisel ja juurutamisel (artikkel **I**; toetatud artikkel **V** poolt). Üldises plaanis on EL-i roll olnud määrava tähtsusega KIE riikide innovatsioonipoliitika kujundamisel ja arengus. Samas tänu ülevõetud poliitikate ja lahenduste arenenud riikide keskselele orientatsioonile on need KIE kontekstis jäänud mitmetes aspektides mitte ainult puudulikuks, vaid oluliselt süvendanud ka olemasolevaid probleeme ja võimetust neid lahendada (artikkel **I**; toetatud artikkel **V** poolt).

Siinkohal tuleks esimesena nimetada KIE riikide majandusstruktuurist ja -keskkonnast lähtuvat nn "strukturaalset lõksu" teadus- ja arendustegevuse (T&A) ja kõrgtehnoloogia toetamisel ehk vastuolu ettevõtete ja tööstussektori tegeliku vajaduse ja võime vahel vastavatest poliitilistest prioriteetidest kasu lõigata, viidates omakorda olulistele probleemidele kõrgtehnoloogia arendamiseks vajalike tagasisidemehhanismide olemasoluga seonduvalt (artiklid **I**, **II**).

Teiseks tuleb esile tuua rõhuasetus innovatsioonipoliitikale koos horisontaalsete ja majanduskeskkonda kujundavatele üldistele makromajanduslikele meetmetele ehk teisisõnu meetmetele, mis ei lahenda täna prevaleerivaid probleeme ega panusta nende olemuslikku mõistmisse KIE riikides. Nii on tööstuspoliitika ja eriti selle sektorispetsiifiline käsitlus, millelt võiks eeldada kohalikku konteksti süüvimist, jäänud vastavate poliitikate ja toetusmehhanismide euroopastumise tõttu tagaplaanile. Pigem on esile kerkinud süsteemse lähenemise juurutamine sünergia ja täiendavuse loomiseks innovatsiooniprotsesside ja -süsteemi erinevate osapoolte ning kõrgtehnoloogiliste ja muude majandusharude vahel. Mõlemad arengutendentsid põhinevad arenenud ja varem EL-iga liitunud riikidest pärinevatel erinevatel sotsiaal-institutsionaalsetel eeldustel (eelkõige koostöövalmidusel), aga ka eeldustel vajaliku teadmiste ja kogemuste pagasi olemasolu kohta tehnoloogia-, teadus- ja tööstuspoliitika alal.

Eesti riigi kitsalt piiritletud kõrgtehnoloogiliste tegevuste (s.o biomeditsiin ja e-õpe) näitel ilmneb selge vajadus sellise sektoripõhise poliitika kujundamise võimekuse järele, mis oleks suuteline arvestama ja hindama nii vastavate sektorite arengut mõjutavate tehnoloogiate olemuslikku, arengufaasidest lähtuvat ja neid enim toetava sotsiaal-institutsionaalse raamistiku spetsiifikat kui ka riiklikku vajadust ja võimekust valitud kõrgtehnoloogiaid süstemaatiliselt riigi majandusarengu eesmärgil arendada (artiklid **II**, **III**, **IV**; toetatud artikli **VI** poolt). Nii on eelnimetatud kõrgtehnoloogiliste valdkondade arendamisel ilmnenud praegu teinegi probleem, nn “lõks tehnoloogia arengutsüklis”*,* mida iseloomustab riigi suutmatus a) sekkuda tehnoloogia arengusse kindlatel arenguetappidel, b) arvestada sektorite eripärasid, ning c) luua sidemeid teiste asjakohaste valdkondadega nende kaasajastamise ja laialdasema sünergia loomise eesmärgil (artiklid **III**, **IV**).

Eespool nimetatud vajadust konteksti- ja sektorispetsiifilise lähenemise järele kõrgtehnoloogiliste valdkondade arendamisel on omakorda oluliselt pärssinud n-ö detsentraliseeritud ja agentuuridepõhise poliitikate kujundamis- ja elluviimissüsteemi juurutamine. Seega innovatsioonipoliitika ei ole põhinenud mitte ainult EL struktuurivahenditel ja vastavatel eesmärkidel, vaid on samuti olnud tugevasti mõjutatud EL struktuuritoetuste jaotussüsteemist. Nii on KIE riikides ja Eestis agentuuride loomine innovatsioonipoliitika valdkonnas aset leidnud väga spetsiifilises võtmes: (1) luues rakendusüksusi (nagu nt Ettevõtluse Arendamise Sihtasutus), et tagada tööjaotusmehhanism innovatsioonipoliitika kujundamise ja rakendamise vahel, nii nagu see on saanud “heaks praktikaks” EL riikides innovatsioonipoliitikas üldiselt (artikkel **I**; vt ka **II**); (2) valitsusväliste organisatsioonide (nt sihtasutuste) kui Eestis arengu eest vastutavate üksuste prevaleerimise kaudu töös vaadeldavates kõrgtehnoloogilistes valdkondades. Kuigi agentuuride loomise eesmärk on tagada avalikus halduses spetsialiseeritud teadmised ja kompetents, ei ole agentuurid väitekirjas esitletud juhtumite analüüside põhjal suutnud seda teha, vaid pigem on nende tegevus päädinud võimaluse loomises vastutusest taandumisega vastavate valdkondade arengus riiklikul tasandil või on seda süsteemsel tasandil pingestanud (artiklid **III**, **IV**; samuti artikkel **VI**).

Ühelt poolt on siinjuures oluliseks mõjuteguriks innovatsioonipoliitika teadlik n-ö EL-kesksus ja teisalt agentuuride tegutsemispiirid. Kui rõhk on suunatud poliitika kujundamise ja selle elluviimise eraldamisele (mis on mõlemas aspektis omakorda kaldu EL-ile omaste trendide suunas), siis ei saa vastavatelt rakendusüksustelt eeldada konteksti ja tagasisidemehhanisme arvestava poliitika kujundamist, nagu seda üldjuhul detsentraliseeritud mehhanismilt oodatakse. Lisaks hetkel piirava tööjaotusskeemi kaotamisele eeldaks vastav süsteem samuti paindlikkust, teadlikkust ja suutlikkust reageerida ja juhtida kõrgtehnoloogial põhinevaid muutusi nii kohalikke kui ka väliskeskkonnast tulenevaid tingimusi silmas pidades. Haldussuutlikkus juhtida agentuuridel baseeruvat ja innovatsioonile suunatud initsiatiive ja projekte tuleb olulise problemaatikana esile Eesti Geenivaramu projekti näites (artikkel **III**). Tööjaotus poliitika kujundamis- ja elluviimissüsteemis, aga ka traditsiooniline vastutusejaotus poliitika kujundamisel ministeeriumide vahel (haridus- ja teadusküsimustes vs innovatsiooni- ja majandusarengu küsimustes) on omakorda põhjuseks, miks tagasisidemehhanismide puudulikkus on laienenud ka valitsuse, T&A asutuste ja ettevõtluse omavahelistesse suhetesse (artikkel **I** üldiselt; vt ka artikkel **II**).

Innovatsioonisüsteemi toimimise aspektist vaadatuna viitavad senised arengud lühiajaliselt töötavatele poliitikatele ja mehhanismidele, mille jätkusuutlikkus pikas perspektiivis ja seda eriti üleminekuühiskonna kontekstis on küsitav. Kõrgtehnoloogiliste valdkondade arendamisel toetub viimane seisukoht eelkõige Eesti biotehnoloogia sektori näitele, kus ilmnenud kitsaskohti ja võimalikku ohtu ehk n-ö “lõksu lisandväärtusahelas” iseloomustab riskimaandavate institutsionaalsete lahenduste (vastavad ärimudelid) prevaleerimine, sealjuures sektori tasandil sünergiat erinevate osapoolte vahel loomata (eriti artikkel **II**).

Johtuvalt kasutatud metodoloogiast ei saa siinse väitekirja põhjal veel teha laiemaid üldistusi erinevate riikide, tehnoloogiate ja sektorite tasemel, samuti mitte ka poliitika kujundamise mehhanismi osas. Viimase kirjeldus nii KIE riikide kui ka eraldi sektorite tasandil nõuab laiemat ja detailsemat süstemaatilist analüüsi ning jääb kindlasti edasise uurimistöö võtmesõnaks.

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Europeanization of innovation policy in Central and Eastern Europe

Margit Suurna and Rainer Kattel

This article examines how innovation policies and the respective policy-making systems in Central and Eastern Europe (CEE) have evolved since 1990 and the role that the European Union (EU) has played in these processes. We aim to show that the EU's impact on innovation policies in CEE has been highly positive in terms of reorienting economic policies generally towards more sustainable growth, and thus, Europeanization has rectified some problems inherited from the 1990s' fast and furious industrial restructuring. Europeanization itself, however, has exacerbated other problems of the 1990s and brought additional specific problems into innovation policy in CEE: firstly, an overemphasis on linear innovation and, secondly, weak administrative environment lacking policy skills for networking and long-term planning.

THE INDUSTRIAL RESTRUCTURING in Central and Eastern European (CEE) countries[1] that began in the early 1990s is seen by many in both academic and policy circles as a largely positive process. However, few would disagree that a typical industrial and service enterprise in Eastern Europe today focuses on outsourcing and foreign financing and/or ownership; has limited product range and development, both depending largely on foreign demand; has limited if any local feedback linkages and usually draws on in-house training systems rather than on respective national education systems; and has a low demand for R&D (see e.g. Radosevic, 2004, 2006; Tiits *et al*, 2008). These characteristics resulted from a quick restructuring of industrial enterprises that was made possible by economic policies in the 1990s which drew their inspiration from the Washington Consensus and were centered on the ideas of macro-economic stability and foreign direct investments, the main drivers for the fast restructuring (see also Radosevic, 2009 generally).

While during the 1990s innovation policy was considered to be secondary to transition-related concerns (Mickiewicz and Radosevic, 2001: 10), a considerable change in the innovation environment in CEE can be witnessed since the second half of the 1990s together with the looming European Union (EU) accession. This is characterized by the formation of the first strategic documents and policies related to innovation and R&D, the onslaught of a number of innovation policy measures, especially since 2004, and a rise of the respective implementation agencies (see here the INNO-Policy TrendChart country reports, available for CEE countries since 2000; INNO-Policy TrendChart, 2006, 2008). This article, descriptive in its nature, examines changes in the policy environment in the CEE countries since the 1990s and particularly during the 2000s and treats integration into the EU as a viable tool to describe and understand the contextual aspects related to these changes. Indeed, we will show that accession to the EU is probably the key variable influencing innovation policy evolution in CEE economies since the late 1990s.

Theoretical and methodological note

This article brings together two rather independent concepts: first, Europeanization and, second,

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innovation systems. The concept of innovation systems provides a necessary roof above the aspects related to different actors in innovation, innovation policy and policy-making processes and hence provides necessary structural coherence in assessing the EU's impact on innovation policy issues.

It is relatively simple to come up with a straightforward definition of innovation and innovation policy. Probably the most often used definition of innovation originates from Schumpeterian economics and is used by international organization such as the Organization for Economic Cooperation and Development (OECD) and the EU:

> An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. (OECD and Eurostat, 2005: 46; see also Schumpeter, 1939, 1954)

Innovations are often associated with fast growth in productivity that leads to strong and sustained economic growth. It is noteworthy, however, that first, innovations do not happen in a vacuum, but almost always take place as part of an interplay of various actors and relationships that interact in the production, diffusion and use of new, and economically useful, knowledge (Lundvall, 1995: 2). This multi-dimensional interplay on the one hand, but also a systemic approach to innovation on the other, have been defined as an innovation system referring to:

1. Patterns of scientific, technological and industrial specialization;
2. Organizational-institutional profiles; and
3. Structures of interactions (OECD, 1999: 23; Carlsson *et al*, 2002).

At the root of such complex interactions is a highly embedded form of policy-making of increasing co-ordination, dialogue and cooperation. Accordingly, we define innovation policy here as a set of public-sector efforts aimed at enabling the private sector to move into activities that exhibit high rates of innovations in forms of new economically useful knowledge and a high number of feedback linkages associated with such innovations and knowledge (see also Radosevic, 2009; and further Lundvall and Borrás, 2005; and Borrás, 2003, on European innovation policy). Derived from the systemic perspective on innovation processes described above and in line with research methodology used by the main innovation observatory for Europe (the INNO-Policy TrendChart), the innovation policy measures in this article cover the following aspects:

- The characteristics of the knowledge base and human resources;
- The characteristics of innovation activities together with knowledge transmission and application;
- The characteristics of demand-side issues;
- The characteristics of environment for innovation (regulatory, financial, values, etc.).

There is, however, no clear and accepted definition of the concept of Europeanization. How the term is treated and how its impact on the domestic level is analyzed depends heavily on the different perspectives of social and political science (see here for an overview of the literature e.g. Gwiazda, 2002; Sedelmeier, 2006). The overall awareness of research design in the field is estimated to be low, and thus often the research results are not comparable (see Exadaktylos and Radaelli, 2009; also Knill, 2001: 9–19). By and large, and following Börzel and Risse (2000: 4), the term Europeanization describes processes of domestic change resulting from three different aspects: policies, institutions and policy-making processes. Due to the interdependence between these aspects, where the design and implementation of general policy approaches and policy measures is highly dependent on the administrative structures and patterns of interest intermediation, the impact of these have to be estimated and seen in a systemic way as well (see here also Héritier, 2001; Knill, 2001).

Börzel and Risse (2000: 2) have made a distinction between a 'top-down' and a 'bottom-up' dimension in the concept of Europeanization. The top-down dimension emphasizes the decisive role played by the EU level; the bottom-up dimension, in turn, emphasizes context-specific developments at the member states' level. Such a distinction is highly relevant when one assesses the EU's 'transformative power' (Grabbe, 2006), which is connected to the candidate countries' ability and power to influence the content of the rules imported. Haughton (2007: 243) has brought out that the so-called 'acquis-conditionality' varies during the accession process and beyond (see also Schimmelfennig and Sedelmeier, 2004, 2005). According to Haughton (2007), the EU is the most powerful when it decides whether or not to begin accession negotiations. Also according to Bauer *et al* (2007: 418), the country's ambition to receive membership status is the decisive factor in determining the potential effects of EU policies. These observations are especially important in the framework of this article as they form a specific basis for the Europeanization processes to take place in the selected target countries. Due to the dependence on accession criteria, the fact that the extent and speed of the latest enlargement is not comparable to previous ones (Schimmelfennig and Sedelmeier, 2005: 225) leads to limited possibilities for contextual domestic specifics in the process of Europeanization as well as the limited possibilities to be involved in European-level policy-making (and hence also the limited opportunities for bargaining; see in particular Méndez *et al*, 2006), which has to be acknowledged.

Accordingly, the so-called 'bottom-up' approach carries extreme value in explaining the variations in the EU impacts, the varying responses and importance of domestic institutions against pressures from the EU, also within one country (see e.g. Olsen, 2002, and Ladrech, 1994, generally; Marginson and Sisson, 2002, and Bell, 2008, on varying implementation practices for one policy in several countries; Gwiazda, 2007, on the varying impact of the EU on different policies in one country; Dimitrova and Toshkov, 2007, on the varying practice in EU coordination structures). It was already highlighted by Ladrech in 1994 that:

> organizational logic in terms of politics and policy-making refers to those new or developing behaviors or practices inspired by the new rules and procedures emanating from the EC, together with pre-existing or unfolding national trends or tensions. (Ladrech, 1994: 72)

Thus, in trying to understand how the EU influences member-state policy-making in a given area, it is useful to look at a wide variety of factors and changes taking place within the respective policy area. The reasons why the 'bottom-up' approach offers more valuable research options could be summed up as follows.

In trying to understand how the European Union influences member-state policy-making in a given area, it is useful to look at a wide variety of factors and changes taking place within the respective policy area

First, the different modes of EU regulatory policies and hence a range of discretion given to domestic administrations in each case (see in more detail below; on the CEE perspective Bauer *et al*, 2007). Hereby, various dimensions and aspects of uncertainty related to the EU policies and their implementation, created in the accession process by the EU itself, have to be taken into account (Grabbe, 2002). On the other hand, the stage of national regulation in relation to the EU policies (pre-reform, reform, post-reform), the extent to which these fit the national social and political environment as well as the level of administrative capacity and compliance for change determine to which extent the EU policies are embraced at the local level (e.g. Olsen, 2002; Héritier, 2001; Knill, 2001; Bell, 2008). For example, it is believed that the impact of the EU on national law is stronger in relation to those states for whom specific regulative principles are relatively novel (Bell, 2008: 42).

Second, the factors characterizing the local innovation environment, such as industrial structure, product-market integration, traditions of industrial relations, company variations, etc. (see Marginson and Sisson, 2002: 673). But also the reasons why and how the EU's conditionality and the respective changes are used for and undertaken by domestic actors: whether European policies provide additional legitimization for domestic leaders to justify national reform policies, give support for solving specific domestic problems or aim to alter the domestic opposition (Knill and Lehmkuhl, 1999: 9–10; Sedelmeier, 2006: 18).

The final aspect is related to the distinction between formal change (the legal transposition of rules) and behavioral change (implementation, application and enforcement), referring in turn to the importance of alternative perspectives and informal dimensions in Europeanization literature, such as 'lesson-drawing' and 'social learning' (Sedelmeier, 2006; see also Schimmelfennig and Sedelmeier, 2005), 'policy transfer' (see Ladi, 2007; Bulmer and Padgett, 2004), and the role of informal institutions in forming but also in adapting to the institutional set-up and production processes (Borrás, 2004). In general, the aforementioned aspects imply that the adoption of EU rules can be related to processes of persuasion and learning in which EU actors socialize CEE actors rather than coerce them, referring specifically to capacity-building (Schimmelfennig and Sedelmeier, 2004: 670, 676; see also Schmidt, 2006: 678).

Although Europeanization studies are mainly oriented to assessing the extent to which the EU has a domestic impact, and second what the mediating factors are for this (lack of) impact (Sedelmeier, 2006: 8). It is also brought out that the Europeanization concept as such:

> may be less useful as an explanatory concept than as an attention-directing device and as a starting point for further exploration. (Olsen, 2002: 943)

What we do see in the literature (in general but concerning the CEE countries in particular) is the orientation to political aspects in the process of Europeanization. Some key issues that have not been thoroughly researched so far include, first, the evolution of policy-making and administrative capacities (for overall overviews in the case of innovation policy and policy-making and the respective capacities see here e.g. Radosevic, 2004; Karo and Kattel, 2010; for the general Europeanization perspective, see Knill, 2001); and, second, the behavioral adoption of the EU directives to guarantee real and not only formal adoption and implementation effectiveness (Schimmelfennig and Sedelmeier, 2005: 1-28, 226–228).

This article relies strongly on the work of Christoph Knill, who, together with several co-authors, has extensively published on linkages between different EU-level policy areas and the member-state level (Knill and Lenschow, 1998; Knill and Lehmkuhl, 1999, 2002; see also Bulmer and Radaelli, 2004). Knill has taken a policy-analytical approach, where the central role is given to regulatory measures in the policy-making process and to the national administrations in the implementation of EU regulatory policy. The overall model for assessment of the influence of the EU's regulatory policy, based on Knill and his co-authors, covers the aspects starting with the extent to which the EU can intervene in a certain area to the extent to which the respective policies/decisions are actually implemented and achieve their intended objectives (problem-solving capacity but also the appropriateness of the EU rules) at the national level (Knill and Lenschow, 2003: 5; see also Schmidt, 2002: 897–899, 2006; Gwiazda, 2002; Schimmelfennig and Sedelmeier, 2004: 670–676).

The main focus of this article is to look at the developments in innovation policy in CEE and specifically at the local contextual (read, policy and administrative) compliance with the objectives and developments taken at the EU level and through that to evaluate European policy outcomes and impacts at the local level. This article will examine what has been changing in CEE countries due to accession to the EU, what are the possible reasons for change and how the changes fit into the local domestic policy-making in one specific field, and hereby use Europeanization as an attention-driving toolbox.

We aim to show that in the innovation policy development in CEE, the EU's impact, or Europeanization, has been pervasive and significantly noticeable. While it is clear that there are significant differences among CEE countries and their respective economic and innovation performance, we propose to look at stylized facts of CEE development both in innovation policy and Europeanization. We acknowledge that this might do injustice to single country cases. We propose to look at the following secondary data and stylized facts:

1. European Commission (EC) reports on innovation policy (see PRO INNO Europe webpage <http://www.proinno-europe.eu>), EC evaluation reports and negotiation mandates on pre-structural and structural funding.
2. Stylized facts from literature and World Bank data on macro-economic and in particular innovation policy developments since the 1990s.

As time is an important variable in the Europeanization-related analyses and especially while assessing the impact of the EU on national policies (Héritier, 2001: 10), the time line in this article covers the pre-accession period, accessions in 2004 and 2007 and the first set of the post-accession (the so-called first financial programming) period: from the late 1990s to 2006 and 2007. As mentioned above, this is a period during which the EU's impact in formal terms has been the most pervasive, and hence the EU's impact on CEE countries is also arguably the most clearly detectable, which also forms the main basis for the argumentation regarding selecting CEE countries as a case study.

Stylized facts on the scientific, technological and industrial specialization of CEE economies since the early 1990s

In this section, we try to briefly describe the changes that took place in the late 1980s and especially in the 1990s in CEE innovation systems. That is, we try to see what was the state of the economy and innovation systems in CEE before the EU came into play.

At the end of the 1980s, Eastern European and former Soviet economies were generally highly industrialized, and many of these economies were seemingly on a path of industrialization and growth similar to that of the East Asian economies. According to the World Bank data, countries such as Estonia, Latvia and Hungary were ahead of Korea in the early 1980s in terms of industrial value added *per capita*. After the fall of the Berlin Wall, most CEE and other former Soviet economies saw deep dives in their growth rates and in industry as well as service-sector value added. It took more than a decade for most CEE countries to reach the growth and development levels of 1990 (see further Tiits *et al*, 2008; see also World Bank, 2006).

This happened because of the way Soviet industrial companies and industry in general were built up and run in a complex web of planning and competition. A sudden opening of the markets and the abolition of capital controls made these industrial companies extremely vulnerable. The partially extreme vertical integration that was the norm in such companies meant that if one part of the value chain ran into problems due to the rapid liberalization, it easily brought down the entire chain or complex. However, foreign companies seeking to privatize plants were almost always interested in only part of the value chain (a specific production plant, infrastructure or location), and thus privatization turned into a publicly led attrition of companies and jobs (see Frost and Weinstein, 1998; Young, 1994).

Such a drastic change made it relatively easy to actually *replace* Soviet industry: with the macro-economic stability and liberalization of markets, followed by a rapid drop in wages, many former Soviet economies became increasingly attractive as privatization targets and outsourcing of production. Indeed, one of the most fundamental characteristics of CEE industry (and services) since 1990 has been that the majority of companies have engaged in process innovation (e.g. in the form of acquisition of new machinery and mastery of production capabilities) in seeking to become more and more cost-effective in the new market place (Tiits *et al*, 2008).

Perversely mirroring the above-described cluster-like characteristic of Soviet industrial activities, the Soviet R&D system was based on a similar vertical integration of R&D into specialized institutions:

> Under socialism, most technical change was pushed from one institutional sector … which was essentially a grouping of R&D institutes and other related activities … This sector was involved in activities far beyond R&D including design, engineering and often trouble-shooting activities. (Radosevic, 1999: 282)

These institutions were usually also the originators and carriers of patents and forms of intellectual property rights (Radosevic, 1999: 285). This means that the Soviet-style R&D system had a very low level of company in-house R&D (Radosevic, 1998: 80–81). Industrial conglomerates were effectively cut off from various potential learning and feedback loops; production and actual innovation (in particular in the form of new products and processes) took place in different institutions, both, however, highly concentrated and integrated. Thus, in general the system was highly linear and supply-based.

The R&D institutes often concentrated on ‘gray’ literature (manuals and the like) and overwhelmingly on mechanical engineering, which means that mostly these R&D capacities had little if any experience with a competitive environment and the imperfect competition prevalent in technologically and innovation-driven markets. These characteristics led in transition to:

> the fast marginalization of once hyper-developed R&D; the collapse of industrial demand for R&D; changes in industry demand for R&D; polarization of the R&D spectrum; and a changing institutional landscape. (Radosevic, 1998: 84)

The former research and development institutes could have played a key role in bridging academic research with industry needs as they were essentially the only existing link between the two

Indeed, the once complex engineering, designing or similar tasks were very rapidly replaced by significantly simpler commodified support activities as many companies were wiped out, privatized or restructured. The former R&D institutes could have played a key role in bridging academic research with industry needs as they were essentially the only existing link between the two. With the collapse of the institute system, the link between academy and industry became, as Radosevic suspected in 1998, the weakest link in the CEE R&D system (1998: 90). Indeed, in:

> conditions of high uncertainty and prolonged privatization, the intangible assets and know-how of industrial institutes, primarily embodied in R&D groups, probably erodes much faster than production skills in industry. (Radosevic, 1998: 100)

The massive onslaught of foreign direct investment (FDI), in particular since the second half of the 1990s, and the privatization of enterprises gave foreign enterprises a key role in industrial restructuring and innovation. This, in turn, only reinforced the severing of linkages between former R&D institutes and the enterprise sector (see also Radosevic, 1999: 297).

In the framework of this article, it is important to emphasize the fact that the Washington Consensus policies were considered by many CEE countries as *the* implicit innovation and industrial policy measures, and in essence, there were no other policy initiatives in the 1990s. The stable macro-economic environment was deemed to engage foreign investors who would transform the domestic industry through direct replacement of previous capabilities, production units and technologies as well as through spillovers and demonstration effects. During this period, almost all economic policy-capacity-building was directed towards macro-economic competencies (at central banks, ministries of finance, also think-tanks). This was greatly helped by advice and assistance from

Washington institutions such as the World Bank and the International Monetary Fund; but also from OECD (see here Kattel and Primi, 2010). Innovation policy was considered to be secondary to transition-related concerns (Mickiewicz and Radosevic, 2001: 10). As there were no innovation policies proper, there was also essentially no institution-building. Further, derived from the economic structure and reliance on outsourcing, most CEE countries had no need and almost no experience in creating long-term policies. Policy networking, coordination and cooperation were almost completely ignored.

Thus, we can sum up the key features of CEE innovation systems before accession to the EU as follows:

- Privatization programs and other measures to attract foreign direct investments;
- Emphasis on macro-economic stability;
- Erosion and partial disintegration of the previous Soviet R&D system;
- Prevalence of macro-economic policy skills.

The impact of the EU on innovation policy in CEE

The EU played a considerable role in setting the criteria for accession to the Union and actively participated in building up capacities to meet these criteria from the early 1990s (Bruszt, 2002: 121). This is expressed in particular by the EU financial aid through the PHARE program that became the key instrument for the harmonization of CEE's legal context and also the first wave of Europeanization.

PHARE was launched in 1989 as an EU financial instrument to assist the CEE countries (initially only Hungary and Poland) in their political and economic transition from a centralized communist system to a decentralized liberal democratic system (see European Council, 1989; EC, 2005a). In its initial phase, PHARE remained a project-based financial assistance scheme: it paid for inputs rather than for results in terms of the effective adoption and implementation of the *Acquis Communautaire* (Martens, 2001: 37; Grabbe, 2006: 80–81).

The period of pre-structural funding and accession (1998–2004)

Policies: harmonization with European standards and innovation policy models

As PHARE was profoundly reformed in the 1990s, the grasp of the EU also became stronger:

1. PHARE was expanded to an additional 11 countries eligible for support; and
2. PHARE's goal as the EU's main financial instrument for support changed considerably: away from transition issues and economic restructuring towards support of the accession process (Martens, 2000, 2001; Bailey and De Propris, 2004).

As a result, since 1998, (through the accession partnerships) PHARE can be considered a legal basis for securing the transposition of the *acquis* on a deeper scale and scope (Martens, 2000: 5). In 2000, PHARE's support was extended to economic and social cohesion and institutional capacity-building (preparation for management with structural funds) (EC, 2003c).

While the EU's importance for the CEE countries' economic policies was visible already in the early 1990s, the change that increased the EU's impact considerably was the beginning of accession talks with most CEE countries in 1998 and later. The EU's impact in economic governance in CEE countries was strongly related to the compliance with single market norms in such areas as competition policy, sectoral policies and industrial standards (Grabbe, 2002: 17). Indeed, Havlik *et al* (2001) argue that the adoption of the EU *acquis* has had a much stronger impact on the modernization of CEE industry than official (often rudimentary) innovation policy in the 1990s. The introduction of new regulation (usually with significantly higher safety, health, environmental and other standards) and its implementation that often required considerable investments (see here also Havlik, 2005: 123) meant that CEE industry:

> was forced to choose whether to modernize their products and production facilities rather drastically, to subject themselves to mergers with bigger players with greater economies of scale, or to close down altogether. (Tiits *et al*, 2008: 76–77)

However, while harmonization with European standards is a distinct driver of changes in the private sector and also in many legal documents, it is important to note that such harmonization made outsourcing and relocation of production much easier. In essence, on the one hand, the harmonization process was a continuation of restructuring processes that started in the 1990s. On the other hand, through so-called pre-structural funding and its management, many CEE countries started to develop first strategic documents and policies related to innovation and R&D proper (e.g. accession partnerships, national development plans). This marks the first step in CEE towards actively managing economic policy and thus innovation and industrial restructuring in a distinctly different manner from the previous period where the free market and external forces were seen as key drivers of change.

Institution-building: start of the agency-era

In the late 1990s, due to the progressive decentralization of the PHARE management structures as well as the EU requirement for the creation of regional and local institutions to administer the EU funds after the accession, a system of implementation agencies linked to the National Funds was created and pursued in CEE (in particular local agents paid from the operational costs of the PHARE budget) (European Council, 1999; EC, 2003a; Grabbe, 2006: 82).

This decentralization, and in particular the existence of autonomous state agencies, has been seen as a positive feature in state–market relationships due to multi-level accountability (Bruszt, 2002) but also due to the ability of this kind of policy-making system to reflect and affect adequately the dynamic, global and technology-driven economy (see e.g. Goldsmith and Eggers, 2004; Goodsell, 2006). The main driver behind the engagement of agencies in policy-making is believed to be in the specific knowledge and expertise carried by these agencies (so-called ‘best of breed’ providers) (Goldsmith and Eggers, 2004: 29) but also the agencies’ ability to be more in touch with certain specific circumstances and environments (Peters and Savoie, 1994: 422), and hence also with the needs of clients (‘increased reach’) (Goldsmith and Eggers, 2004: 28, 34; on agencies generally, see Pollitt *et al*, 2001, 2004).

Although the EU and its member states were involved in shaping public institutions in CEE countries, for example, through the creation of new agencies and new coordination procedures within and between these agencies, policy transfer, etc., it rarely prescribed how to do this in terms of precise institutional solutions. (The EU’s message stayed mainly on the level of slogans calling for administrative capacity and effective implementation and enforcement; see Grabbe, 2002: 20.) Hence they somewhat followed the general perception that network-based modes of governing are seen to ‘self-organize’ (for the real practice based on the EU old member states, see Schout and Jordan, 2008: 970).

However, the compartmentalized and structured nature of EU support (EC, 2007) on the one hand, and the lack of tradition of partnership and inter-institutional coordination and cooperation between administrative levels on the other hand, meant that agencies created in some cases more difficulties and problems than they solved in CEE (ESPON, 2005). It is also important to see that these newly established agencies were mostly for managing external funding; policy creation and respective capacity-building played almost no role in these agencies. The need for implementation capacity was, however, in particular relevant in the areas where the *acquis* was not specific and well-defined and where the implementation of *acquis* needed complex and relatively well-developed public administration systems with a high degree of strategic policy-development capacities (EC, 2004a, 2007; see also Martens, 2001: 40, 2000: Annexes).

As a result, institutional reform in CEE remained formal and was not able to support the implementation and effective enforcement of the everyday policy-making system (e.g. issues such as political commitment, change management, absorption capacity) (Schimmelfennig and Sedelmeier, 2004; EC, 2007).

Policy-making: lack of attention to demand-side issues

Due to considerable time pressure — harmonizing the legal infrastructure and preparing for accession within six years — the adoption of the EU’s legal infrastructure was executed hastily and without much attention to the local context (EC, 2004a, 2007; see also Schimmelfennig and Sedelmeier, 2004; Goetz, 2001). This is deepened, at least at the beginning of the CEE countries’ accession process, by the centralization of policy-making on the domestic level — the emergence and strengthening of the EU-related ‘core executive’ in CEE (see Grabbe, 2001; Lippert *et al*, 2001; also Goetz and Meyer-Sahling, 2008). Thus, on the one hand managing EU funding is decentralized into independent agencies; on the other hand negotiations about policy contents are centralized to a ‘core executive’, that is top civil servants. This, however, created the basis for the fragmentation of the actual policies implemented, starting with the trend where policy-makers who supposedly would have been responsible for policy-learning moved to the posts in different EU organizations in Brussels (see Schimmelfennig and Sedelmeier, 2005: 227).

Indeed, insufficient support was provided to develop the adequate strategies for economic and social development and public investments in CEE and the instruments for delivering them. Consequently, the pilot investments were generally not made on the basis of proper needs assessments but were instead executed more on the basis of *ad-hoc* allocations of funding. In addition, early programs were over-ambitious, and suffered from heavy administrative procedures, delays in processing and hence from pervasive implementation-efficiency problems (EC, 2004a, 2005b, 2007; ESPON, 2005).

In addition, although economic issues have compromised a major part of the *acquis* (Havlik *et al*, 2001; EC, 2003a) and have been emphasized particularly since the 2000s, the projects in the area have focused on infrastructure investments together with little accompanying capacity-building measures and financial allocations (including innovation capacity, human-business resources, etc.) as discussed above (EC, 2004b; see also ESPON, 2005).

The period of structural funding and EU membership (since 2004)

While harmonization with the EU’s legal infrastructure was important both in terms of the actual changes it brought to industry and in terms of policy-implementation agencies that were created to manage the EU’s financial help, the key change in innovation policy proper came with EU structural

Key problems that emerged during the harmonization period (low networking, weak administrative capacity, coordination and cooperation) may in fact become deepened during the current period

funding that started in 2004. Indeed, the EU structural funding significantly changed both the policy content and the implementation. However, as we will also see below, key problems that emerged during the harmonization period (low networking, weak administrative capacity, coordination and cooperation) may in fact become deepened during the current period.

Policies: emergence of high-technology bias

The impact of the EC on the creation of innovation policies has been enormous. In some countries, EU accession triggered a very significant policy change which brought innovation policy onto the agenda very strongly.

As for similarities, it is common to all CEE countries that:

1. The normative policy documents on innovation policy were formulated very recently and to a great extent due to the EU's pressure;
2. Innovation policy plans were often short-term; and
3. The existing policy mix reflected strongly the priorities and objectives as defined in the EU programs for R&D and innovation (see here INNO-Policy TrendChart, 2006–2007).

The latter is supported by the fact that the EU accession boosted the introduction of innovation policy measures in CEE countries from 2004 onwards (generally co-financed by the structural funds) (INNO-Policy TrendChart, 2008: 29, 39). The evolution of priorities within the EU's innovation policies (from measures supporting primarily science–industry links at the beginning of the 2000s to measures targeting start-ups since 2006) (see INNO-Policy TrendChart, 2008: 29) is illustratively characterized in Figure 1.

Similarly, emerging CEE innovation policies tend to concentrate on high-technology sectors, on commercializing university research, technology parks for start-ups (Radosevic, 2002: 355; Radosevic and Reid, 2006: 297) and similar initiatives emphasizing science and technology (S&T) components in innovation policies reflecting in general the predominance of the 'linear model' thinking in the Framework Programmes and in the budget for structural funds (Tunzelmann and Nassehi, 2004: 481).

The literature on the EU's innovation policy tends to question how effective such a policy focus has been. We find arguments in the literature in general, for example in Bagchi-Sen *et al* (2004: 214) that the aforementioned model of funding start-ups and incubators in designated science parks, etc. is attractive to policy-makers because of the relative ease of

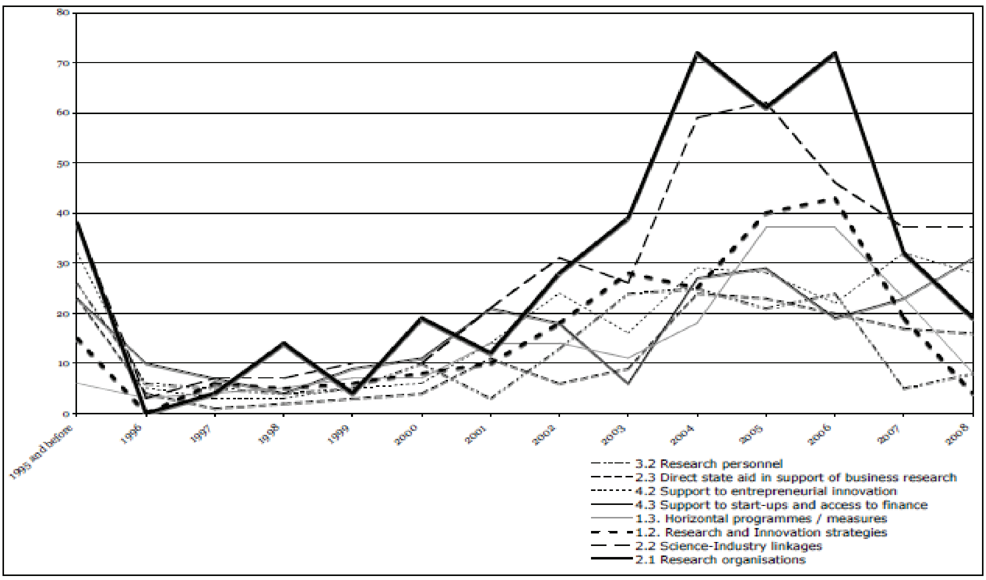

Figure 1. Evolution of measures addressing the most frequently selected innovation policy priorities (based on launch dates from the mid-1990s to mid-2008) in the EU
Source: INNO-Policy TrendChart (2008: 30)

delivery, the positive image attached to it and because of being an easier policy target than some more sophisticated taxation and regulatory policies. The same applies to the implementation of structural funds (Tunzelmann and Nassehi, 2004: 482).

The transfer of EU policies emphasizing high-technology and networking (such as S&T parks, clustering, centers of excellence, academy-industry links, etc.) did not respond to the local problems in CEE and did not resolve the main constraint, namely the lack of collective action (Radosevic, 2002: 355–356). It also did not take into account the weak state of domestic actors, especially if compared to foreign firms investing comparatively more in R&D and innovation. As a result, the emphasis was on building new institutions, which did not respond to specific local problems and, second, did not actually support the ways to overcome and surpass them (see, for an example of high technology, Lacasa, 2008; in general also Tunzelmann and Nassehi, 2004: 482).

Even further, it has been claimed that the legacy from the 'Soviet Model', favoring a linear innovation approach together with an overemphasis on science as the main source of knowledge (instead of suppliers and customers) and separation of different actors involved in the different phases of the innovation process (see Lacasa, 2008: 366),

> has given way to a new pattern dominated by FDI, resulting in the collapse of national innovation systems. (Tunzelmann and Nassehi, 2004: 482)

As a result, there was and still is a considerable gap between the performance in the development of the knowledge base and its economic usefulness (Lacasa, 2008: 371). Second, the development led by the technological progress derived from Western countries was oriented to respond to supply-side developments and not according to local needs of demand together with limited attention to local 'absorptive capacity' (Tunzelmann and Nassehi, 2004). Third, as FDI spillovers were often restricted to vertical linkages, and horizontal spillovers were absent or negative (Radosevic, 2006: 47), the reliance on FDI actually supported the concentration of high-tech manufacturing in CEE on the low value-added segment (see e.g. Radosevic and Reid, 2006; Radosevic, 2006). Finally, the changes were and often are accompanied by relatively little increase in actual funding and, as importantly, by relatively little public attention and discussion of policy strategy (Tiits *et al*, 2008).

For example, TrendChart country reports reveal that the implementation of a wide range of innovation support measures has been relying strongly on EU structural funding, resulting in the R&D and innovation policy set-up where structural funding is replacing rather than supplementing national funding in many CEE countries (see here INNO-Policy TrendChart, 2006–2007; for the current state see INNO-Policy TrendChart, 2008: 39–40). The European Commission negotiation mandates (2004–2006) also bring out a serious concern with the unreasonably high co-financing burden foreseen for the private sector (see more below on the mandates; see also INNO-Policy TrendChart, 2008: 40).

Next to concentrating on R&D as the main source of innovation, the lack of knowledge base and human resources for R&D, the insufficient cooperation between universities/research institutions and the business sector, and the unfavorable business environment together with the low capability for exploitation of existing research results have been brought out as the main challenges to innovation policy in CEE by the national correspondents and that not only at the end of the old financial period 2002–2006 but also at the beginning of the new one (2007–2013) (see here INNO-Policy TrendChart, 2006–2007; the main innovation policy trends and challenges in CEE are summarized in Appendix 1). As a matter of fact, the so-called 'capability failures' are very strongly addressed in CEE countries, while in the old member states the focus has been given to 'framework' and 'network' failures, reflecting a shift to a broader and holistic understanding of innovation drivers in their economies (INNO-Policy TrendChart, 2008: 16, 40).

One of the best ways to follow how the EC negotiated with CEE countries on the above-listed matters, and how strong its influence was, is to follow the so-called negotiating mandates (essentially communications from the EC about the accession countries' plans for how and to what ends to use the EU's structural funding). These documents are not public; thus we will quote here (Box 1) from various negotiating mandates in a way that allows for countries to remain anonymous. All quotes pertain to national development plans (NDP) for the 2004–2006 period (EC, 2003b).

These examples stem from different negotiating mandates and different countries, but it is interesting that most of them are distinctly similar in the following aspects:

1. The EC goes to great lengths to emphasize the need to manage both the creation of new knowledge (through FDI and knowledge transfer as well as through domestic industry and R&D) but also the alleviation of obvious negative effects of the rapid restructuring that took place in the 1990s (e.g. addressing regional imbalances, the need for active labor-market policies).
2. Next to providing funding for various activities that should enhance industrial upgrading, the EC stresses the need for 'functioning markets' in various areas. This development is paralleled in the way the Lisbon strategy was transformed around 2005 from a clearly Schumpeterian innovation-oriented strategic framework to very wide strategic guidelines that seek to deepen the EU's

Box 1. Examples from negotiating mandates between the EC and new member states, 2004–2006

Example 1
The Commission distinguishes three core areas of intervention:
- Business infrastructure, improvement of institutional structure for business development and improvement of facilities for technology transfer and cooperation mechanisms between research departments and industry in order to boost the innovation capacity of the private sector and to increase the added value and labour productivity;
- Active labour market policies in order to reduce the gap between (qualitative) demand and supply on the labour market and to upgrade the training infrastructure in order to adapt to demands on the labour market in a flexible way;
- Upgrading of the quality of transport, environment and other technical infrastructure.

Example 2
The description of the priorities is insufficiently selective. Formulation of objectives, priorities cover a very wide 'sector of interests' and do not define priority (preferential) needs and solutions … Therefore the EC recommends the *** authorities to seek for further reduction of priorities and prioritisation of actions.

Example 3
The current structure of Priorities does not seem to reflect the real needs of the business sector. There is e.g. very little said on the development of research environment, facilities, and infrastructure and there are only a few references to investment in research infrastructure. No clear measure is foreseen on how to establish links between R&D and Industry, though the importance of this type of relationship is stressed.

Example 4
In this regard, the NDP is effectively silent on the country's use of Foreign Direct Investment as an element of its industrial policy and makes no reference to industrial specialisation and emergence of clusters where *** may have a competitive advantage.

Example 5
One of the most prominent features in the structure of the *** economy is the wide disparity that exists in sub-regional development … The NDP does not analyse this as a separate entity, and this is needed.

Example 6:
As well as a national strategy for catching up, a comprehensive approach is needed to provide more favourable conditions for employment creation, by, for example, improving the functioning of the labour, product, and housing markets, especially in areas of high unemployment.

common market and see in the increased competition the main driver for innovation and growth (see further Reinert and Kattel, 2007).

3. The need to set up, reduce or change the development priorities according to local needs, highlighted several times in EC mandates, refers in turn to the need for long-term strategic management together with the administrative capacity to set concrete measures and manage respective financial resources. The question of administrative and absorption capacity can be seen as one of the biggest problems brought out by the EC mandates.

Thus, to sum up, while with the introduction of structural funds and through the strong influence of the EC, CEE innovation policies have significantly changed since the mid-2000s, there are also serious problems that emerged with this trend or are still emerging. The emerging innovation policies tend to be based on a rather linear understanding of innovation (from lab to market) whereas most CEE countries are specialized in low-end production activities virtually void of any research and with low demand for high skills. Indeed, one can argue that CEE emerging innovation policies copy the 'European Paradox' thinking from the older member states (on the latter, see Dosi *et al*, 2005, 2006; further on how CEE economies transfer innovation policies, see Karo and Kattel, 2010).

Institution-building: the spread of agencies

In terms of implementation, the trend initiated during the harmonization period by the creation of financial and management agencies has been intensified with the structural funds. Appendix 2 gives an overview of innovation policy management agencies (overwhelmingly charged with structural funds management and funded through the same) in CEE, which have mostly emerged in the mid-2000s.

The creation and role of innovation policy agencies is seen in very positive terms by the INNO-Policy TrendChart (2006: 65), mainly as agencies create a division of labor between ministries and agencies (policy design being the responsibility of a ministry following political decisions taken by the government, and policy implementation being dealt with by agencies). The respective current tendencies in CEE are brought out in Table 1.

However, almost all CEE innovation policy implementation problems go back to weak and disorganized actors and the fragmented policy-making system on the whole, resulting in considerable coordination problems in policy design and implementation together with insufficient policy appraisal, evaluation, monitoring and policy-learning systems (INNO-Policy TrendChart, 2006–2007; see also Radosevic, 2002: 355). There are serious obstacles in information flows while preparing and implementing national development documents:

In terms of implementation, the trend initiated during the harmonization period by the creation of financial and management agencies has been intensified with the structural funds

Table 1. Approaches to sharing responsibility for innovation policy-making in CEE countries

Country	Policy design (including coordination mechanism)	Program design	Program management	Program administration tasks
Czech Republic	There is to be a full-responsibility ministry (currently bipolar)		Shared responsibility, mainly ministries	
	Research and Development Council since 2005 (established in 2002)			
Estonia	Shared responsibility between two ministries and agencies		Full-responsibility agencies	
	Research and Development Council (initiated in 1990) together with two sub-commissions			
Hungary	Shared responsibility – involvement of high-level councils and agencies, dominant Ministry of Economy and Transport and the National Office for Research and Technology		Full-responsibility agencies	
	Science and Technology Council (headed by Prime Minister) since 1999			
Latvia	Full responsibility of ministries (two) Since 2005, also the Ministry of Regional Development and Local Government		Shared responsibility	Full-responsibility agency
	National Development Council headed by Prime Minister (established in 2007). The previous Innovation Program Steering Council for 2003–2006 did not work in reality.			
Lithuania	Full responsibility of ministries (mainly two)			Full-responsibility agency (in the area of the Ministry of Science and Education, the division of labor is unclear)
	Science, Technology and Innovation Commission since 2002 (renamed 2005)			
Poland	Full responsibility of several ministries (Ministry of Science and Higher Education, Ministry of National Education, Ministry of Economy, Ministry of Regional Development)		Shared responsibility, changes towards decentralized system very recent	
	High-level Science and Innovation Council intended to be established			
Slovakia	Shared responsibility, with a strong responsibility for the Ministry of Economy and its agencies		Shared responsibility, especially on the part of the Ministry of Education	
	No national innovation council; Slovak Government Council for Science and Technology (restructured in 1999)			
Slovenia	Shared responsibility, between several ministries together with the Office of the Government for Growth		Full-responsibility agency	
	National Science and Technology Council premier policy body for S&T policy (changed 2002)			
	National Innovation Centre (2006)			
Bulgaria	Full responsibility of two ministries		Shared responsibility, especially on the part of the Ministry of Education, which directly operates the National Science Fund (2003)	
	National Council on Innovations, National Council for Scientific Research – no formal mechanisms for coordination between the two institutions			
Romania	Shared responsibility, key role for the Ministry of Education and Research together with its agencies			
	National Council for Science and Technology headed by the Prime Minister, since 2002			

Source: based on INNO-Policy TrendChart (2006–2007); also TrendChart Policy Workshop, 2006: 9–10, Appendix A–B, Country Briefings for TrendChart Policy Workshop 2006

1. On the ministerial level, due to which complementarities between different measures and priorities but also operational programs are weak and do not create synergies as expected;
2. Concerning the partnership principle, it is not clear how the other social partners have participated in the elaboration of the development plans, what has been the scale of their comments and, more importantly, how they have been involved in the implementation (see here EC negotiation mandates [2004–2006], EC, 2003b). Most problems in the innovation policy-making system in CEE are also summarized in Appendix 3.

On the one hand, many of these problems reflect the separation of policy responsibility between education/science and innovation/industry on the ministerial level and its delivery system (see also Nauwelaers and Reid, 2002: 365). On the other hand, this kind of fragmented policy-making system refers to the lack of inter-linking and cooperation between different innovation-related activities and actors such as research organizations, government and industry.

We have shown that the importance given to innovation policy, the respective tools and organizational system have changed considerably in the CEE countries when the 1990s and the 2000s are compared

Policy-making: fragmentation and market-rationale

Due to its emphasis on efficiency, the innovation-policy implementation model relying on agencies favors the outsourcing of program management and is generally highly market-friendly as signals from the market are believed to be the best policy guide (see INNO-Policy TrendChart, 2006: 65–66). However, many CEE countries saw their economies massively restructured in the 1990s, which resulted, as we saw above, in an economic structure oriented towards outsourcing and low value-added activities or sectors where networking and linkages are naturally very low. Indeed, under circumstances where the global environment employs outsourcing to enforce de-agglomeration effects upon such economic structures and where macro-economic competencies have been a priority throughout the previous decade, most CEE countries have almost no experience in creating long-term policy frameworks that deal with networking, sectoral upgrading and so on. Thus, it is clear why the EC went to such great lengths to influence what the CEE countries do with the EU structural funding.

It is, however, also clear that to create implementation agencies in such a situation is bound to complicate the problems. Indeed, agentification in such circumstances is unable to foster networking practices but rather may cause severe problems in policy design and implementation as agencies are by definition at arm's length to government offices. Such proclivities tend to cause instability in a system as a side effect (see here case studies in the old member states by Pollitt *et al*, 2004). That is why the issue of agentification, in particular in innovation policy, has been heavily raised by the OECD in one of its latest reports (2005). Besides fragmented policy coordination, together with goal congruence, contorted oversight, communication meltdown, capacity shortages and relation instability (for the most fundamental overview in these issues, see OECD, 2005), the delegation of public authority may be seen as a means of shifting the responsibility away from the government, and hence causing severe accountability problems.

By the creation of innovation policy implementation agencies (for structural funding and beyond), the innovation policy landscape has been fragmented, and previous problems in policy creation (lack of strategic skills and capacity, networking and coordination non-existent) and implementation (competitive grant-based programming that relies on market signals without being able to follow set priorities and goals) may be deepened. Due to this kind of fragmented innovation policy-making system where, in addition, ministries and agencies do not enjoy the respect of stakeholders to the extent that TEKES, VINNOVA or NESTA do, the weak and low-quality administrative capacity inherited from the past, together with a certain lack of trust-based relationships forming the underlying core in the innovation 'climate' (see Chaminade and Edquist, 2006), are the challenges for innovation governance in the majority of CEE countries which have remained crucial also today (see here INNO-Policy TrendChart, 2008: 52).

Thus, we can sum up the influence of the EU upon CEE innovation systems as follows:

- A much more active role of the state in structural and innovation policies;
- Increasing fragmentation of the policy arena through implementation agencies that results in strong coordination problems;
- Growing mismatch between R&D system, high-tech biased innovation policy and actual industry needs.

Conclusion

We have shown that the importance given to innovation policy, the respective tools and organizational system have changed considerably in the CEE countries when the 1990s and the 2000s are compared. In order to understand the changes in the policy substance and environment in the CEE countries, a parallel to the integration process into the EU was drawn that served in this article as an important tool to provide the necessary contextual background information. As becomes clear from the analysis, the EU's role in the formation of innovation policies and the related structures in CEE has been significant.

The influence of the EU can be seen to emerge during the accession talks in the form of harmonizing the legal infrastructure together with pre-structural funding and its management. As a result, a considerable push was given to the formation of first long-term strategic documents and policies related to innovation and R&D — for example, accession partnerships, national development plans — in many CEE countries. The accession into the EU further boosted the introduction of innovation policy measures from 2004 onwards (generally co-financed by the structural funds), the concentration of which, however, was and still is often oriented towards high-technology sectors and towards initiatives emphasizing science and business cooperation, reflecting in this way a considerable convergence to the general goals prevalent in the EU Framework Programmes and in the budget for the EU structural funds.

Further, since joining the EU in 2004 and 2007 respectively, and during the accession talks already, there has been a strong change, which was almost not discussed publicly at all, in economic and particularly in innovation policies in many CEE countries towards a more active role of the state. This change entails a clear and strong role of the EU's structural funding for CEE countries, particularly in the negotiations and planning that comes with it. The impact of the EU in the creation of these policies has been equally, if not substantially more, strong and visible, as the EU had the means (funding) and tools (e.g. the EC comments on the CEE countries plans how and for what to use structural funding) to demand rather specific changes in policy plans (not only in innovation policies). Further, the EU-provided assistance in the form of structural funds formed the basis for creating the first innovation-policy implementation agencies, starting with decentralization of the PHARE management structures but later usually serving for administering the EU structural funds.

However, it has to be acknowledged here that the EU's discretionary power to affect CEE countries is bound (through autonomy of politics at the domestic level, lack of sanctions, etc.), and accordingly its role cannot be considered a universal and complete factor for explaining the changes in the innovation area in the CEE countries.

The Europeanization of innovation policies has not been sufficient to tackle the problems of policy and administrative compliance at the local level; as a result, innovation policies in the CEE are often poorly tailored to local circumstances and implemented in a way that only exasperates the situation. As we show in the article, many of these issues have been highlighted in the EU strategic overviews since the very beginning, starting with the reviews on the implementation of the PHARE program, but remain crucial and unresolved until today.

Based on the analysis in this article, it can be argued that the Europeanization of innovation policies has come with specific problems: first, there is an over-emphasis in emerging CEE innovation policies on linear innovation (from lab to market) that is based on the assumption that there is a growing demand from industry for R&D (which is not the case because of the structural changes that took place in the 1990s), and, second, the increasing usage of independent agencies in an already weak administrative capacity environment lacking policy skills for networking and long-term planning.

As the evaluation of the innovation governance system was beyond the scope of this article, this paper serves as an important research area for the future (e.g. what is the impact of agencies on CEE innovation policy effectiveness?). Based on the description and analysis provided in this article, but also taking into account the overall functioning of implementation agencies in the CEE innovation policy arena (competitive grant-based programming that relies on market signals without being able to follow set priorities and goals), it may be assumed that in its implementation, the Europeanization of innovation policy in CEE, while highly positive in directing CEE to reorient economic policies towards more sustainable growth, potentially deepens and exasperates the existing problems of networking, clustering and coordination.

Appendix 1. Overview of main challenges and weaknesses of innovation policy in CEE

Country	Main challenges and weaknesses of innovation policy in CEE at the end of the old financial period (2002–2006) and for the beginning of the new one (2007–2013)
Czech Republic	1. Emphasis on research as the main source of innovation 2. Insufficient human resources for R&D 3. Insufficient cooperation between universities/research institutions and the business sector 4. Insufficient extent and unsuitable mechanism for financing innovation in business entrepreneurship 5. Low patenting activity/low commercialization of research results
Estonia	1. Concentration on R&D 2. Renewal of the knowledge base, including improvement of research quality 3. Reliance on EU structural funds 4. Need for specialization of technology development 5. Insufficient emphasis on upgrading of traditional industries and their competitiveness 6. A business environment not favorable enough to establish and develop firms with high growth potential
Hungary	1. A large number of policy measures to foster RTDI activities 2. Potential shortage of human resources for R&D and innovation 3. Low occurrence of co-operation in innovation activities 4. Low share of innovative firms in general and innovative SMEs in particular

(*continued*)

Appendix 1 (*continued*)

Country	Main challenges and weaknesses of innovation policy in CEE at the end of the old financial period (2002–2006) and for the beginning of the new one (2007–2013)
Latvia	1. Need for an increasing number of science and engineering graduates 2. Weak cooperation between the stakeholders 3. Need for increasing business R&D and innovation expenditure 4. Need for enhancing the innovative activity of SMEs 5. Need for more effective exploitation of existing research results 6. Lack of additional government funding for R&D 7. Uneven distribution of R&D funding in the regions
Lithuania	1. NIS seen in a narrow sense, promoting R&D-intensive innovations in high-tech sectors 2. Innovation policy adopted from Western models and not completely relevant to the current industry structure (low value added, traditional sectors dominating) 3. Need for improving skills for innovation and entrepreneurial attitudes 4. Need for building R&D capabilities in firms and development of sound R&D base 5. Insufficient R&D expenditures and outputs 6. Need for the development of knowledge-intensive clusters across public-knowledge poles 7. Lack of venture capital schemes for new business and new technology-based business
Poland	1. Innovation still low on the political agenda 2. Need for improving the quality of human resources (the number of young people entering science, engineering and technology careers) 3. Need for stronger links between science and the industry sector 4. Need for business networking and clustering activities in sectors and areas with innovation potential 5. Need to boost RTDI potential of SMEs 6. Lack of regulation about commercialization policies in the higher education institutions
Slovakia	1. Most innovation policies overlap with S&T policies 2. Most activities are concerned with knowledge production rather than with implementation and commercial use of innovation 3. Lacking human resources for the R&D system 4. Weak ties between the industry and academia sectors 5. Insufficient links between the education system and labor market needs 6. Low competitiveness of domestic enterprises 7. Low shares of innovating enterprises in the industry 8. Low R&D spending 9. Very low levels of commercialization of R&D activities 10. Underdeveloped innovation culture
Slovenia	1. Need for the development of human resources to support innovation activity 2. Better exploitation of R&D inputs and closer links between public R&D and the business sector 3. Lack of coordination and measures focused on the promotion of innovation and entrepreneurship between different organizations 4. Insufficient attention on the low absorption capacity of current innovation support schemes in the business sector, especially small enterprises 5. Stagnation in ICT expenditures
Bulgaria	1. Low level of employment in high-tech manufacturing 2. Low level of R&D expenditures 3. Insufficient cooperation between universities and business 4. Low level of business expenditures on R&D 5. Private innovation structure underdeveloped, dominated by the public sector 6. Low commercialization of research base 7. Low level of value added by high-tech manufacturing 8. Low competitiveness of enterprises due to low level of innovativeness 9. Not enough measures addressing the development of the innovation infrastructure and support services 10. No venture capital schemes
Romania	1. Need to increase international visibility of the Romanian S&T community 2. Low public and private R&D expenditure 3. Poor correlation between RDI-project portfolios and business needs, leading to low co-funding from economic agents and applicability of results 4. Need to improve industry-university-R&D institutions partnerships 5. Need to improve innovation and business-support infrastructure (business incubators, technology-transfer offices, S&T parks, etc.) 6. Early development stage of technology transfer and innovation infrastructure and diffusion mechanisms 7. Increase business R&D expenditure and strengthen the innovative potential of SMEs 8. Low patenting of research results

Appendix 2. Overview of governmental agencies in innovation policy design and implementation in CEE

Function	Governmental agency (year of foundation)				
	Czech Republic	**Estonia**	**Hungary**	**Latvia**	**Lithuania**
Business development, including SMEs	• CzechInvest Agency (1992) – FDI + *** • Czech Trade Agency (1997) • Czech Industry Agency (2000; 2004 merger into CzechInvest Agency) • Agency for Business Development (1990s; 2004 merger into CzechInvest Agency) (oriented on SMEs)*	• Enterprise Estonia (2000, grown out from previous ESTAG and Innovation Foundation – 1990) (previously oriented on SMEs)*** • KREDEX (2001) • Development Fund (2006)	• Hungarian Foundation for Enterprise Promotion (1990) (SMEs) • Hungarian Economy Development Centre (2006; grown out from Hungarian Development Bank – one-stop-shop office for SMEs (2001))** • National Development Agency (2006; formerly National Development Office (2004)) (responsible for NDPs)**	• Latvian Agency for the Development of SMEs (initiative of 1997 and early 2000s) • Latvian Investment and Development Agency (2003; formerly Latvian Development Agency (1993)) – FDI + ** • Latvian Guarantee Agency (2003) (SMEs)	• Central Project Management Agency (1996)*** • SME Development Agency (SMEDA) (1996)* • CSC Investment and Business Guarantees (INVEGA) (2001) • Lithuanian Development Agency (2002)* • Lithuanian Business Support Agency (2003)*** • Lithuanian Environmental Investment Fund (LEIF) (2004) • National Regional Development Agency
Research and education and technological innovation	• Academy of Sciences (1992) • Grant Agency (1993) • National Education Fund • Technology Agency (2008) (interface between research & industry)	• Archimedes Foundation (1997)*** • Foundation Innove (2003)** • Estonian Science Foundation (1990)	• Hungarian Scientific Research Fund (1991) • Agency for Research Fund Management and Research Exploitation (2003)**	• Latvian Academy of Sciences (1997)	• Lithuanian Academy of Sciences (1991) • Lithuanian State Science and Studies Foundation (1993) • Agency for International S&T Development Programs (2002/1999) • Lithuanian Fund of Human Resources (2003)**
	Poland	**Slovakia**	**Slovenia**	**Bulgaria**	**Romania**
Business development, including SMEs	• Industrial Development Agency (1991) • Agency for the Restructuring and Modernisation of Agriculture (1994)* • Polish Agency for Enterprise Development (1995; reorganized in 2000) (orientated also on SMEs)*** • Foundation for Innovation, Restructuring and Entrepreneurship (2002) • Foundation Innovation Centre (2002) (start-ups)* • Polish Information and Foreign Investment Agency (2003; formerly State Foreign Investment Agency (1992) and Polish Information Agency (1991)) • Agency for Regional Development, Technology Agency, Privatisation Agency (all closed in 2002)	• Slovak Guarantee and Development Bank (1991) • National Agency for the Development of Small and Medium Enterprises (NADSME) (1993)*** • Innovation Fund (non-investment semi-private fund) (1997) • Slovak Investment and Trade Development Agency (SARIO) (2001) – FDI + *** • Slovak Innovation and Energy Agency (SIEA) (1999; since 2007 goal to become a national innovation agency)**	• Slovenian Enterprise Fund (1996) (orientation on SMEs) national funds + ** • Slovenian Innovation Agency (proposed in 1999, never implemented)* • National Innovation Centre (2006) • National Agency for Entrepreneurship and Foreign Investment (JAPTI) (2006; former Public Agency for Entrepreneur-ship, Foreign Investments and the Slovenian Agency for Trade and Investment Promotion) • National Agency for Regional Development	• Innovation Relay Centre (1997) • Information Technology and Communications State Agency (2003) • Bulgarian Small and Medium-sized Enterprises Promotion Agency (2004)*** • PHARE Implementing Agency (2004)* • National Innovation Fund (2005)	• Romanian Development Bank (a joint venture commercial bank, together with state ownership fund (1998)) • The National Centre for Program Management (2002/2004) • Romanian Agency for Foreign Investment (2003) – FDI • National Regulatory Authority for Communications and Information Technology*

(*continued*)

Appendix 2 (*continued*)

Function	**Governmental agency (year of foundation)**				
	Poland	**Slovakia**	**Slovenia**	**Bulgaria**	**Romania**
Research and education and technological innovation	• Foundation for Polish Science (1991) • Polish Academy of Sciences (1997) • National R&D Center (2007)	• Slovak Academy of Science • Center for Advancement, Science and Technology (1991) • Scientific VEGA Grant Agency (1996) • Research and Development Agency (2001)	• Academy of Arts and Sciences (1994) • Slovenian Technology Agency (TIA) (2002; active since 2007) (interface between research and industry) • Slovenian Research Agency (2002; active since 2004)	• Bulgarian Academy of Sciences (1991) • Applied Research and Communication Fund (1991) • National Fund for Scientific Research (2003)	• Romanian Academy (1990) • National Authority for Scientific Research (2005; formerly National Agency for Science, Technology and Innovation (1998)) • The Executive Unit for Funding Academic Research

Source: Based on INNO-Policy TrendChart (2006–2007); in some cases (to specify facts) reports for earlier years have been used
Notes: * Responsible for management of PHARE
** Responsible for management of EU structural funds
*** Responsible for both: management of PHARE and EU structural funds

Appendix 3. Overview of main challenges and weaknesses of the innovation policy-making system in CEE

Country	**Main challenges and weaknesses of innovation policy-making in CEE at the end of the old financial period (2002–2006) and for the beginning of the new one (2007–2013)**
Czech Republic	1. Public administration of R&D and innovation not effective 2. Public support for R&D and innovation extremely fragmented
Estonia	1. Coordination between different documents and programs rather good 2. Coordination between the Ministry of Economic Affairs and Communications, the Ministry of Education and Research and especially the Ministry of Finance complicated – all parties driven by their own visions of R&D, innovation development and support 3. Structural funds implemented with a considerable delay due to complicated administrative procedures – most measures of the period 2004–2006 are implemented in 2006–2008
Hungary	1. Policy co-ordination mechanism fragmented in practice, and at best takes place bilaterally (e.g. between the Ministry of Economy and Transport and the National Office for Research and Technology) 2. Lack of co-ordination among major policies 3. A large number of policy measures to foster RTDI activities; the implementation of those rather poor 4. Policy schemes changed too frequently and/or the same objectives supported by several schemes 5. Policy-making processes not sufficiently transparent – lack of systematic, thorough dialogues with stakeholders and experts 6. Modern policy-making methods – technology foresight, technology assessment, evaluation – rarely used 7. Systematic international comparative policy analysis not used
Latvia	1. Innovation policy issues divided between two different ministries (Ministry of Economics, Ministry of Education and Science) 2. Lack of inclusion of innovation-specific cross-cutting themes in policy documents of other policy areas 3. Weak cooperation between stakeholders and the effect of a prime body charged with the task of coordinating innovation policy rather limited – lack of strong and determined leadership 4. Lack of mechanisms for appraising the impact of policy 5. Many innovation policy measures have been terminated as they expire 6. Uneven absorption of R&D funding in the regions
Lithuania	1. Limited administrative capacity for policy design 2. Implementation of policies focused more on institutional and regulatory framework creation, without paying much attention to the development of human resources and competencies needed for successful innovative activities and encouragement of knowledge flows between various actors of innovation policy 3. Weak institutional mechanisms to encourage links between R&D and business sector 4. Non-existing innovation policy appraisal and evaluation system 5. Insufficient international policy-learning and cooperation, especially in designing bilateral programs and implementation schemes
Poland	1. Need for improvement in innovation governance 2. Strategic intelligence for policy-making not considered a priority 3. Intermediary organizations' offer of services is under-developed 4. Local and regional authorities not experienced in managing innovative projects

(*continued*)

Appendix 3 (*continued*)

Country	Main challenges and weaknesses of innovation policy-making in CEE at the end of the old financial period (2002–2006) and for the beginning of the new one (2007–2013)
Slovakia	1. NIS remains fragmented and consists of a number of government, private and non-profit organizations 2. Innovation activities initiated by the Ministry of Economy and the Ministry of Education not coordinated 3. Bulk of government spending is no longer allocated to particular ministries but to specific programs – agencies in charge of their implementation 4. Underdeveloped assessment of impacts by innovations
Slovenia	1. Lack of an overall innovation policy framework that shows a clear division of labor between different ministries and agencies (with a rather complex new organizational scheme of R&D and innovation policy, as well as new measures designed by each ministry and each agency) 2. Each of the past elections brought forward new ideas on how to best organize the government in order to be more supportive to STI 3. Lack of coordination and measures focused on the promotion of innovation and entrepreneurship between different organizations 4. Coordination of innovation policies depended more on personal relationships between senior officers (or ministers) than on the bodies introduced for the purpose 5. Low rate of implementation of government innovation policies 6. Lack of a systematic evaluation of innovation policy and specific regulations
Bulgaria	1. Decision-making process not effective 2. Lack of attention to strategic planning 3. Lack of horizontal coordination at the central level 4. Lack of coordination between the government, universities and businesses 5. Involvement of stakeholders is rather formal
Romania	1. Deficiencies at the decision-making level (weak program monitoring and communication between program managers, weak information system, excessive bureaucracy, etc.) 2. Deficiencies in the RDI program management (poor communication flows between evaluators and program managers, etc.) 3. Lack of a generalized system of policy evaluation

Source: Based on INNO-Policy TrendChart (2006–2007)

Note

1. In the context of this article, Central and Eastern European countries are the following 10 most recent member states of the EU: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.

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Article II

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Case Study

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ABSTRACT In light of the current debate on the validation of the prevalent business models and trends taking place in the field of biotechnology in developed countries (see here in particular Pisano versus Glick), it is relevant to explore whether, and if so in which form and circumstances, the set arguments hold up and could be complemented by the context prevalent in transition countries. As one of the main concerns for the long-term development in the area relies on Pisano's argument that the sector is moving towards greater fragmentation, the deep analysis of that becomes particularly important in an environment where the very same problems are somewhat rooted in the local policymaking context and business environment. A specific example can be drawn here from the Central and Eastern European countries (CEE). Derived from this, the aim of the current article is to trace the trends in biotechnology business models in one of the rather well-performing CEE countries: Estonia. The article argues that the developments in the business models in Estonia are led by two rather contrary directions, where on the one hand increasing specialization and fragmentation and on the other hand movements towards geographical and institutional convergence can be detected.
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INTRODUCTION

Modern biotechnology has been considered a driving force for economic development in many national research and development and innovation strategies. At the same time,

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technological innovation alone does not guarantee business success, but has to be matched with an appropriate business model (defined in this article as a conceptual framework bringing together the organizational and financial 'architecture' of a business).[1] Together with the biotechnology sector, a novel organizational form of entrepreneurial firms deeply immersed in science has emerged, the so-called science-based business.[2] In a paradoxical way, though the emphasis on the business model as such has attained increasing attention, the concept itself lacks a clear theoretical grounding in economics or business studies,[1] in turn raising questions about varying signs coming from theoretical literature about the current state and about the appropriateness of the prevalent business models to capture the value of innovations in the field of biotechnology.

Looking at the international trends in the field, statements for appraising them are rather contradictory. On the one hand, it is believed (Pisano and Hopkins *et al* in particular) that the biotechnology sector is still in its early experimentation phase, with a rather disappointing performance of the sector. This means that contrary to the extremely high and fundamental expectations towards the area, the real implementation taking place has been more difficult, costly and time-consuming than hoped.[2–4]

The main aspect of Pisano's argumentation is derived from the concern for the long-term sustainability of the biotechnology industry, where the central importance is given to long-term and deep relationships between the companies (and even vertical integration)[2,3,5] and to the design of science-based businesses able to manage long-term risky investments and support integration across bodies of knowledge and cumulative learning over time.[6] The current tendencies in the trends of the business models are contrary to the ones suggested: prevalence is increasingly given to lower-risk and faster-payback models such as licensing existing projects and products from other companies and then refining them and so on.[2,7] On the one hand, these kinds of development allow better risk and portfolio management;[4] on the other hand, they enable biotechnology companies to implement strategies for achieving revenues before achieving product sales.[7] Owing to that, however, the biotechnology sector appears to be retreating from its position at the radical and risky end of the R&D spectrum and, second, is moving towards specialization and fragmentation, supported by the creation of new firms, backward movements in vertical integration, a market for know-how and the 'monetization of intellectual property'.[2,4]

This kind of development does not support cross-disciplinary research and linkages between newer and older technologies, learning above the level of individual organizations, the accumulation of tacit knowledge and closer long-term collaboration and vertical integration, which lies at the core of Pisano's argument. The latter is also important in the light of the work by Hopkins *et al*, according to whom the development of the biotechnology sector and the respective impact on economic development has not been as revolutionary as supposed – it has complemented rather than substituted the older traditional technologies and techniques.[4] As a result, the biotechnology-related context has been growing in size and become more complex with time, supported in turn by its reliance on cross-cutting disciplines on the level of basic science and applications within many different domains.[2,8]

On the other hand, there are statements aimed at proving the financial success taking place in the area. One of the best overview of this can be found in an article by Glick[7] intended to counter Pisano's arguments regarding the usage of misleading business models in the field of biotechnology together with wrong inferences on the role of science in it and the specifics of science in the field of biotechnology, then compared to, for example information and communication technology.[2,3,5] Glick argues that the business models relying on disintegration and (strategic) alliances have enabled both pharmaceutical and biotechnology companies to enjoy commercial success faster and to a more far-reaching extent, meaning in turn that the biotechnology-industry structure is not flawed, and that there is no need for fundamental change in the near future. According to him, there has been a considerable change in the groupings comprising the 10 largest biopharmaceutical companies over the 15-year period between 1990 and 2005, from one 5-year period to the next. He elaborates that … *the number of younger companies (incorporated in 1985 or later) among the top ten grew from two to four to five … . And … the percentage of profitable companies in 1990, 1995, 2000, and 2005 were 30, 40, 60, and 70 per cent respectively*.[7] His argumentation is confirmed by the recent information about the US biotechnology industry, which in 2008 arguably reached aggregate profitability for the first time in its 42 years of history (about 0.4 US$ billion in net profits).[9]

The increasing usage of external knowledge and technologies at the entrepreneurial level also forms the basic core of the latest leading theoretical concept of 'open innovation'.[10,11] In a paradoxical way, especially when considering that the name of the theoretical approach implies open knowledge flows, the respective subsequent theories provide a particular emphasis on knowledge embeddedness in different networks, also from the regional perspective, thus setting considerable limits for knowledge flows and purposes for which different knowledge flows can be used.[12–14] This implies that the pure commercialization of a new technology as such should be treated with certain caution, and rather that it should be asked how much real value this can produce and for whom.[15] Further, there are a number of cases where negative effects from the excessive prevalence of private ownership (including the negative effect from over-patenting in the area of biotechnology and pharmaceuticals) can be detected already, in other words problems derived from the creation of so-called 'gridlock economies'.[16,17]

The issue of the arising business models in high-technology areas is particularly relevant and challenging in Central and Eastern European (CEE) countries.[18] The CEE countries have given increasing emphasis to high technology and especially biotechnology in their innovation policy strategies. At the same time, there is a threat that biotechnology, like many other high-technology industries in CEE, is rather concentrating on the low-value-added segment and serving the rest of the West as a popular outsourcing destination[19] (see for general developments the works by Radosevic).[20] Although there are a number of surveys mapping different biotechnology-related policies and their implementation schemes in CEE,[21–23] there is still limited knowledge about the situation in the business sector and the most prevalent trends in business models for biotechnology in CEE (for the overall overview in these issues, see the report by EuropaBio and Venture Valuation in 2009),[19] which could complement the information available for the international arena. The CEE-specific approach is also valuable and justified in the light of the recent studies, according to which the approach of country-specific case-study analysis has shown much of the context specifics in possibilities for the developments in the field.[24] As a case study, one of the rather well-performing CEE countries, Estonia, has been selected.

Derived from this, the aim of the current article is to use Estonia as a case study to examine what the most prevalent business models are in the field of biotechnology in CEE countries, to which extent these can be 'aligned' with international industry trends and business models and to which extent they are affected by the CEE-specific local and policy factors, and what the conditions are that the current tendencies set for the future developments in the selected region.

PISANO'S PARADOX IN THE CONTEXT OF TRANSITION COUNTRIES

The theoretical framework for the article is based on the one developed by Pisano, one of the key theorists in the area. As biotechnology is deeply rooted and dependent on the state of scientific knowledge, and hence is highly uncertain, full of risks and with deep learning curves, it creates a very specific set of so-called 'functional requirements' for the business models in the area and for the institutional settings of the whole sector – the so-called 'anatomy of the sector'.[2]

The essence in Pisano's argumentation is driven by the notion that innovation does not occur in a vacuum, but relies to a great extent on inter-organizational relations. These relationships play a crucial role in meeting the participants' needs in terms of the availability of cutting-edge science and strong inside R&D capabilities, which are all important presumptions to cope with innovative activities and to reduce risks.[2,25] The other aspect is related to the essence of the biotechnology sector and its fusion with different industrial spheres, which assumes the functionality, competitiveness and regularity of these industrial fields and also the respective partnership schemes to be in place.[8,26] The importance of relationships between different actors of the field has also received a rather large amount of attention at the scholarly level (see here for an overview, *The Introduction in Research Policy* of 2007),[27] including the issues such as the nature of strategic alliances prevalent in the area,[7,28] the importance of R&D institutions,[29–32] the importance of contacts at the personal level and networks[33,34] and so on.

The biotechnology industry is not characterized by specific business models, and neither is there one single model for success. The business models prevailing in the area vary in focus and change over time. This in turn implies the need for continuous adaptation processes to manage changing internal and external conditions but also for continuous experimentation,[2,3,35] making the latter especially crucial in the situation where the balance between science and business orientations but also between different actors in the business models is still to be found in order to make it possible for successful performance to be enjoyed by the whole sector.[36] This in turn makes cumulative experience-based managerial knowledge an important precondition for the development.[37,38]

Next to the sectoral specifics and company-level drivers, the development of the biotechnology sector is highly dependent on the existing socio-economic background. Although the international forces affecting the local context are highlighted now more than ever before, it still cannot be ignored that the change taking place is always embedded in the system and hence is affected by the rules and patterns of the system.[39] The institutional arrangements that affect activities of enterprises but also the interaction between different actors of the field compromise the third layer of Pisano's model and refer in particular to the importance of public policy. According to him, interactions are shaped by the institutional environment together with rules and regulations (for example, intellectual property rights, FDA regulations, price regulations and reimbursement policies).[2] Although Glick has highlighted the dependence of the biotechnology field on extensive governmental regulations, he has not gone deeper into the policymaking level and the respective impact on the industry, contrary to Pisano, who has given to public policy and its impact a more focused role. In the literature also other, and more general, factors have been highlighted, such as social and political culture and specific technological, entrepreneurial or scientific patterns, in which innovation processes are embedded.[39–44]

The former raises questions about the possible effects that public policy and regulations may have on the biotechnology business models. One of the most crucial issues both in the area of biotechnology and in the trends of business models in general is related to protective barriers of innovations (and legal forms of these in particular) *in order to afford the innovator a bigger 'slice' of the pie*.[45] At the theoretical level, the aforementioned trend is reflected most of all in the rise of the 'open innovation' concept (originally from Chesbrough),[10] providing a way for management strategies to use external technologies and knowledge flows to their advantage and hence innovation processes above single enterprise boundaries (including more delicate intellectual property management, peer production, commons-based strategies and so on).[46]

According to Pisano, the problem here is the flawed understanding at the academic level and also in practice that the 'openness' in these collaborative innovation forms is often treated only as 'flatness'.[47] This kind of understanding does not take into consideration that the protection of in-house R&D through the use of intellectual property, and its 'monetization' may actually restrain information flows on scientific discoveries and the accumulation of tacit knowledge,[2,5] and, owing to the specific nature of the biotechnology, may lead to the other restriction, namely the availability of well-defined intellectual property rights.[5,48] Although both Pisano and the concept of 'open innovation' complement the issue of how the external environment (state support schemes, venture capital and so on) affects the evolution of the biotechnology sector and in particular the management schemes at the entrepreneurial level, and consequently the over-patenting that has come along with it (for the trends and barriers related to the 'open innovation', see above), it has to be kept in mind that 'open innovation' is derived from and concentrated at the micro level, meaning that the concept is not to give answers to how the development of biotechnology could support the overall socio-economic development. On the one hand, patenting and the protection of technological progress has been undervalued so far and this is mainly because of the lack of respective management skills and resources but also awareness; on the other hand, however, patenting should not be the purpose in itself: the number of patents alone gives only a limited picture of innovative activities.[17]

From the perspective of catching-up and transition countries, it is of utmost importance to highlight the relevance that the presumption of an 'open innovation' has for a certain level of technological development, as well as of a wider supporting socio-economical environment and policymaking capacities to be achieved in order to benefit from this conceptual change. A limited local knowledge base, poor economic structures, as well as low absorptive capabilities and capacities can profoundly limit the positive impact on the economic development in these countries.[49,50] In other words, the issues related to local context and public policy may set several barriers for the use of the business models prevailing in developed countries. A very specific example can be drawn here from CEE countries, where much of the policies have been developed according to the prevailing trends, not taking into account the real needs and context. While going through the reports for the biotechnology area, we acknowledge that, to a large extent, the strategic activities are dependent on the mapping of policymaking structures, policies and also the sector's performance but (1) based on the general and aggregate indexes on scientific, commercialization and output activities and (2) compared to the respective indicators and established institutions and structures in developed countries.[8,21,51,52]

Furthermore, while looking at the general policymaking context, as well as the business environment and traditions in CEE, a number of preconditions are found, which could be considered rather in favour of the tendencies of fragmentation occurring in the field of biotechnology. A concentrated overview of these could be stated as following:

- Profound problems at the policymaking level start with weak and disorganized actors and end with considerable coordination problems both in policy design and implementation.[53] In this context, most challenging is the tradition of separation of policy responsibility between education/ science and innovation/industry at the ministerial level and its delivery system,[54] which in turn has supported the lack of interlinkages and cooperation between different innovation-related activities and actors such as research organizations, government and industry.[55] There is also evidence for the same situation in the field of biotechnology.[22,23]

- The legacy from the 'Soviet Model' favouring a linear innovation approach together with an overemphasis on science as a main source of knowledge (instead of suppliers and customers) supported in its own turn a separation of different actors involved in the different phases of innovation process.[22,23,55] As a result, there is a considerable gap between the performance in the development of the biotechnology knowledge base and its economic usefulness. These tendencies also reflect the weak indicators for outputs and markets in CEE countries, and especially the limitations of the home market and the limitations of reliance on international linkages.[22,23,51]
- The emphasis on policy transfer and the building-up of the new institutions, which often, however, have not responded to the local specific problems and, second, have actually not supported the ways of overcoming and surpassing them.[22,56] This concerns the building-up of the local context-driven policymaking capacity; there the trend towards the so-called 'copying paradox' can be seen instead, which, however, cannot be considered the right recipe for solving local contextual problems at the firm and industry level characterized by restricted capabilities for innovation but also in some aspects by limited capabilities for imitation.[49,57]
- Little attention on the development of knowledge and skills by learning through trial and error, referring rather to reliance on Western achievements in technological innovation and hence limited experience in experimentation as it is highlighted by Pisano. The negative impact of the situation is boosted by the so-called 'Eastern European paradox' – the geographical closeness to the highly developed industrialized European R&D, which has not only enabled 'development without local development', but also attracted highly skilled specialists to leave peripheral regions.[58] In the industrial sphere, the same tendency can be seen in the attraction of FDI and foreign firms, which has led the activities of R&D and innovation, but those spillovers have been restricted or almost absent and have rather supported the economies' … *specialization at the lower end of the Quality Index and the value chain with grave difficulties of upgrading and, most importantly, strong enclavization, de-linkaging and primitivizing tendencies*.[55,20]

On the basis of the previous discussion, the hypotheses can be put forward that the innovation environment as well as the policymaking problems in CEE countries in general and in the field of biotechnology in particular do not only match Pisano's concern regarding the current prevalence of trends in biotechnology business models together with an orientation towards short-term returns and higher specialization in the lower value-added-creating activities (from the perspective of R&D intensity), but instead considerably deepen the current problems existing at the innovation system level and make the relationships between different actors of the system even more strained.

Regarding the previous discussion, it is relevant to look at the developments in the field in one of the rather well-performing CEE countries, Estonia.[19,23,51] The very latest review in *Nature Biotechnology* confirmed Estonia as one of the leading countries in the area of biotechnology in comparison to other new EU member states.[59] Further, as Estonia is considered to be *a poster child for successful* *transition to Western-style science* according to *Nature* news, together with its strengths in material, biomedical and environmental technologies,[60,61] the developments in the science-intensive area such as biotechnology could be considered a particularly interesting and informative example for the other CEE countries to learn from. The case study based on Estonia is interesting also in the light of the recent positive developments in preparing a national R&D programme for the biotechnology area and the respective feasibility study (carried through by Ernst and Young Baltic AS in 2009).[62,63]

THE DEVELOPMENTS IN THE FIELD OF BIOTECHNOLOGY AND BIOTECHNOLOGY BUSINESS MODELS IN ESTONIA

Social network analysis is used as a methodological tool to detect possible trends in relationships and linkages between R&D institutions and enterprises and between enterprises in the field of biotechnology. In order to gain deeper information on the prevailing business models in the field of biotechnology in Estonia, the social network analysis is complemented by the main characteristics for enterprises such as a foundation year, convergence of enterprises (based on the location), size of enterprises (based on the number of employees), sales revenues (including the share from export) and structure of costs (mainly labour expenses). Background information on R&D institutions, scientists and their activities in Estonia is another important aspect for the discussion. The material to be relied on mainly concerns two databases relevant to these purposes: (1) Business reports on financial activities on each biotechnology company in Estonia and information on ownership structures from the *Estonian Commercial Register* (*Äriregister*) (http://agent.aripaev.ee/default.aspx), and (2) the *Estonian Research Portal* (ETIS) (www.etis.ee/index.aspx) for the activities of R&D institutions and scientists of the field. In order to also have an international comparative perspective, data and databases for the EU FTP programmes and patent activities have been used (cf. the respective websites http://cordis.europa.eu/ and http://ep.espacenet.com/).

A brief overview of the biotechnology sector in Estonia

The main competence in both science and entrepreneurship for the Estonian biotechnology sector is found in biomedicine or the so-called 'red biotechnology'.[64] The total number of companies active in the field exceeds 65, whereas since 2004 altogether 4 competence centres (CCs) relevant to the field have been established (these are CC for Cancer Research, Bio-CC of Healthy Dairy Products, CC of Food and Fermentation Technologies, CC for Reproductive Medicine and Biology Technology) (see Tables 1 and 2 for the overview of biotechnology enterprises in Estonia).

The number of dedicated biotechnology companies (including dedicated R&D biotechnology companies) extends to 30: 26 of them are oriented on R&D services, 1 and 3 respectively (see here and below the definitions by the EU).[19,64] However, it is very important to note here that the distinction between different types of biotechnology companies may be rather fuzzy, and this is because of a number of biotechnology companies in Estonia whose main activity, that is R&D, is dependent on sub-activities, like sales, the provision of consultation and so on (see here the Estonian Biotechnology Strategy 2008–2013.[63,64] The tendency is also apparent when going through the annual financial reports for the year 2007 in the *Commercial Register*).

The enterprises active in biotechnology have converged in two cities in Estonia: Tallinn (over 30 enterprises together with 14 start-ups from 2007 to 2009) and Tartu (30 enterprises together with 6 start-ups). The sector consists overwhelmingly of small and micro enterprises,[19] where only one company

Table 1: Overview of biotechnology enterprises in Estonia based on the year of foundation, location and number of employees

Name of enterprise	*Foundation*	*No. of employees*	*Location*
Quattromed HTI Laborid OÜ	1999	55	Tartu/Tallinn
CC for Cancer Research	2005	48	Tallinn
Asper Biotech AS	1998	33	Tartu
Quintiles Estonia OÜ	2000	28	Tartu
Cambrex Tallinn AS (previously ProSyntest AS)	1989	23	Tallinn
MedFiles OÜ	1996	21	Tartu
InBio OÜ	1999	20	Tallinn/Tartu
Solis BioDyne OÜ	1995	17	Tartu
Icosagen AS (previously Quattromed AS, Quattromed OÜ)	1999	14	Tallinn
Quantum Eesti AS	2001	14	Tartu
Quretec AS	2004	14	Tartu
Icosagen Cell Factory OÜ (previously Quattromed Cell Factory OÜ)	2005	12	Tartu
Kevelt AS	1998	12	Tallinn
EGeen AS	2001	11	Tartu
ProtoBios OÜ	2003	10	Tallinn
Bioexpert AS	1996	9	Tallinn
Celecure AS	2002	9	Tallinn
Fibro TX OÜ	2005	9	Tallinn
Kemotex Bio OÜ	1990	9	Tallinn
LabAs AS	1997	7	Tartu
NordBioChem OÜ (EMTAK 72111)	1994/2003	6	Põlva
CePeP Eesti OÜ	1996	5	Tallinn
PharmaSynth AS	2004	5	Tartu
MolCode AS	2004	4	Tallinn
Applied Phenomics OÜ	2002	3	Tartu
Bioatlas OÜ	2006	3	Tartu
Naxo OÜ	1997	3	Tartu
TBD-Biodiscovery OÜ	2006	3	Tartu
Baltic Technology Development AS	1998	2	Tallinn
CeMines Estonia OÜ	2004	2	Tallinn
Labema Eesti OÜ	1996	2	Tallinn
LabExpert OÜ	2002	2	Tartu
Immunotron OÜ	2000	1	Tartu
Axon-IF OÜ	1996	—	Pärnu
TorroSen OÜ	1999	—	Tartu
Visgenyx OÜ	1999	No econ. activities	Tartu
BioData OÜ	2000	—	Tartu
IasGen OÜ	2001	—	Tartu
Mikrolabor OÜ	2001	—	Tallinn
Mikrotaim OÜ	2001	—	Räpina
Bestenbalt OÜ	2002	—	Tallinn
Elementum OÜ	2003	—	Tartu
Riistakast OÜ	2004	—	Tallinn, Viimsi
Stenil OÜ	2004	—	Pärnu
Biomedium OÜ	2006	—	Tartu
CC of Food and Fermentation Technologies	2004	—	Tallinn
Bio-CC of Healthy Dairy Products	2004	—	Tartu

Source: On the basis of the list of the Estonian biotechnology companies as stated in the Estonian Biotechnology Strategy 2008–2013, Appendix 3. The list has been complemented with the enterprises belonging under the EMTAK classification of 72 111 and data from financial reports for 2007 from the Estonian Commercial Register. EMTAK is the local Estonian version of the internationally harmonized NACE classification for economic activities.

Table 2: Overview of biotechnology enterprises founded in the period of 2007–2009

Name of enterprise	*Foundation*	*Location*	*EMTAK code*
AMK Diagnostics OÜ	2008	Tartu	72 111
Asper Biolab OÜ	2008	Tartu	72 111
Bacillus OÜ	2009	Lääne-Virumaa	72 111
Bioinf OÜ	2007	Tallinn	73 101
BiotaP OÜ	*2007*	*Tallinn*	*72 191*
Cellin Technologies OÜ	2008	Tallinn	72 111
CERE Code AS	2008	Tallinn	72 111
Dermarep OÜ	*2007*	*Tallinn*	*93 029*
e-Abs OÜ	2008	Tallinn	72 111
ERS Future Energy OÜ	2009	Tallinn	72 111
GeneCode AS	2007	Tallinn	24 411; 72 111
Genorama OÜ	2008	Tartu	72 111
Hansabiomed OÜ	2007	Haapsalu	72 111
Keskkonnaagentuur Viridis OÜ	2007	Tallinn	72 111
Kinasera OÜ	*2007*	*Tartu*	*73 101*
KPA Scientific OÜ	2008	Tartu	72 111
NeuronCode AS	2007	Tallinn	24 411; 72 111
Nordic Energy Works OÜ	2007	Tallinn	72 191;72 111
Perkinelmer Cellular Technologies Germany GmbH Eesti Filiaal	2008	Tallinn	72 111
ProtoLeks OÜ	2008	Tallinn	72 111
CC for Reproductive Medicine and Biology Technology	2009	Tartu	72 111
Ricimer OÜ	2009	Tartu	72 111
Storkbio OÜ	2008	Tallinn	72 111

Source: Estonian Commercial Register, based on the list of companies those economic activity belongs under EMTAK classification of 72 111, November 2009; the list of the Estonian biotechnology companies in the Estonian Biotechnology Strategy 2008–2013, Appendix 3, for the companies founded in 2007 (in italics).

has more than 50 employees: Quattromed HTI Laborid OÜ (55 employees), active both in Tallinn and Tartu. The second largest company is also active in the field of diagnostics and is located in Tartu (Asper Biotech AS). Both companies were founded already in the late 1990s, which is a general tendency for the largest companies in the area (based on the number of employees), hinting in turn at a certain accumulation time needed in the area. Growth ambition is, however, not believed to be dependent on the age of a company (see below).

While looking at the foundation years of the enterprises and their main fields of activity, there is a connection in the timeline. The late 1980s and 1990s are very strongly represented by the firms whose main activities are related to the chemical industry and medical technology, for example Cambrex Tallinn AS (previously ProSyntest AS), Kemotex Bio OÜ, Balti Technology Development AS and so on. The 1990s and early 2000s are characterized by the initiatives in fields other than just health care: for example, the foundation of Bioexpert AS (also additives for food-processing industry); NordBioChem OÜ (manufacturing of chemicals and materials from renewable sources; also lactate fermentation) or Mikrotaim OÜ (active in plant tissue cultures). During the same period, there is a wave of establishing enterprises outside the main centres. The rise of enterprises concentrating on R&D-related activities started together with the foundation of Asper Biotech AS in 1998 and Icosagen AS (previously Quattromed AS) in 1999. The year 2004 marks a surge in the establishment of CC, reflecting also more goal-oriented activities taken and the respective financial support by the state.

The developments in the biotechnology business models during the past 3 years

In line with Pisano's argument (increasing fragmentation), it is interesting to note that altogether 20 new start-ups identifying their main activity as R&D in the field of biotechnology (EMTAK classification 72 111) and one CC have been founded just during the past 3 years (2007–2009). The field of activity of newly established biotechnology enterprises is very varied and can be summed up in four keywords: bioinformatics (genotyping), dedicated biotechnology firms for pharmaceutical industry, personalized medicine and therapeutics (including some cosmetics), and environmental issues (including both diagnostics and new energy sources). A detailed explanation of the main characteristics of the newly established enterprises follows.

First, most of the newly established biotechnology enterprises tend to be related to the respective enterprise groupings that already exist (see also Figure 1):

- In the case of Tartu, Asper Biolab OÜ and Genorama OÜ are start-ups in the group led by Asper Bio OÜ, to which Asper Biotech AS and BioData OÜ belong among others.
- In the case of Tallinn, the newly established e-Abs OÜ, BiotaP OÜ, Cellin Technologies OÜ, ProtoLeks OÜ are all related to ProtoBios OÜ directly or indirectly. For the first three, an umbrella company has been established – Bioinf OÜ; the accountancy-oriented enterprise StemCells Baltic OÜ also belongs in this group. The other enlargement is related to Baltic Technology Development AS, under which three subsidiary companies have been created: NeuronCode AS, GeneCode AS, CERE Code AS. Also in this group a holding company has been established together with two companies oriented on informatics. Both aforementioned two groups are either partners or founding organizations of the CC for Cancer Research.

Also in general, a number of biotechnology companies form different groupings based on institutional indicators (based on ownership structures, also those related to CCs). The EGeen AS group in Tartu, the Celecure AS group in Tallinn and the Icosagen AS group related to both regions can be named here. The trend is supported by the notion that in Estonia, cooperation in the field is greater between companies that belong to one owner group.[65] Expansion of this kind is, however, rather extraordinary. It seems that the developments of the field are rather related to the risk management strategies. The claim becomes more obvious when we trace the ownership structures of the newly established enterprises, where the established subsidiaries are often dedicated to the development of specific technologies grown out in the parent enterprise. In addition, an analysis of the financial characteristics of the enterprises belonging to the same group reveals that there are grave differences in performance, raising in turn questions regarding the real purpose and essence of the cooperation between these enterprises.

Regarding knowledge transfer and geographical concentration of research and business activities, it is interesting to note that two-thirds of the newly established enterprises are founded in Tallinn, whereas the internationally competitive scientific activity in the field is a rather characteristic feature of the Tartu region, especially the University of Tartu (see also Figure 1 and the location of start-ups, marked in black).

The level of top research leaders and research activity at the University of Tartu is three times higher than at the next organization on the list (Tallinn University of Technology).[63] These universities are followed by the Estonian Biocentre and the National Institute of Chemical Physics and Biophysics, both of which have connections to the aforementioned universities through common (or previous) employees. In the other public universities of Estonia, the top-level research activity is considerably lower. This claim is based on data on publishing activity in category 1.1 (articles indexed by the Thomson

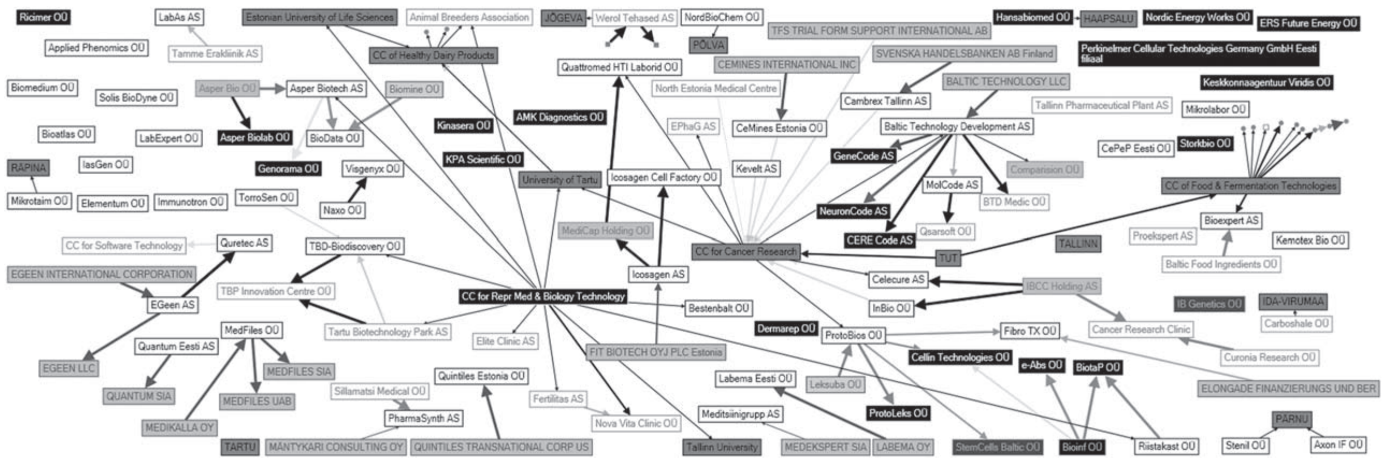

Figure 1: The map of biotechnology enterprises related to R&D institutions and to each other on the institutional bases.
Source: On the basis of information on ownership structures from the Estonian Commercial Register. Start-ups are in black boxes. International companies are marked with capital letters in grey boxes (lighter arrows refer to limited dependence). In other cases grey refers to companies outside the biotechnology sector (including holding companies).

Reuters Web of Science and/or published in journals indexed by the European Reference Index of the Humanities categories A and B; information from the *Estonian Research Portal* (ETIS)).[66] The current state of different R&D institutions becomes even more obvious when filtering the research activity to the publication impact factor (as indexed in Thomson Reuter's Journal Citation Reports for the year of 2007) (see also Figure 2). For the different specializations in terms of basic and applied research and rather independent research activities in particular at the University of Tartu and Tallinn University of Technology, see also Ernst and Young's report for Estonia (2009).[63] Statistically, the spectrum of the scientific activities in the biotechnology R&D is very broad, especially if one considers the number of units active in the field (as revealed in the database of ETIS), which, however, are often not of critical size. One of the conclusions relevant for this article is the notion that, to a large degree, the increase in start-ups cannot be considered the result of knowledge accumulation, but rather serves another purpose.

One of the forcing mechanisms behind the trend of establishing new firms during the last few years can be found in the availability of EU structural funding and the respective support mechanism by the Foundation of Enterprise Estonia (EEF) (which is one of the largest institutions within the national support system for entrepreneurship and one of the implementing units of the European Union structural funds in Estonia, see also www.eas.ee/index.php?setlang=en-GB). Since 2004, the intramural R&D activities in the business sector have been increasingly supported by the state, especially by the EEF. Next to the state funding, however, the share of R&D expenditures by the enterprises has rather shown a decreasing tendency (see Table 3), reflecting implicitly on the R&D-expenditures structure in Estonia[67] but also on the fundamental gap between basic research and its possible development by the industry.[63]

The limitations related to the R&D-oriented activities become especially obvious in the light of the situation that the enterprises at the end of the list based on the financial features are the leading ones in patenting-related activities (see below). Not to mention here that the existence of an active patent strategy is believed to convey the growth ambition and that, nevertheless, the fact that the intellectual property management in the case of SMEs in Estonia is considerably limited.[68] The number of patent applications has increased considerably in 2008–2009, based, however, on the biotechnology inventions concentrated in the hands of a relatively restricted number of enterprises, whereas in many cases also strong cooperation with international researchers (especially with Swedish and Russian researchers) can be detected (based on the information from esp@cenet databases, December 2009). Another characteristic for intramural R&D activities that can be considered here is the participation rate in the EU FTP 7 programme in the field of health, biotechnology and food. The general representation of the Estonian enterprises is relatively modest (also in the previous programme).[69] The list of enterprises participating as partner organizations in positively funded projects by the EU FTP 7 programme overlaps with the ones either funded by EEF projects or active in patenting but only to a very limited degree (based on the inquiries from Archimedes Foundation, July and November 2009) (see Figure 3).

Derived from this, it is somewhat interesting to discover that seven of the newly established enterprises also receive funding from the EEF for R&D-related activities such as the programme for feasibility studies and applied research: Bioinf OÜ, BiotaP OÜ, Cellin Technologies OÜ, Nordic Energy Works OÜ, Hansabiomed OÜ, Kinasera OÜ and Storkbio OÜ (based on the database for supported projects: www.eas.ee/index.php/toetatud-projektide-andmebaas/toetatud-projektid-alates-2004a-aprill).

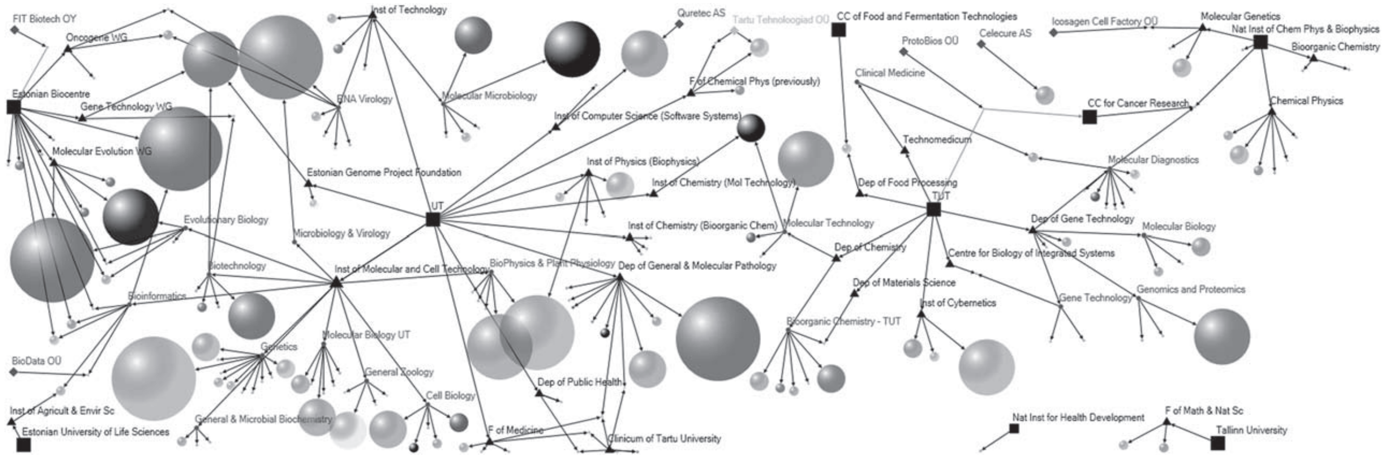

Figure 2: Front-line research at the R&D institutions active in the field of biotechnology. *Source*: On the basis of data on publishing activity in category 1.1 in the field of biotechnology-related research (information from the ETIS database) and impact factors from Thomson Reuter's Journal Citation Reports. The methodology is worked out during the cooperation project with Ernst and Young Baltic AS, see also Ernst and Young's report for Estonia (2009). The overview involves enterprises stated in ETIS as the main workplace.
Note: The size of the bubble refers to the total number of publications and the contrast to the highest impact factor.

Table 3: The structure of R&D expenditures in the R&D-oriented business sector in Estonia

Indicator	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Intramural R&D expenditure in business enterprise sector by sources of financing (percentages)										
Government	33.2	25.2	1.3	0.2	13	11.9	2.3	39	43.7	50.9
Business enterprises	37.4	25.4	29.2	53.2	50.1	51.9	62.6	39.8	46	34.6
Higher education	0	0	1	0	0.1	0	0	0	0	0.6
Foreign funds	29.5	49.4	68.5	46.6	36.8	36.3	35.2	21.2	10.3	13.9
Intramural R&D expenditure in business enterprise sector by kind of expenditure (thousand kroons)										
Labour expenses	2273	4232	4189	5259	7973	11 453	12 785	35 889	37 542	44 418
Materials, supplies and intermediate goods	1674	1405	4344	3261	3661	4383	4045	12 720	14 968	20 919
Laid-out work related to R&D	359	600	142	486	47	292	222	10 540	23 717	22 680
Maintenance costs of buildings	255	31	328	790	364	637	901	1576	1589	2929
Other costs	1241	2719	1065	1241	1753	3815	1537	5563	8142	10 595
Construction and acquisition of buildings	0	0	0	0	0	0	0	0	0	0
Acquisition of instruments and equipment	257	708	1197	303	1095	3176	2473	5599	12 684	2163
Repair and restoration of fixed assets	0	0	0	0	78	0	0	3	12	0
Acquisition of intangible assets	0	11	11	30	4255	73	229	172	854	3609
Other investments of fixed assets	44	0	0	4	0	267	0	0	436	26

Source: On the basis of data from Statistics Estonia, www.stat.ee/?lang=en, October 2009.

When other enterprises funded by EEF are added to the aforementioned list, a great linkage between the projects and companies supported by EEF can be seen, as well as a relation to the CC for Cancer Research, as many of the aforementioned companies are related to the respective CC either directly or through an associated company. The main problem that arises is related to the question of the extent to which the establishment of new enterprises has been related to the availability of support measures by EEF, and if this is the case how sustainable is this kind of business model in a longer perspective (whether the respective enterprises are able to live over the period of the support measures and what could be a set of supplementary measures to make the new initiatives viable). In this context, it is worth mentioning that according to the recent audit on the enterprise support measures by the National Audit Office of Estonia, 77 per cent of EEF's R&D-related support (1.24 billion EEK) from the years 2004–2009 has converged to the areas of bio- and materials technology. Owing to the fragmentation in the support measures, as well as their marginal size, their impact in contributing to the enterprises' competitiveness is, however, believed to be small.[70] These are, however, the profound issues that deserve to be dealt with in a separate article and cannot be answered here. It has to be highlighted that the same kind of problems in the field have also been raised recently at the European level, and especially in the context of the European Investment Bank and Fund – *a key issue is determining whether the lack of capital currently stifling many companies reflects a problem with the financial instruments currently administered … or a problem with the companies themselves. In other words, are deserving companies being let down by the current system, or should these companies not be receiving funding at all as they are unlikely to become sustainable enterprises?*[71]

A particular example to illustrate the current state in Estonia is the fact that a number of the companies that have received

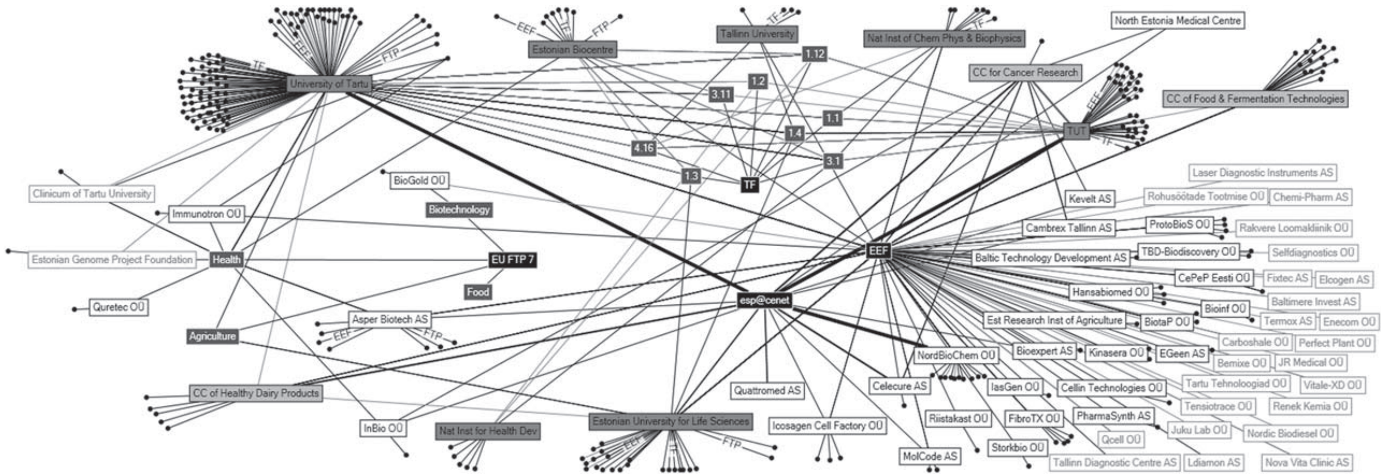

Figure 3: Recipients of targeted funding (organized by the Ministry of Education and Research), participants in the projects funded by EU FTP-7 and in R&D programmes funded by the Enterprise Estonia Foundation, activity in submission of patent applications (esp@cenetdatabase).
Source: Information on targeted funding from the database of ETIS (for classifications see here also regulation No. 640 by the Ministry of Education and Research, 28 July 2006, available at: www.hm.ee/index.php?044630), participation data on EU FTP programmes from Archimedes Foundation (inquiry in July and November 2009), information on supported R&D-oriented projects from the Enterprise Estonia Foundation's online database (October 2009), patenting activity from the free online database esp@cenet (December 2009).

funding from EEF tend to have a higher share of labour expenses than is the practice in average (comparison to other biotechnology companies). The share of labour costs in sales returns increases in quantities in the case of the enterprises whose sales returns stay below 1million EEK. In addition, most of the enterprises in question are struggling with financial difficulties (net loss in 2007). The exceptional enterprises here are Fibro TX OÜ and NordBioChem OÜ, which also enjoy the greatest financial support from EEF (see Table 4). Also in general, the highest share in intramural R&D expenditures is formed by labour expenses (see also Table 3), referring in turn to one of the relevant constraints in intramural R&D-oriented activities.

This leads us to the next aspect related to the possible lack of absorptive capabilities of the enterprises to take advantage of the scientific knowledge, as well as the lack of motives and the feasibility to realize it. Biotechnology is one of the areas with the highest value-added created per employee when compared to the other business areas in Estonia.[64] At the same time, most biotechnology companies are mainly 'suppliers' and service-oriented in Estonia,[63] whereas there are basically no companies of the 'fully integrated' type operating from research to final market.[67] One can argue about the degree to which these enterprises provide the initiative to reach a higher value-added level in the Estonian economy and in the biotechnology sector in particular, especially in a situation where 60 per cent of all employees in Estonian biotechnology enterprises are non-R&D-oriented employees.[19,63] Not to mention the high level to which contract agreements are used.[64]

Although the linkages between the field of activity and its profitability is rather fuzzy, the service orientation clearly prevails in TOP-10 enterprises based on net profits (for example, clinical studies, laboratory and medical diagnostics equipment and laboratory chemicals, medical diagnostic services, manufacturing of chemicals and development of chemical processes, production of (sterile) pharmaceuticals, personalized cell therapeutics, bioinformatics and the respective services). The claim is supported by the statistics on the most active exporters (share of export revenues in total sales revenues) and the biggest exporters (based on sales revenues over 1 million EEK). This group is mainly formed by service (including R&D)-oriented enterprises. In addition, a number of pharmaceutical companies and companies oriented towards laboratory and medical diagnostics equipment can be seen on the list. The ones that have been most successful are those relying on platform-technologies and the respective services or export-oriented niche products. This concerns in particular Icosagen AS, Quattromed HTI Laborid OÜ, Fibro TX OÜ and ProtoBios OÜ. Among the less successful enterprises, the difficulties of the Celecure Group enterprises focusing on cancer research stand out (see Table 4).

In terms of the Estonian small internal market searching ways to expand the biotechnology business to export markets,[64] the current state in the value-added chain may set up severe barriers for the future development. The other question is how much and in which form the export-orientation has actually been supported by the state. Despite the significant share of the EEF's R&D-related support to the field, this has not been complemented by the export support measures (respectively, 3.5 million EEK).[70] The description of financial indicators of the R&D-oriented enterprises of the field together with marginal sales returns (on average 10 times lower than the support) and limited export refers to the possible tendencies in the business models oriented on R&D-related (and in particular intellectual property) commercialization.[70] In the context of the prevalence of 'open innovation' theories, one can see that the goals such as increasing patenting activity and its commercialization have also been written into the strategy documents of the field (for example Estonian

Table 4: Overview of the main financial features in the Estonian biotechnology enterprises (in Estonian kroons)

Name of enterprise	*Sales revenues in 2007*	*Share of export in 2007 (%)*	*Share of labour costs as compared to sales revenues in 2007 (%)*	*Profit in 2007*	*Funding from the EEF in the period of 2004-2009*
Quintiles Estonia OÜ	**46 758 140**	100	37	**22 943 577**	0
Quantum Eesti AS	**73 875 547**	8	5	**8 826 159**	0
Quattromed HTI Laborid OÜ	**50 056 798**	NA	22	**8 770 648**	0
MedFiles OÜ	**23 229 474**	75	22	**4 238 169**	0
Cambrex Tallinn AS	**14 622 585**	98	31	**3 531 167**	0
Icosagen AS	**55 000 428**	6	28	**1 896 399**	0
EGeen AS	**24 823 526**	95	67	**1 862 267**	5 496 345
LabExpert OÜ	**12 167 430**	9	4	**1 795 826**	0
Asper Biotech AS	**15 800 078**	90	48	**1 685 716**	6 034 275
Kevelt AS	5 380 851	68	27	**1 525 687**	0
Fibro TX OÜ	609 216	98	**356**	**1 289 732**	30 886 311
Quretec AS	4 774 795	0	75	**1 169 553**	0
PharmaSynth AS	4 627 058	100	16	929 500	120 000
Solis BioDyne OÜ	5 869 633	80	27	799 780	0
Bioexpert AS	**22 903 359**	19	8	728 156	2 641 000
TBD-Biodiscovery OÜ	2 054 503	98	14	660 292	7 955 688
Labema Eesti OÜ	2 499 605	0	20	440 280	0
Kemotex Bio OÜ	5 562 767	32	34	284 306	0
LabAs AS	1 757 030	58	31	278 789	0
ProtoBios OÜ	3 306 837	77	86	216 984	13 484 477
Bioatlas OÜ	639 799	76	25	34 518	0
TorroSen OÜ	31 500	0	NA	11 906	0
Nordic Energy Works OÜ	5720	0	NA	9410	0
CeMines Estonia OÜ	53 813	100	0	−835	0
Immunotron OÜ	87 904	NA	14	−7062	129 402
Kinasera OÜ	28 610	100	**309**	−38 959	407 412
BioData OÜ	156 716	0	**170**	−72235	0
Naxo OÜ	**10 021 976**	4	17	−129 726	0
Applied Phenomics OÜ	249 873	42	**121**	−166 487	0
InBio OÜ	**16 291 002**	13	19	−247 992	0
CePeP Eesti OÜ	53 364	0	NA	−355 907	4 902 100
Cancer Research Clinic	367 369	NA	**202**	−1 055 415	0
Baltic Technology Development AS	0	—	—	−1 208 312	14 725 205
Icosagen Cell Factory OÜ	236 240	NA	**576**	−2 647 131	16 110 104 (plus 10 143 151 under the name of Quattromed Cell Factory OÜ)
Celecure AS	817 270	NA	**148**	−3 450 390	200 000
NordBioChem OÜ	0	—	—	−3 576 185	30 249 432
MolCode AS	1 266 518	3	**197**	−3 830 966	6 934 360

Source: On the basis of data from financial reports for the Estonian biotechnology enterprises in 2007 from the Estonian Commercial Register, information on supported R&D-oriented projects from the Enterprise Estonia Foundation's online database (October 2009).

Note: Bold values indicate top highest shares and numbers in the table.

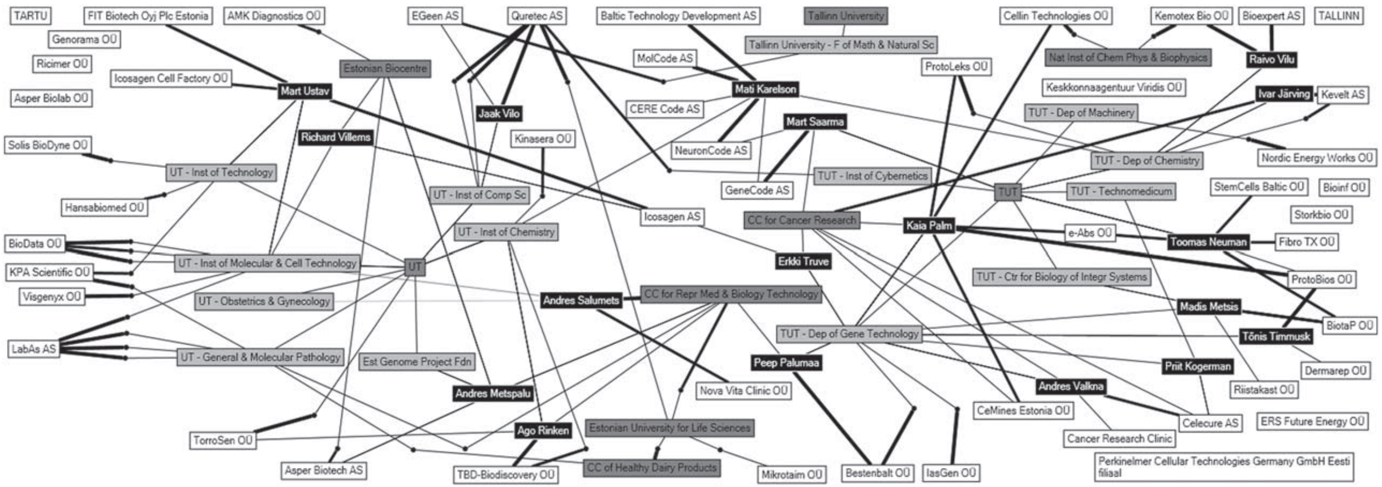

Figure 4: The map of biotechnology enterprises relationships to R&D institutions through personal bases of founders (**−**), managing board (−) or council (−).
Source: On the basis of the information on persons connected to the enterprises from the Estonian Commercial Register and on their main work of place in the R&D organizations active in the field from ETIS database.

Biotechnology Programme). In the framework of the local market, the export orientation has created another situation for those who are not able to enter and compete on the international market but try to expand their activities on the horizontal rather than the vertical level through a specialization in the value-added chain.[65]

The last notion about the developments of the field indicates that a large portion of the newly established companies is related to the main R&D institutions active in the field of biotechnology in Estonia, and if not on the institutional basis, then through personal ties between founders or persons active in managing boards and councils. The greatest exceptions here are the TOP-6 enterprises with the highest profit returns, which are related to international firms and have no connection to the local R&D institutions (see Figure 1 and Table 4). The second group of companies having rather high profit returns also involves those with personal linkages to R&D institutions, mainly to the University of Tartu, Tallinn University of Technology and the Estonian Biocentre.

Furthermore, according to the social network analysis of the personal contacts between R&D institutions and enterprises in the field, there are a number of companies that have converged around a limited number of persons (only those with an academic background have been taken into account). Derived from this, it can be claimed that the whole sector is highly dependent on the competence of single key players (Figure 4). Not to mention here that many of the enterprises in the field are established by academics in Estonia.[64] The only companies for which no ties to other enterprises and R&D organizations at an institutional or personal level were found are: Ricimer OÜ in Tartu and Storkbio OÜ, ERS Future Energy OÜ, Keskkonnaagentuur Viridis OÜ and Perkinelmer Cellular Technologies Germany GmbH Eesti filiaal.

Apparently, the formal and informal mechanisms are created to facilitate internal and external information flows between the R&D and industry levels in the field; the problem is that the industry has not been able to create value from this, and that the created social networks are limited in their local and international reach.

The local contextual factors in policies and policymaking

According to the Ernst and Young report, Estonia could use as an advantage the overall movement from fully integrated business models towards virtual integration, which provides opportunities for small structures with advanced technological bases, and this through specialization and risk reduction. In the Estonian context, this would mean in particular an emphasis on small niche research groups grown out from CCs and with international influence.[63] In practice, the enforcement of the strategy is rather problematic in many aspects (some of the problems already discussed above) and especially in terms of the long-term sustainable development. One problem is the lack of an interdisciplinary perspective in policies for the field. As a result, there are not enough synergies created at the local level between biotechnology and traditional industrial sectors, and the respective gap owing to the current export orientation taken at the policy level of the field may in fact be widening. The low development level in the local traditional sectors has severely prohibited the sectors from being considered as a market for biotechnology products and services (also the smallness of the market is another important factor). At the same time, a number of traditional fields that could have a considerable role in the Estonian economy are characterized by limited awareness of the potential biotechnologies could provide, as well as by the limited R&D taking place in the fields in general (for the more detailed overview, see the report by Ernst and Young).[63]

One of the main priorities of CCs (another innovation policy measure by EEF) is to form a basic platform to support developments in the specific technologies and to facilitate cooperative mechanisms between scientific institutions and business, but also at the industrial level. The developments as described above raise questions regarding the CCs' role and their capabilities in stimulating innovative activities, creating complementarities between different sectors but also promoting networking in the field of biotechnology. One of the very few CCs that have been successful in involving different counterparts in its activities, parties both from different R&D institutions and from different sectors (in particular chemical industry next to biotechnology) is the CC for Cancer Research. The same concerns the CC for Reproductive Medicine and Biotechnology, which has a rather wide range of partners, also from private medical clinics. The number of projects funded by EEF and carried through by the CC for Cancer Research, however, is rather limited and mainly concerns building up the CC. In the framework of the Technopolis Ltd study in 2008, experts also stressed the fragmentation of the projects at the centre and the lack of partners with the financial and industrial strength to realize its positioning in 'upstream' innovation processes.[72] The number of EEF-supported projects is considerably higher in the case of other CCs. As Figure 3 reveals, the CC of Food and Fermentation Technologies has been rather active in participating at projects funded by EEF, and the CC of Healthy Dairy Products has been successful in patenting activities. From the point of view of advancement of biotechnology in Estonia, however, the aforementioned two centres are rather oriented towards increasing the competitive advantage of single companies and often in a project-based form for the local market, whereas the involvement of biotechnology companies and the respective cooperation in more traditional areas is questionable.[72] Hence, the question arises as to whether, and to what extent, the EEF policy to facilitate cooperation mechanisms for the area is also reflected in the real practice, rather showing tendencies towards higher specialization and fragmentation in the context of CCs.

The latter implicitly refers to the fact that there is still a lack of qualitative thinking while developing measures to support the progress in the field (including technology transfer), which is another CEE-specific but extremely important aspect when speaking about possible future trends. A very specific example can be drawn here from the recently approved Estonian Biotechnology Programme (approved by the Estonian government on 29 December 2009) according to which approximately a half billion EEK is foreseen for 2010–2013 to build up the field.[62] The longest and most detailed list of activities is devoted to the development of education and research, and the greatest budget to the R&D programme (145 million EEK). At the same time, measures oriented towards the most crucial problems prevailing in the area and related to technology transfer find only superficial treatment and are covered by implementing units such as Archimedes Foundation and Estonian Science Foundation (read implementation units for already existing measures for R&D), both mainly oriented towards the advancement of science in Estonia as well as in Europe. The other question is how different activities in the R&D cycle are divided between different actors and institutions so that the activities are not duplicated in the scientific and business spheres. This particularly concerns the emphasis on grants from the Estonian Science Foundation as one of the measures in the programme.

It can be argued that the gap between scientific and economic activities reflects the more profound problems prevailing in the environment that is favourable for R&D and innovation, which start at the policymaking level. The area of biotechnology sets considerable requirements for the field-specific policymaking capacity, especially in terms of inter-ministerial, but also in the form of ministerial and business cooperation. In the Estonian case, the real practice is reflected in the rigid distribution of functions and their application mechanisms between the responsible and related ministries, especially between the Ministry of Economic Affairs and Communications and the Ministry of Education and Research (read the ministry of innovation and the ministry of education and science).

DISCUSSION

While analysing the current state and the respective trends in Estonia in Pisano's framework, the prevalence of fragmentation in both the scientific and business area and at the industrial level together with an orientation towards higher specialization is obviously the case. Therefore, although it seems that there is a lot of potential, the main problems for development are rooted at the structural level. These are fundamental and systemic issues not dealt with or answered by Glick or 'open innovation' theory while dealing with the disintegration orientation in business models. Hence, Pisano's concern regarding the long-term development becomes the central issue not only in Estonia, but also in other CEE countries.

In the CEE countries, there are considerable problems in each of the core factors when managing the high technological innovations and companies, and especially in the field of biotechnology. First, the linkages existing between the scientific and business activities are marginal, and do not substitute each other, while at the same time the R&D capabilities and capacities inside the companies are limited. The situation is rather serious owing to the limited influence from the (borrowed) institutional mechanisms (such as CCs, cluster initiatives, industrial parks, incubator systems and so on) created for technology transfer, which could play a considerable unifying role in terms of supporting cooperation between different actors of the field, as well as enabling the creation of synergies between scientific and business activities and between different industrial fields, but which, however, so far have not rooted enough into the overall formal and informal environment.

Second, instead of accumulating organizational routines, tacit knowledge and learning, we see increasing specialization and fragmentation at the industrial level. The problem is of utmost importance in the environment where learning experience in general has occurred mainly in the form of imitation, including the policymaking level. One may argue that the rise of newly established start-ups in R&D for biotechnology could characterize the new level reached in the development. A closer look at the current tendencies, however, rather links it to the risk management approach favouring a narrow technological specialization and, in the long run, fragmentation. The argumentation for this claim lies in the spheres where the specialization occurs, and in its real essence. The aim of the current article is not to prove that specialization as such is negative, but rather that the positive spillover of specialization occurs while having critical mass behind it and mechanisms supporting the creation of inter-linkages where needed. This kind of situation is especially challenging in the current context of limited influence from CCs and limited technology transfer. Furthermore, the concentration based on ownership structures refers to the lack of people having specific academic knowledge, but also to the lack of skills in the management, marketing, sales and patenting and so on relevant to leading the field-specific activities in a long and profound way.[64,65]

The same concerns the policymaking capacities and structures to deal with the problems in the field of high technology. This is, however, extra challenging as the current experience has rather relied on the takeover of so-called 'fashionable trends' from the international arena, which in turn have favoured the encapsulation of the policymaking system from the local context and society.[49] The same can be detected in the field of biotechnology, where on the one hand international trends are favouring the emergence of outsourcing in the economy where supply and service orientation is already prevailing and hence capsulation at the lower value-added end may occur, and on the other where the simultaneous availability and delivery of structural funds (the EU's support system for transition countries) have paved the way for another set of changes that the local level has not been able to deal with strategically (read general political agreement on cooperation, while the opposite trends are spreading in practice). It may be argued that not only specialization and a project-based approach, but also the creation of new firms carrying the aforementioned ideas in the field of biotechnology are supported by the availability and usage of structural funds. The main problem that arises is related to the sustainability of these kinds of business models in the long run and a set of supplementary measures to make the new initiatives viable.

According to this article, the changes in biotechnology business models, which have been oriented towards less risky and faster payback models, create considerable challenges for the transition countries. On the one hand, this trend makes it possible to avoid dealing with the profound problems related to cooperation and synergies and so on prevalent in the general environment for R&D and innovation in the short term. In the long run, however, a higher concentration in service-based models may appear, from which it will be hard to escape, especially in the context of continuous international developments. As a result, in the context of CEE countries, the issue is not whether the disintegration of business models is desirable, but rather the wider socio-economic environment, which sets considerable barriers for achieving the business model's positive outcome and its feasibility.

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Article III

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INNOVATION IN CENTRAL AND EASTERN EUROPE

The Rise and Fall of the Estonian Genome Project

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The Rise and Fall of the Estonian Genome Project*

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Abstract

This paper presents the case study of the Estonian Genome Project (EGP) during its initial phase from 2001 to 2007. In these years, the EGP was an independent foundation established by the Estonian government and almost fully financed by foreign and local private venture capital. In essence, it was a public-private partnership in science, research and development. At the end of 2004, this governance structure broke down and private funding was pulled from the project. The paper discusses what went wrong with the EGP and what the main policy lessons are, namely that particularly developing and transition countries like Estonia with low administrative and policy implementation capacity should approach public-private partnerships in high-tech research and development with high caution as conflicts of interests and loss of accountability seem likely; this is particularly the case in biotechnology because of the high scientific and business uncertainty characteristic of the field.

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1. INTRODUCTION

The creation of a fast-growing and innovative high-tech sector is seen by many developing countries as one of the main goals of their innovation and research and development (R&D) policies. However, the question that is rarely asked in theory and practice is how exactly a catch-up country should organize and manage its high-tech policies and ventures: what kind public management structures and institutions should one use in order to create effective innovation policy? This is, in fact, a highly complex set of questions, ranging from what kind of organizational form to adapt to what kind of funding mechanisms to use for respective policies. This complexity is significantly compounded by the fact that the organization of the public sector (who manages what, when and with what means), and its theoretical justifications, have been significantly changing in the last 30 and more years. Keywords like privatization, deregulation, decentralization, agentification, public-private partnerships, governing by networks, etc., have come to characterize public sector change and public management in developed as well as in developing countries. In practical terms, this has brought about rapidly growing involvement of private and third sector organizations in policy making processes and also in public management itself.

Studies that deal with the role public management plays in economic and innovation policy focus on those countries that have most recently managed to catch up more or less successfully, such as Taiwan, South-Korea, Ireland and Finland (see, respectively, Wade 2004; Amsden 1989; Evans and Rauch 1999; Ó Riain 2004; Ylä-Anttila and Lemola 2006). There are only a handful of studies that look at how *recent* public sector and management reforms influence, for instance, innovation policymaking in catch-up countries like the new European Union (EU) member states from Eastern Europe (see, e.g., Kattel 2004 and 2007). This paper takes a closer look at one case study, the Estonian Genome Project (the EGP), a population-wide genetic database,[1] which has probably been one of the best publicized innovation and R&D policy undertakings from Eastern Europe in the last decade.[2] The EGP as a policy initiative was built up according to highly fashionable public management ideas: in its initial form, from 2001 to 2007, it was a foundation established and legally owned by the government of Estonia, but funded almost entirely by private companies. At the end of 2004, this management structure fell apart; the main private financiers discontinued the funding and the activities of the EGP were more or less frozen for two years. In

[1] For a most recent international comparative study on genetic databases, see OECD (2006).
[2] The homepage of the Estonian Genome Foundation, http://www.geenivaramu.ee,
has documented most of the international press coverage the project has received, from *Nature*, *Science* and other leading science journals to European leading dailies like *Frankfurter Allgemeine Zeitung* and *Guardian*.

2007, the governance structure of the EGP was completely re-organized; the EGP became part of the University of Tartu (the largest public university in Estonia) and is now funded directly by the government. This paper looks at the reasons and developments that led to the fall-out and tries to discern the role the public management structure played in these events.[3]

Estonia is often seen as one of the most advanced new member states in the EU; particularly its development in ICT (from Skype to e-voting in parliamentary elections) has drawn attention from scholars and journalists alike. Similarly, Estonia has been embracing with relative ease many new public management reform ideas, from the growing use of quasi-autonomous non-governmental organizations (quangos), independent agencies and public-private partnerships to the privatization of public services (an excellent case study is Lember 2004). Indeed, Estonia, along with all other new EU member states from Eastern Europe, relies heavily on quangos and agencies in their innovation and R&D policies.[4] Particularly implementation agencies (often also charged with managing European structural funds) tend to be independent agencies in Eastern Europe. However, there has been scant research on the influence such management structures have on policy outcomes and impacts. This paper offers a case study that might shed some light on how policy management structures may influence innovation and R&D policies in Eastern Europe.

The EGP was in its initial phase a quango[5] with private funding, or simply a public-private partnership in R&D. The most common definition of quangos, also used in this paper, is given by van Thiel (2004, p. 176): "quangos are organizations which, as their main task, are charged with the implementation of one or more public policies, and which are funded publicly but operate at arm's length of the central government, without an immediate hierarchical relationship existing with a minister or a parent department". When the term was coined in the late 1970s, researchers foresaw that quangos would enjoy only a short life; in reality, however, there has been a quango explosion at all levels of society – regional, central, European (Massey 1997, p. 22; see also Greve et al. 1999; Pollitt et al. 2004; van Thiel 2004). This is also the case in Estonia, where both the number of these entities and the respective allocations from the state budget have been growing rapidly in recent years (Tavits and Annus 2006).

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[3] There is a growing interest in public-private partnerships in biomedical research, see for instance Bouchard and Lemmens (2008) for a most recent overview.

[4] A good overview of respective innovation and R&D policy management structures in new member states can be found on the European Commission's website's INNO-policy TrendChart in Europe, see in particular under annual country reports, http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=263&parentID=52.

[5] We use here the term quango in order to emphasize that legally, the EGP was a non-governmental organization, but established and owned by the government; alternatively, we could also use the term agency (see in general Pollitt and Bouckaert 2004).

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In what follows, we first give a (very) brief overview of the theoretical literature and issues surrounding the use of quangos and agencies in public policy, and then, second, we look at the case of the EGP from 2001 to 2007. In describing the EGP case study we use publicly available data from websites, newspapers and scholarly articles.

2. The Rise of Quangos

Perhaps the most profound change in the public sector in the last 30 years has been the transformation in civil service organization and in policy-making from a predominantly hierarchical (Weberian) organizational model to a wide variety of organizational forms that try to use market forces and logic, and involve the cooperation between numerous organizations of public, private and third sectors. It can also be called a shift towards governing by networks (Goldsmith and Eggers 2004). Quangos and agencies play a key role in this shift, which has its roots, on the one hand, in the rise of neoclassical and public choice economics, merging in the 1990s into neo-liberal political ideology, but also, on the other hand, in the change of the techno-economic paradigm under the influence of the information technology-led revolution in recent decades (on the latter, see in particular Perez 2002). The techno-economic paradigm shift has significantly changed the way private sector organizations work and are managed (e.g. from hierarchies to flat networks, etc.), thus creating a powerful management fashion that has also influenced public management reform (see Drechsler 2005).

To summarize from existing research, there are the following main reasons for using quangos and agencies in public management; first, there is the perceived need for the public sector to quickly adapt to a dynamic technology-driven economy and generally to a fast-changing global economic environment (see, e.g., Goldsmith and Eggers 2004, p. 7; Goodsell 2006, p. 632). Arguably, these challenges often transcend organizational boundaries, and accordingly government should use service delivery models of greater complexity (Goldsmith and Eggers 2004, p. 21; Mintzberg 1996, p. 82; Peters 2006, p. 300) and with wider external linkages (Klay 1998, p. 153; Trott 2002, p. 20). Second, the policy implementation kept at arm's length through specific agencies and quangos is believed to be more effective, efficient (see Bertelli 2006, pp. 256-257; Bevir 2006, p. 428; Peters 2006, pp. 300-301; Pollitt et al. 2004, p. 20; van Thiel 2004, pp. 179, 182), and also innovative (Goldsmith and Eggers 2004, p. 29; Shleifer 1998, p. 6) than implementation by governmental hierarchy. Thus, quangos and agencies should provide a favourable basis for innovation and creativity in policy design, and for flexibility and speed in service delivery as opposed to inflexible bureaucracies which allegedly tend to react slowly to new challenges (Goldsmith and Eggers 2004, p. 31; see here also Klay 1998, p. 157; Pollitt et al. 2004, p. 20).

However, there are also clear and rather severe limitations to using quangos and agencies in public management: The first and most serious limitation is related to a possible loss of accountability and transparency (see, e.g., Brock and Banting 2001, p. 155; Goldsmith and Eggers 2004, p. 12; Peters 2006; Peters and Savoie 1994, p. 423; Rhodes 1994; Wisniewski 1992, p. 110; Drechsler 2005, p. 101; Milward and Provan 2000, p. 366; van Thiel 2004, pp. 181-182). The delegation of public authority may be seen as shifting the funding responsibility away from the government, which in turn might bring a 'resource squeeze' and that would endanger the implementation of a given policy or even change the original policy goals (Goldsmith and Eggers 2004, p. 34; Brock and Banting 2001, p. 23, pp. 26-27; see also Manning and Matsuda 2000; Peters 2006). This resource squeeze is perhaps the main reason, along with a somewhat neo-liberal ideological background that sees market incentives and mechanisms as the main solutions to problems in the public sector, why the usage of quangos is seen to move public sector activities away from Weberian legalistic rationality (emphasis on the common good) towards the economic rationality of efficiency (emphasis on the lower costs) (see here especially Samier 2005, pp. 77-88). In other words, "what effectiveness and efficiency bring about is always a decrease in accountability and responsibility" (Drechsler 2005, p. 101).

Second, the use of quangos and agencies significantly increases the risk of a conflict of interests as various, often clearly contradictory, interests are involved in policy implementation: private companies with clear profit motives, non-governmental organizations with specific aims that may diverge from given policy goals, etc. (Mattli and Büthe 2005, p. 405; Milward and Provan 2000, p. 363; also Pollitt et al. 2004, p. 4).

Third, quangos are seen to bring about a loss of coherence and adequate control over the respective service implementation by the government. The essence of the problem lies in the fragmented coordination mechanism and in the lack of ability to manage instability (see Goldsmith and Eggers 2004, p. 49; Milward and Provan 2000, p. 363). The result is that there can be serious discontinuities between what the concrete public programme or policy is about and what the related agency is in fact doing or even capable of doing (Manning and Matsuda 2000; Peters and Savoie 1994, pp. 422-423). The other aspect of fragmented coordination is about the reduction in efficiency due to the functional and jurisdictional overlapping (Rhodes 1994, p. 146).

Fourth, the increasing use of quangos and agencies in public management leads to a significant shift in the nature of administrative capacity away from Weberian merit-based civil service and legal rationality towards charismatic leadership and project management (see in particular Samier 2005). The latter significantly add to problems of transparency and accountability.

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Thus, there are several pros and cons for organizing a certain policy field or programme through quangos, and the latter seem to outweigh the pros. However, there is almost no research on how such public management changes and reforms influence innovation and R&D policy-making.

3. THE ESTONIAN GENOME PROJECT

3.1 THE ORIGINS OF THE PROJECT

The aim of the EGP is to create a database of health, genealogy and genome data that would entail data from a large part of the Estonian population. The database should enable research into links between genes, environmental factors and common diseases, and make it possible to apply the information gained from research to making new discoveries in genomics and epidemiology, which, in turn, might lead to increasing efficiency of health care. The EGP is supposed to become the largest database of its kind in Europe (Web-page of the Estonian Genome Project Foundation). In addition, at least according to initial plans in 2000, the EGP should also have supported existing entrepreneurship in the field of biotechnology (Draft of Human Genes Research Act 2000). Medical biotechnology in general is seen in Estonia, similar to many other countries, as one of the 'core technologies' in transforming Estonia into a knowledge-based economy (see here the national R&D strategy *Knowledge-based Estonia 2002-2006*). While many countries pursue biotechnology as one of the strategic fields, Estonia has a relatively strong base in biotechnology: within Estonian science, biotechnology and its neighbouring disciplines such as chemistry, medicine, biology and bioinformatics are certainly the strongest fields in terms of international publications and citations (Allik 2003; Kattel 2004). Against this background, establishing a genetic database is certainly a legitimate and not far-fetched policy initiative.

The initiative for the project came very clearly from scientists themselves. A number of established scientists from the University of Tartu, most notably Andres Metspalu (professor of biotechnology; the main initiator behind the project, also currently acting head of the EGP) and Richard Villems (professor of evolutionary biology; now president of the Estonian Academy of Sciences; initially also a board member of the EGPF, see figure 1 below), along with Jaanus Pikani (then head of the University of Tartu clinic; initially member of the board of directors of the EGP, and CEO of EGeen Ltd, see figure 1 below) were among the most active initiators of the project.

In January 1999, Metspalu and other scientists founded a private foundation, the Estonian Genome Foundation (*Sihtasutus Eesti Geenikeskus*),[6] which effectively became the organization that started to work very actively in establishing a nation-wide genetic database (see, e.g., Äripäev 2000). The idea reached newspapers in the fall of 1999 when Metspalu and others gave a series of interviews,[7] and it took a little over a year before the Parliament, without any significant discussions internally or within the media (Hallap 2004; Korts 2004), passed the Human Genes Research Act in December 2000 that made the establishment of the genetic database possible.

In this preparation phase, two important ideas took shape: first, as the Human Genes Research Act would later state, the genetic database would, by the act of the government, be started as a foundation (private legal entity); second, the financing of the database would come from both public and private sources. While it is impossible to trace in detail the origins of these ideas, we can speculate that they came hand in hand: in 2000, the initiators foresaw that the EPG would need funding at least in the range of 100 million euros[8] over the next 4-5 years, and it must have been clear for everybody involved that such levels of public funding would not be available. At the same time, there seemed to be quite strong enthusiasm about finding private financing, particularly from abroad (see for example Eesti Päevaleht 2000). In fact, in 2001 Rain Tamm, representing LHV investment bank, which was advising the group of scientists from the Estonian Genome Foundation, spoke openly about the project as something that should be attractive to venture capitalists (Eesti Päevaleht 2001). Indeed, it is in this phase of establishing the EGP that the focus of the project seems to shift decidedly from a scientific long term endeavour to a commercial project, where innovation and venture capital become dominant.

Thus, setting up the database as a foundation seemed to enable the involvement of private funding without many regulatory problems. It is very likely that the positive experience of the Estonian ICT sector, where private companies extensively funded similar foundations that turned out to be quite successful, particularly in infrastructure projects (see in details Suurna and Kattel 2008), played a key role here as a precedent. Thus, using a foundation also for the genetic database must have seemed such a logical solution that until today, there has been no discussion of this governance issue either in the Parliament, the media

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[6] See in detail the homepage of the still existing foundation, http://www.genomics.ee. From the organizational-institutional perspective, the foundation has not been related to the EGP directly. The aim of the foundation is to create a common platform for coordinating the activities of different interest groups.

[7] The homepage of the EGP documents in detail both Estonian and international media coverage of the project from the very beginning, see http://www.geenivaramu.ee.

[8] All financial data is given in euros, Estonia has a fixed exchange rate, 1 euro equals 15.6 kroons.

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or scholarly literature, Estonian or international. In fact, this aspect of the EGP is not mentioned once in discussions (other than just stating the fact that the foundation was being used for the database).

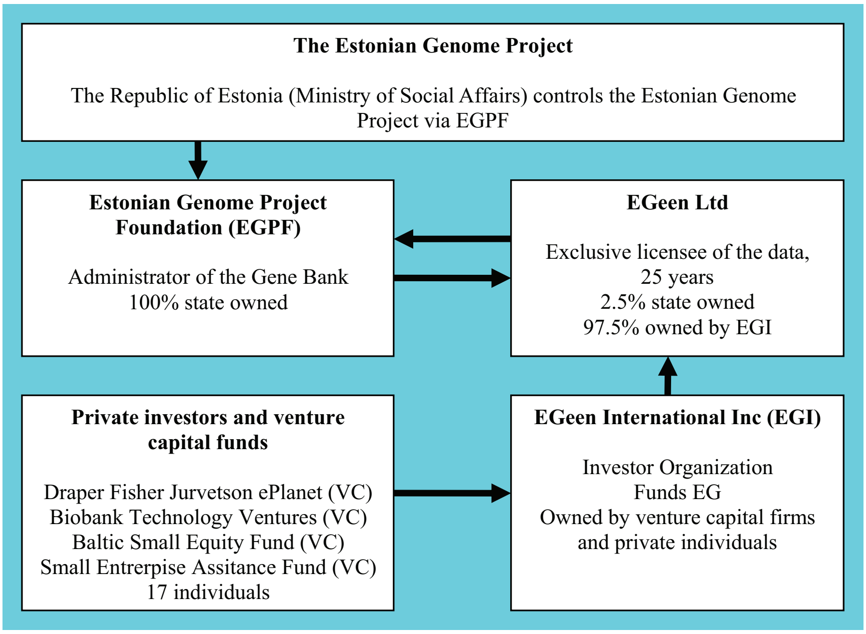
As far as public funding of the project is concerned, it is difficult to discern how realistic it was in the beginning. During the preparatory phase in 2000, the representatives of the Estonian Genome Foundation (Metspalu and other scientists) spoke about the share of public funding as amounting to 1/3 of the 100 million euros (Draft of Human Genes Research Act 2000; Eesti Päevaleht 2000). However, during the parliamentary debates in late 2000, there was no real indication of funding intentions from the government.[9]

In 2001, the government of Estonia established the necessary institutional and organizational framework for the EGP by enacting the Human Genes Research Act and founding a non-profit organization, the Estonian Genome Project Foundation (EGPF – *Sihtasutus Eesti Geenivaramu*) under the Ministry of Social Affairs to govern the project. However, the public funding of the project remained symbolic until 2007 (see figures below). Thus, in 2001, the EGPF founded a private company EGeen Ltd (registered in Estonia) to finance and also commercialize the results of the EGP; EGeen Ltd held exclusive commercialization rights of the EGP. In addition, EGeen Ltd was obligated to make the annual payment of about 300 thousand euros to the EGPF; there were also additional payments depending on the financial success: unlimited annual profit payment of 0.5%, and 3% of the turnover (Sutrop and Simm 2004, p. 258; Kattel and Anton 2004, p. 119).

The EGPF and EGeen Ltd, in turn, founded a US-based private company, EGeen Inc, which pooled funding from different venture capital firms (mostly international) and private individuals (mostly Estonians). EGeen Inc was represented in the EGP and in the public by Estonian-born US-based scientist, Kalev Kask. Figure 1 illustrates the organizational and funding set-up of the EGP in 2001; this set-up lasted until late 2004.

[9] The Parliament discussed the Human Gene Research Act twice during the fall of 1999, on 20 September and 13 December, when it also passed the law; both debates are available as reports of the Riigikogu on http://www.riigikogu.ee.

Figure 1. Governance and ownership structure of the Estonian Genome Project, 2001-2007.



Source: Kattel and Anton 2004 (modified).

3.2 THE CONFLICTING OBJECTIVES

While EGeen Inc was quite quickly able to find initial funding for the EGP, it seems that the company grew unhappy with the way the DNA samples were gathered. Indeed, EGeen Inc was arguably interested in a significantly narrower approach to genetic databases and in a focus on a few specific diseases; such an approach was believed to deliver realistic and marketable results much sooner and thus provide incentives for private capital to contribute to the project (see Kask quoted in Eesti Päevaleht 2004). However, questionnaires used by the EGP contained only general information and no questions about specific illnesses (Äripäev 2006; Eesti Postimees 2005). Thus, it seems that the EGP was locked into a collision course with EGeen from a very early stage.

Indeed, as the post-Nasdaq crash venture capital market turned out to be much less euphoric than expected about high risk R&D ventures, it was only a matter of time until EGeen Inc would demand a much narrower approach to DNA samples and the disease-specific approach that would make some commercial

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success possible early on in the project. The EGPF, and along with it the Ministry of Social Affairs, were unwilling to change sample gathering. In addition, significantly, the situation was compounded by the fact that EGeen Ltd, the Estonian-based company founded essentially by the EGPF itself, did not agree with EGeen Inc and soon Kask (EGeen Inc) and Pikani/Metspalu (EGeen Ltd/the EGPF) were accusing each other of not fulfilling the contract in newspapers.[10] At the end of 2004, the contract with the main financier EGeen Ltd and the EGP was terminated (arguably by mutual consent) and capital flows from foreign investors to the EGP stopped. The only substantial project during the period from 2004 to 2007 was a project in cooperation with Latvia on cancer prevention measures in Estonia and Latvia (funded by the EU); 5,000 additional samples were gathered by the end of 2006 (see here the web-page of the Estonian Genome Project Foundation).

The main reasons for refusing to change the way samples were gathered are arguably scientific: it is debatable even today whether a broader population-based or a narrower disease-based database would yield better results in terms of health and medical research (Eesti Ekspress 2004b).[11] However, the conflict can also be stated in another way: short-term vs long-term success. EGeen's US parent company was obviously interested in the short-term commercial success, and the EGPF was understandably more interested in the long-term impact on medical research and health care. Both interests, however, are legitimate if prone to conflict. Indeed, it can be argued that much of biotechnology business is ridden with the same clash between business and scientific values (see especially Pisano 2006).[12]

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[10] A good summary of the respective accusations was given by Eesti Ekspress (2004a).

[11] The heterogeneity of the Estonian population (the result of various occupations over the last few hundred years) was believed to provide a rather good basis for commercialization (Fletcher 2004). However, Spielman et al. (2007) show that more than 25% of the genes tested in an initial survey differ significantly between populations. They suggest that these differences are likely to contribute to the differential prevalence of common diseases among groups of different ancestry. From this it appears that a population-based and not a disease-based genome database would be better for research purposes.

[12] Michael Crichton's (2006) latest thriller, *Next*, similarly depicts conflicting values of business and science in biotechnology.

While EGeen Inc financed the EGP during 2001-2004 with 4.3 million euros,[13] the public sector's financial support for the project during this period amounted to appropriations of little over 60 thousand euros in 2001 (and later in 2001, an additional 250 thousand euros as a loan from Enterprise Estonia) for activating the project, and after the termination of the contract with EGeen Ltd to 275 thousand euros in 2005 and 330 thousand euros in 2006 for covering the operating expenses of the project and for maintaining the DNA samples.[14]

Thus, the public sector funding fell clearly short of what the government vaguely, if at all, promised in 2000 (Draft of Human Genes Research Act 2000). With only private financing available in any significant amount, the EGP fell into a serious resource squeeze and EGeen Inc tried to take advantage by changing the focus of the database.

Text box 1. Brief chronology of the EGP.

2000 – Enactment of the Human Genes Research Act for coordinating the establishment and retention of the gene bank, and for gathering, processing and disseminating the information related to it. The act serves as the legal basis for the EGP.

2001 – Foundation of a special non-profit organization, the EGPF, to carry out the EGP. The EGPF "has the right to organize the taking of tissue samples, to prepare descriptions of state of health and genealogies, to code, decode, store, destroy and issue descriptions of state of health and genealogies, to perform genetic research and to collect, store, destroy and issue genetic data" (Human Genes Research Act § 3 lg 1). The EGPF is owned by the state and belongs formally under the Ministry of Social Affairs.

2001 – Foundation of a private company called EGeen Ltd by the EGPF to finance and commercialize the results of the EGP. The shares of EGeen Ltd were in co-ownership of EGeen Inc (97.5%), the US-based private company, and the EGPF (2.5%) (Kattel and Anton 2004, p. 119). According to the contract signed on 19 September 2001, EGeen Ltd obtained the commercialization rights of scientific results made in the framework of the EGP for 25 years.

2002 – Gathering of first tissue samples from gene donors.

2004 – Termination of the contract with the main financier EGeen Ltd. EGeen Ltd had by that time invested altogether about 4.3 million euros into the EGP (web-page of the Estonian Genome Foundation; Äripäev 2006). This also meant that the EGP was released from the exclusive rights agreements with EGeen Ltd and that EGeen Ltd was no longer obligated to finance the activities of the EGP. The database contained by that time samples from roughly 10,000 gene donors.

2004-2007 – Political debate over the future of the EGP. The activity of the project is frozen during this period, the emphasis is on the maintenance of gathered DNA samples. The only substantial project during this period is a cooperation project with Latvia about cancer prevention measures in Estonia and Latvia (funded by the EU), 5,000 additional samples were gathered by the end of 2006 (see here the web-page of the Estonian Genome Project Foundation).

2007 – Amendment of the Human Genes Research Act by the Parliament, according to which the EGP will continue as a structural unit of the University of Tartu, the largest and oldest Estonian public university, and is guaranteed public funding amounting to 7.7 million euros for the years 2007-2009 (web-page of the Estonian Genome Project Foundation). In 2007, the government finances the EGP with around 1.15 million euros (State Budget Law 2007). The EGP should research 100 000 gene samples by 2010.

[13] In comparison, all research grants from the Estonian Science Foundation in 2004 amounted to 5.6 million euros, and the Ministry of Education and Research financed research grants in 2004 in the amount of 13.8 million euros (websites of Estonian Science Foundation and Ministry of Education and Research).

[14] Additionally, the operating expenses of the Ethical Committee of the EGP have been covered from the state budget, ca 13,000 euros annually (web-page of the Estonian Genome Project Foundation).

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However, because there is no clear understanding of what genetic databases can bring in terms of science and commercial success, it is also clear that the policy objectives are bound to be very vague. And in the context of a quango, where clear hierarchies are missing, such a situation is bound to end up in a serious conflict of interests. Indeed, we can argue that with recruiting private funding, the EGP was brought to the brink of breakdown as private and public interests (or different understandings of unresolved scientific issues) collided.

A significant factor in this conflict was the fact that the public sector was represented by the Ministry of Social Affairs, in charge of health and medical issues (Government of the Republic Act § 63, 67), which had no prior experience in funding and managing R&D projects of such magnitude, let alone innovation-related public policy issues. In fact, it can be argued that Estonia did not have innovation policy initiatives and thus also any management structures up to the year 2000 (Kattel 2004). Indeed, Enterprise Estonia, which is the main funding agency of innovation policy initiatives in Estonia, was only founded in 2000, also as a quango dealing mainly with EU structural funding (Kattel 2004; Tavits and Annus 2006). Thus, in the entire public sector, there was no unit with significant administrative capacity to deal with the deep scientific and management issues that the EGP faced in 2004. But even if strong competencies had been available in the public sector, under the serious scientific and commercial uncertainty characteristic to biotechnology, such collision of interests was bound to happen sooner or later and since the entire organizational structure of the EGP was based on a quango where strict hierarchies are by definition missing, the resolution of the conflict almost had to be the (at least temporary) breakdown of the EGP and creation of decidedly new organizational structure with direct governmental funding. Clearly, this was needed from the beginning.

Indeed, it seems legitimate to ask whether under the circumstances of such strong uncertainties it was sensible at all to include private capital in such a direct way in developing the genetic database. It is clear that genetic databases, and biotechnology in general, are in their infancy both in terms of scientific research and even more so in terms of commercial success. This calls for a much more direct and clear role of the state, especially in funding and management structures, otherwise conflicts of interests will happen all too easily. It remains to be seen whether the current solution of moving the EGP to the University of Tartu and funding it directly from the state budget gives more stability to the project and whether and when this pays off in terms of research results and commercial success.

If we look at the international funding and management of genomics, and in particular of genetic databases, we see that while the private sector has been a greater financier of genomics research than the public sector, studies show that at least in the early phases more than half of the capital has come from the state (Deegan, Chan and Johnson 2000, p. 8). Austin, Harding and McElroy (2003) argue that there seems to be no correlation between the ownership and the success of the gene banks, as every bank seems to depend more on its own specific institutional framework. However, if we look how genetic databases have evolved in recent years, we can detect quite a clear tendency towards more and direct public sector involvement (Figure 2).

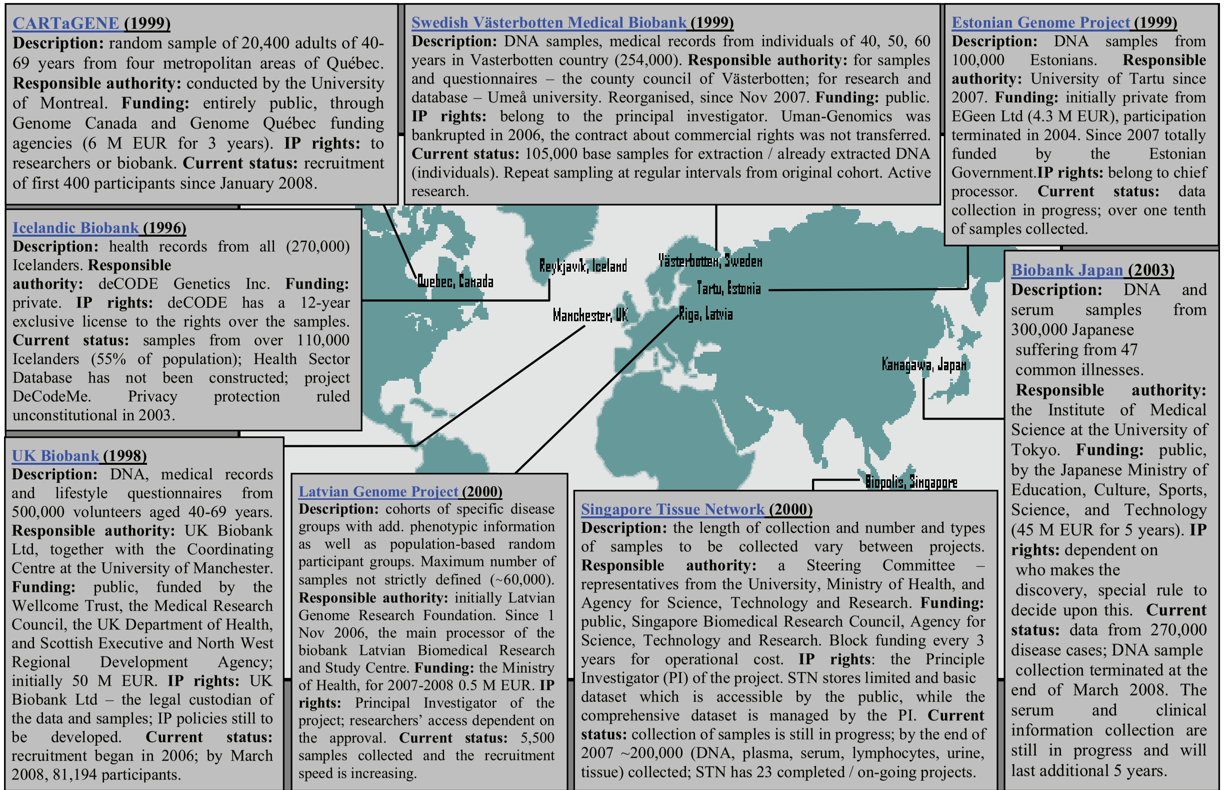
There appears to be a clear tendency to bring genetic databases under the auspices of public universities and use direct public funding (see Estonia, Latvia, Sweden in Figure 2). In essence, this indicates that there is a growing realization that the main scientific questions about genetic databases are not resolved, and thus clear funding and management structures provide better conditions for these questions to be thoroughly researched.

3.3 Public Management and Innovation Policy

In the context of innovation policy, it is important to note that the exclusive commercialization rights of scientific results given to EGeen Ltd for 25 years potentially had a severe impact on the innovative environment of biotechnology entrepreneurship in Estonia. Firstly, there was a remarkable gap between scientists involved and not involved in the project, as the EGP was strongly related to one of the public universities in Estonia, the University of Tartu (consider, e.g., the composition of the board of the EGPF; see here the web-page of the Estonian Genome Project Foundation; see also Äripäev 2001). One can argue that such a constellation would have limited possible synergies with other public universities and private companies not directly involved in the EGP. In effect, the exclusive rights agreement created a monopoly where there was no policy rationale for it (e.g., no market failure). On the contrary, as biotechnology is in its early stages of development, we see internationally that there is growing collaboration between companies in R&D in order to share risks and learn from each other. In effect, EGeen's exclusive rights agreements would probably have crowded out most other initiatives in biotechnology in Estonia and blocked or significantly slowed down the diversification of the biotechnology sector. Yet, diversification, and the synergies it creates, within sectors and the economy as a whole, is one of the key aspects in economic development (see Reinert 2007).

DOI: 10.2202/1941-6008.1050

Figure 2. International comparison of population-based biobanks.



Source: Austin et al. 2003; Maschke 2005; Swede et al. 2007; Tutton 2007, p. 463; Nakamura 2008; Seng 2008; Ågren 2008; Klovins 2008.

This brings us to the perhaps most serious flaw in the set-up of the EGP, which is, however, highly common to innovation and R&D policies in Eastern Europe: most innovation and R&D policy initiatives in Eastern Europe are geared towards finding the one killer application à la Nokia and are based on a strongly linear understanding of innovation (an excellent overview is Radocevic and Reid 2006). Such 'nokiafication' of innovation policy initiatives, like the EGP in its initial set-up until 2007, profoundly misunderstands the main features of development policies deployed by Finland and other successful catching-up countries in the last half-century, which were based on building a strong industrial and R&D base in diverse economic sectors.[15] Indeed, it can be argued that perhaps the most fundamental problem programmed into the EGP in 2001 was the misunderstanding that there would be almost immediate R&D products that could be commercialized. That is, the EGP was understood to be about innovations that would create real market advantages for one company, namely EGeen Ltd. However, until today, the main scientific questions about the usefulness of genetic databases are not resolved, let alone the commercial success potential. This misunderstanding made it possible to switch from the initially planned (partial) public funding to private funding and the organizational framework of a quango with relative ease. In fact, this seemed preferable. And as there was almost no capacity in the public sector to deal with the EGP in detail, the private funding was welcome.

In 2007, after a renewed initiative from scientists, notably from Richard Villems as the president of the Estonian Academy of Sciences, the government decided to change the Human Genes Research Act and transformed the EGP into a structural unit of the University of Tartu with direct funding from the state budget (via the Ministry of Social Affairs). Essentially, the EGP was turned (back) into a basic science venture, where results will be available only in the long term. In addition to the Human Genes Research Act, the EGP thus also falls under the University Act, and this means that a certain monitoring power over the project is given to the Ministry of Education and Research and to the National Audit Office of Estonia (University Act § 52, 53). However, the responsible Ministry is still the Ministry of Social Affairs.

4. Conclusions

We can draw three main conclusions from the case of the EGP. **First**, from the beginning, the policy initiative suffered from a misunderstanding about the nature of the undertaking: a project that was thought to have more or less immediate commercial success (i.e. innovative R&D results) turned out to be in fact a basic

[15] An excellent overview of Finnish developments and policies is Ylä-Anttila and Lemola (2006).

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scientific venture with many open-ended questions. This misunderstanding allowed for significant private sector involvement through financing the project. The latter brought with it a serious conflict of interests that led to the termination of the contract between the private company and the EGP in 2004, and almost ended the entire project. Such conflicts of interests are typical of quangos as clear hierarchies are missing. However, innovation and R&D policies in Estonia and Eastern Europe suffer generally from a similarly simplified and linear understanding of innovation. Thus, the case of the EGP could serve as a lesson in innovation and R&D policy management in these countries. Especially as, **second**, the EGP case brings out the clear need for high administrative capacity in the public sector as a precondition in using quangos, public-private partnerships and networks to manage R&D and innovation policy initiatives. **Third**, using a quango structure for managing the EGP, the aforementioned underlying policy misunderstanding and conflict of interests led to significant resource squeeze and possible problems with accountability as the private company backing the EGP was interested in significantly changing the objective of the entire initiative. In sum, the whole rationale of the policy and of the project was jeopardized by a misunderstanding of the nature of the field, and the use of a quango significantly compounded the problem.

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Article IV

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Status and Developments of eLearning in the EU10 Member States: the cases of Estonia, Hungary and Slovenia

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Introduction

As ICT can enable inclusion, better public services and quality of life, all citizens need to be equipped with the skills to benefit from and participate in the Information Society. Education and training systems play an important role in reaching these goals. Using the tools that ICT can offer to enable lifelong learning is an important way of fostering competitiveness and employability, social inclusion, active citizenship and personal development. The Education and Training 2010 Work Programme and the Lifelong Learning Programme aim to develop learning in the Knowledge Society, emphasising effectiveness, equity and quality. A recent Commission Staff Working Paper (2008b) stresses the role of ICT as a lever for transformation and innovation in education and learning so as to meet the needs of the European Information Society.

IPTS (Institute for Prospective Technological Studies, one of the seven research institutes that make up the European Commission's Joint Research Center) has been researching developments in Information Society in acceding countries since 2002 and has launched a project to support eGovernment, eHealth and eLearning policy developments in the ten member states (EU10) that joined the European Union in 2004. These are Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. The research, which was carried out by a consortium led by ICEG EC in 2006–2007, focused on the three key application areas to assess the following: their current status and developments in the field, the most important opportunities and challenges they face, the lessons other member states may learn from them, and the related policy options. National experts from each country gathered the relevant qualitative and quantitative data for analysis with a view to developing an assessment of each country's current state and trajectory, to determine their main factors, and draw conclusions. The situation of each country was captured through various sources and tools, such as desk research on both national and international data via literature and policy documents, and also by means of expert interviews in each country. A common framework was used to gather information from each country on a comparable basis. Furthermore, the intermediate results were discussed and validated in an international expert workshop held in Seville in 2007.

In this study, eLearning was defined as encompassing the aspect of learning through the use of ICT and acquiring the competences to make use of ICT in the knowledge society. For this reason, it considered the use of ICT in formal education (schools and higher education), in training and learning in the workplace (professional education), in non-formal education (including re-skilling and training for jobseekers) and in everyday life (digital literacy/digital competence and informal learning).

Based on the study, this article summarises the status and developments of eLearning in the EU10. Mapping the situation and needs in these countries not only serves for discussing policy suggestions for these countries but it also enables lessons to be learned in the whole of Europe. First, the article describes the context for eLearning in the 10 member states. Then, an overview of the status of eLearning in different educational environments in these countries is presented. Three country cases (Estonia, Hungary and Slovenia) were selected to illustrate differences and similarities between countries, as they represent countries with different levels of eServices development, ICT take-up and social background. This leads to a summary of the policy implications and research challenges for eLearning in the EU10. The national reports and the synthesis report developed in the study can be found on the IPTS website at: http://ipts.jrc.ec.europa.eu/publications/

Context for eLearning in the 10 new Member States

The economies of the EU10 are changing, with the decrease in the share of agriculture and industry being compensated by the growth of the tertiary sector both in employment and its output. Structural changes and rapid economic growth are, however, accompanied by deepening regional divides in income, age and employment. EU10 countries are often characterised by high concentration in larger cities, especially in the capital cities.

Educational Context

In most of the EU10 countries, public expenditure on education as a percentage of the GDP is typically on the same level as, or higher than in the EU15. In 2004, it was 5.4% vs. 5.2% in the EU15. A positive feature of the EU10's education systems is the high rate of schooling, especially at primary and secondary levels. Table I shows that, in 2007, Slovenia, the Czech Republic, Poland were the best EU performers against the European benchmarks for Education and Training 2010 in the share of early school leavers and the upper secondary completion rate. Only Malta is behind the EU averages in this respect. The Maltese national report suggests that this comes from the traditional family oriented culture.

Participation in tertiary education has grown rapidly in many of the 10 new member states. Slovakia and Poland have shown the strongest growth in the whole EU with regard to the number of Mathematics, Science and Technology graduates in recent years and Lithuania is among the top ten in the EU. Many EU10 countries show good scores for their share of female graduates, with Estonia achieving 42.0% in 2006 (European Commission, 2008a). However, EU10 countries are generally behind the EU15 countries in the adult participation rates in lifelong learning, with the exception of Slovenia with 6th best performance in the whole of the EU (European Commission, 2008).

ICT Access, Use and Skills

Although many of the EU10 countries are still behind the EU15 in ICT development, the statistics regarding access, usage and skills are getting close to the EU15 average (see Figure 1). The example of Slovakia shows that lower household

Table I. EU10 values for the E&T2010 benchmarks

Benchmark area	Target for 2010	Three best performers in the EU, EU10 highlighted			EU27 average	The other EU10 countries according to their success in achieving the target, highlighted values better or equal to the EU27 average									
Early schools leavers (18–24, %) in 2007	No more than 10%	SI 4.3%	PL 5.0%	CZ 5.5%	14.8%	SK 7.2%	LT 8.7%	HU 10.9%	CY 12.6%	EE 14.3%	LV 16%	MT 37.6%			
Upper-secondary attainment (20–24, %) in 2007	At least 85 %	CZ 91,8%	PL 91.6%	SI 91.5%	78.1 %	SK 91.3%	LT 89.0%	CY 85.8%	HU 84.0%	EE 80.9%	LV 80.2%	MT 54.7%			
Ratio of low-achieving 15-year-olds in reading literacy (measured by PISA)	At least 20 % decrease (to reach 15,5 %)	Change in the share of low achievers in % (2000–2006)													
		FI -31.4 %	PL -30.2%	LV -29.6%	+13.1 %	HU -9.3%	CZ 41.7%	SK, SI, LT, EE, CY, MT n.a.							
		% of low achievers in 2006													
		FI 4.8 %	IE 12.1%	EE 13.6%	24.1 %	PL 16.2%	SI 16.5%	HU 20.6%	LV 21.2%	CZ 24.8%	LT 25.7%	SK 27.8%	MT, CY n.a.		
Graduates in MST	Increase of at least 15 %	Average annual increase 2000–2006													
		PL +13.8 %	IT 13.8%	SK 12.3%	+4.4 %	CZ 8.9%	CY +8.1%	MT +8.1%	EE +7.1%	LT +6.3%	HU +3.2%	LV +2.4%	SI +0.9%		
		Graduates per 1000 population aged 20–29 in 2006													
		IE 21.4%	FR 20.7%	LT 19.5%	13.0%	PL 13.3%	EE 11.2%	SK 10.3%	CZ 10.0%	SI 9.5%	LV 8.9%	HU 5.8%	MT 5.0%	CY 4.3%	
		% of females among graduates in 2006													
		EE 42.9%	BG 41.2%	PT 39.7%	31.6%	PL 39.2%	CY 35.9%	SK 34.8%	LV 32.4%	LT 31.6%	HU 27.9%	CZ 26.5%	MT 25.9%	SI 25.7%	
Adult participation in lifelong learning (25–64) in 2007	At least 12.5 %	SE 32.0%	DK 29.2%	UK 26.6%	9.7 %	SI 14.8%	CY 8.4 %	LV 7.1 %	EE 7.0%	CZ 5.7%	MT 6.0%	LT 5.3%	PL 5.1%	SK 3.9%	HU 3.6%

Source: Commission working document: Progress Towards the Lisbon Objectives in Education and Training Report 2008 (European Commission, 2008a).

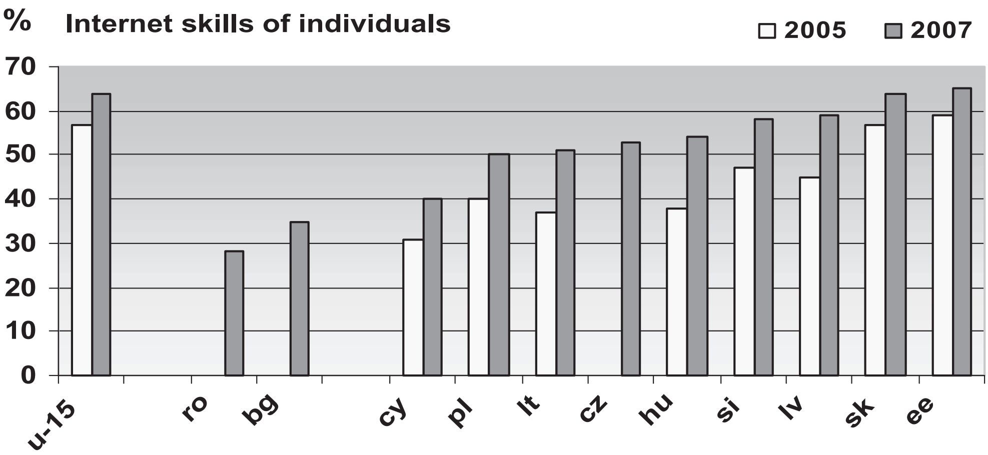

FIGURE 1. Development of Internet skills (people with completed Internet activities)
Source: Eurostat

Internet access does not necessarily hinder the development of ICT use and skills. Many of the EU10 countries have invested in public Internet access points in order to improve their citizens' access to ICT.

However, access and skills still remain a constraint for remote, usually less developed regions, and some user groups, such as ethnic minorities, the elderly, or the unemployed (see Figure 2). In most of the EU10 countries, these divides are larger than the EU15 average. ICT take-up is highest among the young and the well educated. For example, while in 2007, in EU15, 41% of the 55–74-year-olds had used a computer during the previous year, in EU10 this ranged between 12% in Lithuania and 25% in Hungary (Eurostat). However, the gender gap in computer usage in the EU10 countries is often smaller than the EU15 average.

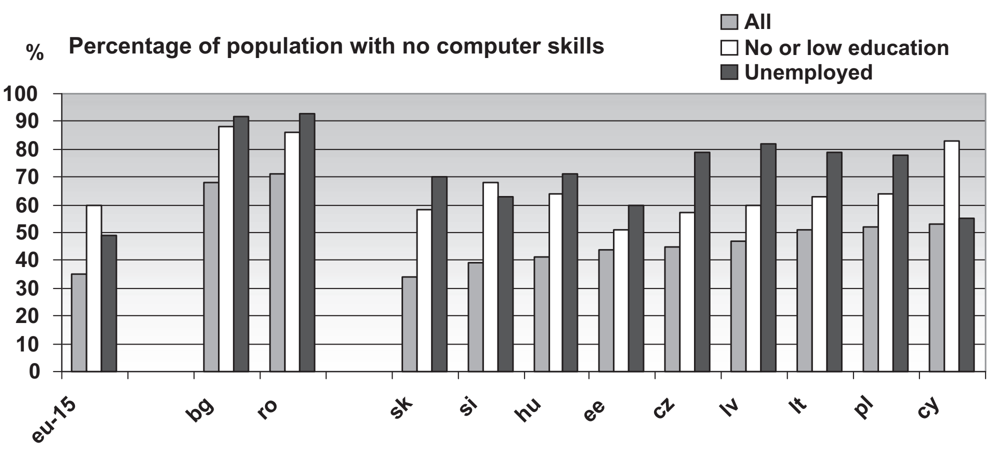

FIGURE 2. Computer skills divides between different groups of people in 2007
Source: Eurostat

Overall eLearning Developments

This section gives an overview of the developments in eLearning in EU10. It is based on both European statistics and the country reports developed in the project.

Primary and Secondary Education

Empirica (2006) provides a good data source for comparing computer use in schools in Europe. In EU10, schools provide separate ICT courses more often than in EU15, with an average of 91% vs. 46%. In EU10, only 54% of pupils use computers in class vs. 69% in EU15. Teacher usage reflects the same — in EU10, only 56% use computers in class compared to 65% in EU15. This seems to be related to the fact that, on average, there are only 6 computers per 10 students in EU10 and 11 in EU15. Teachers in EU10 (49%) mention lack of computers as a main barrier, as do teachers in the EU15.

The Empirica survey showed similar ICT skills levels for teachers in EU10 compared to those in EU15 and that fewer teachers in the EU10 countries considered ICT skills as a barrier for using computers in class than in the EU15 countries. Furthermore, those teachers who used computers in the classroom used them very actively. Survey responses also implied that teachers in EU10 were more interested in using computers in class than their EU15 counterparts. The EU15 average of teachers stating 'lack of interest' as a barrier for using computers was 11%, and all EU10 countries had values below that. The share of teachers who did not perceive clear benefits from using computers in class was 19.6% in EU15, while the EU10 average was 6.8% and only the Czech Republic had a value higher than EU15 average (Empirica, 2006). There are, however, considerable differences between generations, e.g. according to a Maltese national study, 59.5% of teachers aged 55–59 are not confident with ICT, while only 2.8% of teachers under 25 express the same concern (Restall, 2008). National studies reported that those teachers who had been using ICT in their own training made use of it most actively in their classes.

Higher Education

A common feature of ICT in higher education in EU10 is that all the countries provide distance learning courses with ICT. The Estonian report describes a distance learning programme of 17 courses developed by the Estonian Banking Association and the University of Tartu. In the Polish virtual university, more than 100 e-courses support traditional teaching or are offered as separate courses on the Internet. Universities often use learning management systems to support both their local and distance students.

The study reports did not find much quantitative or qualitative information on the ways in which ICT was incorporated into teaching and learning in universities. The national reports give the impression that the focus of eLearning has been on developing infrastructure, digital materials and online courses, rather than on innovative learning approaches for different types of settings. Furthermore, country reports do not show many networking activities or much collaboration between universities. In Estonia, with its national eUniversity (and eVocational school) networks, the opposite is true.

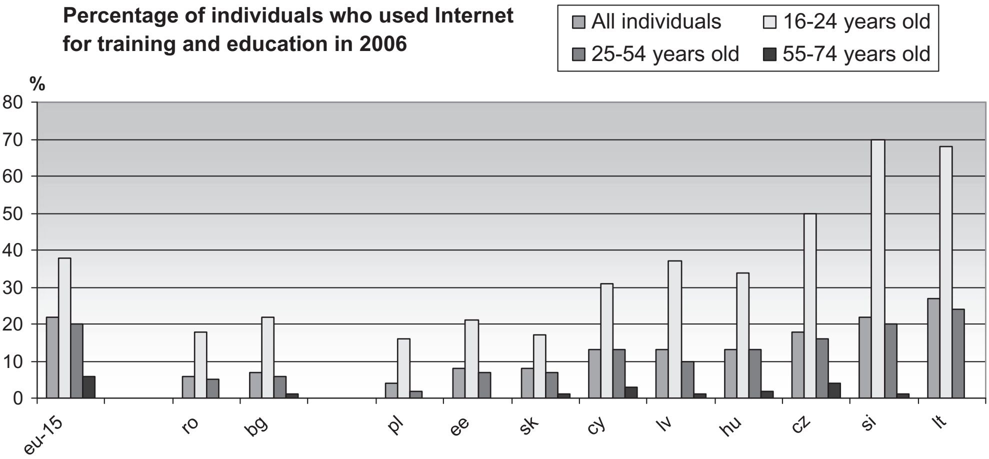

FIGURE 3. Individuals using Internet for training and education, showing different age groups
Source: Eurostat

Adult Learning

The project found information about non-formal adult training to be scarce, both for enterprises and for general adult learning, therefore local expert estimations became important sources for information in this area. Besides this, some Eurostat surveys gather information in this area. Figure 3 illustrates the individual use of Internet for training and education in EU10. People aged 16–24 (including students) form a major group. Many reports show interest in ICT as a factor that has driven eLearning. However, they also suggest that adult learners and employers are suspicious of the quality of online courses, asking for quality assurance mechanisms for online courses in adult training.

Companies declare they use eLearning more in EU10 than in EU15 (see Figure 4), but the surveys regarding Internet use for education among people of a working age show much lower shares. The country reports assert that often employers are not very supportive of learning, which they consider to be the responsibility of the employees. Furthermore, they suggest that eLearning is unequally distributed among enterprises and employees; larger enterprises have more broadband connections and employees in higher positions have more opportunities for eLearning. With regard to types of training, enterprises seem to favour standardised online courses with internationally recognised certification, such as ECDL.

eLearning and Inclusion

The country studies also found that eLearning initiatives aim to improve inclusion in the knowledge society, supported by both public and private funding, and sometimes partnered by international companies. For example, the Hungarian Digital Secondary School helps adults to complete their secondary education through distance education. It is targeted at the Roma minority who has difficulty in accessing labour markets. In Latvia, the Latvia@World project provides training for the unemployed in poorer districts, rewarding participants who complete the

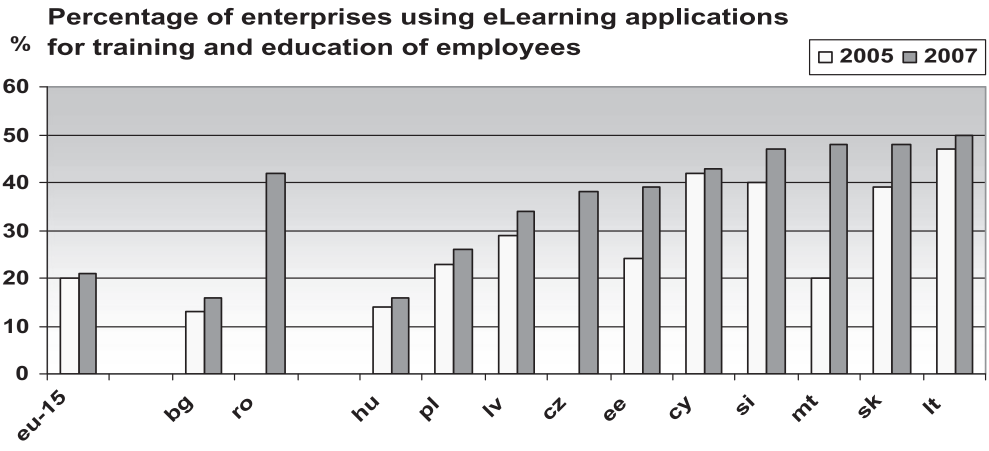

FIGURE 4. Enterprises using eLearning applications for employees
Source: Eurostat

course with a certificate and providing them with Internet access to help them to search for and find jobs.

Heterogeneous Countries

The EU10 is not a homogeneous group concerning educational context and developments in the information society. Comparing the EU10 average to that of EU15 would mask important differences, not least since weighted EU10 average reflects the fact that the Polish population makes up half the total population of the EU10. In order to illustrate various stories of EU10 countries, the following sections describe eLearning in Estonia, Hungary and Slovenia. These cases were selected because of the richness of the information gathered in their country reports and their specificities. Estonia shows diverse and broad developments in eLearning, based on the demand and interest of different actors. Slovenia shows high potential for lifelong learning and ICT use among individuals, but little deployment of these opportunities for eLearning developments. Hungary is an example of a country with large social and digital divides, facing several challenges for ICT, lifelong learning and eLearning developments.

eLearning in Estonia

The political will to build up an information society and a knowledge-based economy has been pursued as a priority, not only in the main national research and development, but also as innovation strategies since the late 1990s.

Various international comparisons have ranked Estonia very highly in the area of ICT, not only among EU10 countries, but also compared to EU15 countries and the global context (see e.g. The Global Information Technology Report 2006–2007, e-Readiness Rankings 2007, Web Based Survey on Electronic Public Services 2006). Compared to the EU15 average, Estonia shows both high ICT penetration and Internet usage rates increasing rapidly over the years and being rather homogeneous at the regional level. The highest rates in individuals' Internet skills, however, are highly dependent on their educational background and activity in the labour market. As a result, the social groups which use ICT most, and particularly the Internet, are students (99.3%), persons with higher education (80.4%) and the employed (75.8%) (http://www.stat.ee).

Besides the well-developed Estonian ICT market, another main stimulus for the provision of eLearning services has been the emergence, acceptance and usability of eServices. Estonia is a well-developed 'e-country', with an eGovernment system, local e-elections, Internet banking services, submission of income tax returns over the Internet, etc.

Status of eLearning in the Country

The first contributions to eLearning were made at the end of the 1990s. Several projects were undertaken by the public sector together with some leading actors in the private sector, such as ICT companies, banks, and telecoms, which improved considerably the ICT infrastructure and skills in schools and in regionally remote areas. These developments included (1) the implementation of Tiger programmes to provide schools and universities with computers and Internet connections, and teacher training; and (2) the implementation of projects such as Look@World which contributes to the improvement of people's basic ICT skills. It is very important to note that these programmes have not just created a physical infrastructure for eLearning, but have also generated public interest.

Since then, core organisations in the field have been established. These are governmental non-profit organisations established under the auspices of the Ministry of Education and Research, such as: (a) the Tiger Leap Foundation (established in 1997) focusing on general education; (b) the Estonian Information Technology Foundation (2000) together with consortia under its authority: (c) the Estonian eUniversity consortium (2002) and (d) the eVocational School (2005). Since 2006, the eLearning Development Center has led the activities of both the Estonian eUniversity consortium and the eVocational School. It is important to note that Estonia has not only relied upon the aforementioned non-profit organisations, but also on schools, universities and local initiatives (both in the design and implementation of policies) rather than on central policy coordination and formulation by the government.

While contemporary eLearning policy has been largely successful in creating infrastructure (all Estonian schools have computer and Internet penetration rates of close to 100%), it has not affected the use of ICT as expected. Neither has the time students spend learning with ICT increased considerably, nor has the teachers' use of ICT in the learning process been comparable to those in EU-25 (Suurna & Kattel, 2008). The existing ICT infrastructure in classrooms, other than special computer labs, is considerably poorer than the EU average: only 28% of Estonian schools that use computers for teaching use them in classrooms (Empirica, 2006). According to the teachers, the shortage of computers is still an issue, resulting in the need for further ICT infrastructure improvements in Estonian schools (Empirica, 2006).

The main target of the eLearning policy has been formal education, with the most interest at higher and vocational education levels, where over one third of university students (35%) who belong to the Estonian eUniversity consortium stated that they had participated in web-based courses (Suurna & Kattel, 2008). However, it could be said that such major developed services are closely related and influenced by the progress of eGovernment services to enhance administrative tasks in the sphere of education. As a result, ICT is used extensively as an administrative tool; e.g. for enrolment in a course or school and for communication with the school and teachers and is very much limited to and closely associated with web-based courses and material delivery (Department of State Information Systems, 2007, p.92).

In the private sector, ICT-supported learning is used mainly by large companies, especially in the financial and telecommunications sectors. The number of enterprises using ICT for the training and education of employees has been increasing continuously since 2005 (See Figure 4). However, it seems that ICT applications are mainly used to deliver learning materials or evaluate employees' qualifications.

The 2006 Eurostat survey on Internet use shows that only 8% of individuals used it in the last three months for training and education in Estonia, compared to 22% in EU15. Furthermore, the current eLearning policy has not tackled the wide digital divide and e-exclusion. This is especially evident when considering the elderly, those with a low level of education and income, and the Russian-speaking population. The web-based courses for these groups are still limited in numbers and in the scope of content and delivery has been entrusted to educational institutions. These developments correspond to overall trends, where society still suffers, although decreasingly, from the little recognition of the need for lifelong learning. The positive developments at the level of informal education include ICT skills training, the creation of Public Internet Access Points (PIAPs) and the 'internetisation' of libraries, often through public-private partnerships.

Developments Led by Foundations and Initiatives

eLearning developments have been based to a great extent on grassroot-level local initiatives, sharing of best practices, active involvement in European networks, etc. The overall ICT policy framework is set by the Estonian Information Society Development Plan for 2013, but with no specificities for ICT in education. The role of the specialised governmental non-profit organisations established under the auspices of the Ministry of Education and Research has been very important. The Tiger Leap Foundation, the Estonian Information Technology Foundation and the eLearning Development Center have developed strategies and programmes of their own. In addition, some universities and higher vocational schools have also developed or are developing their respective strategies. In general education, the eLearning-related activities started as far back as 1997 and have been relying since then on the support from the different educational programmes of the Tiger Leap Foundation. Its most noteworthy initiative is teachers' in-service training, whereby 75% of teachers altogether had been trained twice in ICT skills by 2006. The developments at the general educational level include eLearning services like web-based grade-book eSchool, LMSs and CMSs like VIKO and KooliPlone, web-based learning materials and learning object repositories like Miksike and Koolielu (Suurna & Kattel, 2008).

This means that these strategies have been developed according to the local specifics and future needs. Only the Tiger University Strategy is strongly influenced by the eEurope 2005. The positive developments in higher education owe their success to the fact that the main initiative — eLearning Strategy of the Estonian eUniversity 2004–2007 — was born out of the Estonian eUniversity consortium and not at national level. This approach makes sense in relation to the legal autonomy and the independence of universities in Estonia. Positive features of this kind of network inspired vocational schools to establish a similar network called Estonian eVocational School in 2005. Although the professional and vocational education institutions exercise their activity under the State's supervision, this has not influenced the level of state intervention. Among people acquiring higher and vocational education, the consortium of the Estonian eVocational School covers 87% and the Estonian eUniversity 83% of the total number of learners at the respective educational levels (as of January 2007). As a result of the initiatives of the respective consortia, considerably greater emphasis has been laid on the creation and usage of LMSs (IVA, WebCT and Moodle, respectively) and the design and distribution of web-based learning materials (Suurna & Kattel, 2008).

The loose connections to the central government have created favourable conditions for the involvement of the private sector in the provision of eLearning services. Although involvement is through one-off initiatives and does not rely on an explicit scheme, it is clear that, especially in the late 1990s, the private sector's initiatives and willingness to provide funds served as a catalyst for many public policy actions in ICT and eLearning areas (e.g. Tiger Leap programmes and the provision of financial support for the use of the web-based grade book service eSchool in general education). Furthermore, the financial contributions by the private sector, especially those related to the Look@World Foundation's initiatives, were quite extensive. The Foundation also helped to provide PIAPs with computers and establish Internet connections where needed. Both have been of significant importance in terms of developing the digital skills of people in the rural areas.

Diversification as a Challenge

The progress in the field of eLearning in Estonia has been more demand-driven than policy-led and there are no signs of a change in this trend. The latter is illustrated by the adoption of the eMemorandum between the Estonian higher and vocational educational institutions and the eLearning Development Center in September 2006. It calls on students and teachers (not policy makers) to actively search for ways to take advantage of eLearning so as to raise the quality of the education provided. At the same time, it can be argued as to whether the reliance on demand-driven policy in eLearning is sustainable enough. Whether the current positive developments in the field of ICT have had enough spill-over effect on other closely related areas, including the educational sphere, is also questionable.

First of all, this extremely diversified, decentralised but also market-oriented organisational set-up has resulted in a myriad of strategies and programmes. These strategies and programmes do not share common goals and have not been able to create synergy and functional coherence between developments at the different levels and aspects of ICT education. In other words, in the current policy framework there is no overall consensus on the role of eLearning in education and in society as a whole. In fact, the term 'eLearning' or 'web-based learning' is not to be found in any legislative document related to education. Due to legal shortcomings, several basic questions and significant issues — such as better infrastructure/equipment, usage of ICT in learning process, content, standards, qualifications, training and remuneration system of teachers, financing, monitoring system, etc — have not been mandated by the State and therefore remain unconstrained. For instance, according the National Curriculum, ICT is not a compulsory course either at the basic or upper secondary educational level (it is a horizontal theme).

Secondly, there is a lack of cooperation between respective Foundations, schools at different levels and various actors at central and local levels. Until now, eLearning related projects have been much too centred on and led by the Foundations and respective consortia. The support from the Ministry of Education and Research is particularly important, because, apparently, without support, certain activities (especially of Foundations) remain limited. This means that no connection is created between new and current learning processes. So far, the role of the Ministry of Education and Research has been limited to allocating money to the Foundations, and more importantly, establishing several information systems in education. Further, there has been no cooperation in content production, and the main content owners (e.g. Estonian TV, radio, publishers) have not been involved in eLearning development projects (Suurna & Kattel, 2008). At the same time, it is clear that the Estonian educational and training market is too small to create a business potential for learning materials written exclusively in Estonian.

eLearning in Hungary

Hungary is a middle-sized country with a population of slightly over 10 million. When joining the European Union, its ICT developments were well behind the Western European level: Internet-connected computer penetration (38% vs. 59% in EU15 in 2007) and broadband Internet connection (33% vs. 46% in EU15) of households are still far below the EU15 average. The digital divide is still one of the main issues, as more than 40% of the population lack basic computer skills. The younger generation and wealthy, well educated people, living in the cities are mostly digitally literate. Citizens living in rural areas with poor ICT infrastructure have very limited access to electronic services.

The spread of mobile technology is very dynamic and could be a solution to providing recent ICT infrastructure in rural areas. According to the National Communications Authority, the penetration of mobile phones in November 2008 was 119.1%, meaning that there were more mobile phone subscriptions than citizens. Currently, there are three main providers, and in 2009 at least two new ones are expected to enter the market, enabling better quality of service and greater coverage of mobile data-communication services.

Status of eLearning in the Country

The figures relating to both digital literacy and the general use of ICT indicate that Hungary is not among the leader European countries in the field of ICT-supported educational activities. Regarding Education and Training 2010 benchmarks, it is catching up in almost all fields of education, except lifelong learning (European Commission, 2008a). In 2007, adult participation in lifelong learning was only 3.6% (in 2000 it was 2.9%). Of the 27 EU member states, only Hungary performs better than Greece, Bulgaria and Romania (European Commission, 2008a).

Still, Hungary is one of the best countries in the EU regarding the increase in public spending on education. Between 2000 and 2005, the increase was 0.95% of the GDP, ranking second best among EU-25 countries. This is much higher than the EU average of 0.35% (European Commission, 2008a) and was enough to provide a computer for every 10 pupils, cover 77% of the schools with broadband Internet connection and foster website development among schools (56% of public schools in 2006) (Empirica, 2006). There is a sufficient number of digital learning content available both in primary and secondary schools and every school runs a compulsory course covering the basic topics of computer science. But despite these promising figures there are still serious drawbacks in schools using ICT in education, especially in rural areas, due to their weak ICT infrastucture.

There is no real infrastructural problem in higher education. Universities and colleges are well equipped with ICT and are slowly incorporating technology into their academic processess. Web-based learning is used extensively and there is a growing number of institutions providing eLearning-based distance education programmes (e.g. Dennis Gabor College or Szecheny Istvan University), which include standardised digital content delivery. Learning Management Systems are also present (mostly open-source solutions), but they are not yet widespread.

11.7% of the Hungarian adult population participated in educational activities in 2005 (Magai & Simonics, 2008). This figure is very low compared to the EU15 average (43.9%) and if we consider the abovementioned lifelong learning participation, the figures become even lower. However, as there are no reliable data on the eLearning activities carried out by the private sector, where multinational companies are actively using ICT for employee training, experts assume that the private sector is also a dominant player of the eLearning sector. Many companies are developing Learning Management Systems, student admistration systems, digital learning content, or offering consultancy. Large multinational companies are using ICT in their everyday training activities (Magai & Simonics, 2008).

Many Positive Developments

The intense investment in ICT in the Hungarian educational sector resulted in a quite good coverage of computers and broadband Internet connection in schools, universities and libraries. Only schools in the East — the least developed regions — have serious drawbacks. The government's Information Society Strategy provides a general framework for the developments, which, in the last few years, have resulted in a significant elaboration of the society's digital divide.

In public education great progress has been visible in the last few years. The most important development was the ministerial initiative Sulinet (Schoolnet) Digital Knowledge base, which contains and provides digital learning content in all fields taught in schools free of charge and acts as an important information hub for pupils and teachers. Digital content can be officially accredited by the government and there are also advisory bodies (like the Digital Content Accreditation Committee), whose main task is to foster the inclusion of eLearning in the public eductional sector. Sulinet provides training and support for school teachers, helping them with digital content development and delivery that covers technical and pedagogical issues. Currently, teachers are trained to use ICT in the classroom during their studies, as ICT related subjects are incorporated in various educational BSc and MSc programmes. But despite these efforts, most teachers still have very limited knowledge of ICT-supported educational technologies, related methodologies and pedagogical approaches.

ICT is very well integrated in higher education where students use computers on a daily basis. Several institutions provide eLearning courses with standardised content available through Learning Management Systems. Student administration in higher education is almost completely digitalised and, in some cases, institutional back office and academic content delivery systems are integrated.

Another positive sign is the growing number of educational research activities in higher education. Mobile learning, for instance, is a new emerging field of distance education where academic groups undertake cutting edge, world class research (e.g. Corvinus University of Budapest and Technical University of Budapest). There are also attempts to establish a new generation of content management which is driven by semantic applications.

The government initiated several programmes for the inclusion of citizens living in rural areas (mostly Roma). These include access to ICT infrastructure (computers or internet), mostly at no charge, where courses and tutoring activities are also offered. There is a positive discrimination towards Roma students, making their entrance to higher education programmes and institutions easier than for citizens from other ethnic groups. Despite all these efforts, there are no reliable data or independent studies on the efficiency of these projects.

Challenges for Content and Interest

One of the most important challenges is that the take-up of ICT-based educational services is still quite low, despite the well-established infrastructure. Current reports (Magai & Simonics, 2008) identified several hindering factors which need to be tackled:

- Higher education and adult education lack quality learning content. Most of the higher and adult education institutions have limited expertise in digital content development and delivery. Compared to schools, these sectors do not have a common repository with standard, sharable and reusable learning objects which may foster the development of eLearning-based courses. eLearning-related cooperation is also lacking.
- The digital rights of the learning objects already produced are not handled carefully enough. Content developers and owners are not used to sharing content, nor do they see its benefits. There are no general guidelines, legal support or explanations about the benefits of content sharing.
- In general, teachers' motivation and expertise for using ICT for their work is still quite low. Teachers are reluctant and often experience difficulties in applying different pedagogies and tools compared to those of traditional classroom education. An attempt has been made to incorporate ICT driven education subject matters in teachers' basic and further education, but so far they have not proven effective.
- The demand side of the educational market is very low, people do not understand this novel educational approach, which results in a lack of interest in eLearning. Another problem is the lack of a tradition of distance education, which also contributes to the fact that eLearning is not widely adopted.
- The low level of digital literacy in Hungarian society also hinders eLearning developments. The focal points of the digital divide are (1) the vast differences between the central (Budapest) area and the countryside and (2) the extremely low level of education among Roma people. In the first case, the main issue is to provide access to electronic services in small villages and townships that are far away from cities. One solution might be the spread of mobile broadband networks, which is a promising ongoing process. The problem with the inclusion of Roma minorities needs more attention, as cultural differences and their extreme poverty result in a peripheral social status. Roma people (8% of the population) still have very little access to education, which forecasts growth of social inequalities in the future.

- There are no policies to promote ICT-supported learning. The government could do more to develop eLearning at all levels of the educational system. The efforts made at the beginning of this century were important and partly successful, but eLearning is still not being focused on by policy makers. Incorporating eLearning in official, national educational strategies would force local decision makers to help and promote the implementation of educational technology in mainstream education.

eLearning in Slovenia

Since gaining independence, Slovenian economic, social and political developments have been stable and relatively successful (compared to other NMS). In part, this is due to its starting position in 1991, which was radically different from that of other Central and East European E10 countries because it had open borders with the West for almost the entire period after the 2nd World War. It is therefore not surprising that Slovenia shows high economic growth (its exports amount 60% of GDP) as well as a general openness and flexibility to the neighbouring countries. Slovenians speak many languages (proficiency in English is one of the highest in the EU) and they are also prone to learning new technologies. In a contemporary global world these factors could outweigh aforementioned problems which normally arise because of the small size of the nation (2 million).

Rapid economic and social changes in the last 15 years have also been accompanied by an ageing population and a sharp decline in birth rates. While primary and secondary schools now have fewer and fewer pupils, pre-school (due to economic pressure on working mothers) and post-secondary education are rapidly expanding. The educational system has not responded fast enough or in a suitable manner to the changes in past decades.

Due to its specific developments, in the mid 1990s, Slovenia was slightly above the EU15 average with respect to basic ICT indicators (e.g. PC and Internet penetration). However, strategic measures were not taken to further these early achievements and so a slowdown occurred in the late 1990s. At that time, Slovenia missed the opportunity to position itself as an advanced information society by failing to build on and upgrade its technological position with the benefits of the flexibility and transparency of a small country. While Slovenia is rapidly closing the economic gap and has already surpassed the 80% of EU25 average GDP/capita (PPP), the information society indicators (e.g. Internet penetration, households with PC, broadband, services) are now typically around the EU27 average. However, it does share with other E10 countries a relatively high digital divide, particularly for older generations, but also for those with little education and the unemployed. Another problem, although rapidly disappearing, is a considerable lag in broadband penetration in rural areas.

Status of eLearning

The most general educational features that characterise all E10 countires are also, on the whole, true for Slovenia. The quality of the public education system is relatively high, often around or even above EU27 average. This is particularly true for secondary school enrolment, early school leavers, international test performances (e.g. TIMMS, PISA, SITES), percentage of GDP spent for education (above 6%) and high enrolment in tertiary education. In addition, Slovenia shows extremely strong results in lifelong learning, which is typically a rather weak component in E10 countries. One characteristic which is somewhat below the EU target is the share of MST graduates (see Table I). The number of science and technology students has been stagnating or declining in recent years when the tertiary education sector expanded in the areas of economics, humanities and social sciences.

With respect to primary and secondary school infrastructure (e.g. schools with broadband, schools with webpage), Slovenia is extremely well positioned, which also holds true for the infiltration of separate courses on ICT. However, the general ICT use for educational purposes in primary and secondary schools shows similar deficiencies to those in other E10 countries: lack of computers and low level of PC/Internet usage in the classrooms.

The picture regarding eLearning activities in tertiary education is very mixed. Only one third of the institutions seems to understand the strategic importance of eLearning. The remaining majority is surprisingly slow in adopting eLearning practices. This can partly be attributed to a relatively rigid and monopolistic structure of the tertiary sector which is still awaiting a major transformation and modernisation and partly to a certain lack of initiatives, strategies, coordination and cooperation at the national level, which is particularly critical for the public universities. On the other hand, Slovenia shows strong evidence that ICT is used quite intensively for training and education by individuals, as well as by enterprises.

One specificity arising from the small size of the country is related to various eLearning tools. The complexities related to the production, development and maintenance of the software for a virtual learning environment (VLU) require a critical mass of users. This has not been the case so far. There are very few VLU tools that have been created by Slovenian organisations and adapted to the Slovenian language and those that do exist are relatively limited. Similarly, it is very expensive to create quality eLearning content for a relatively small audience (it is not surprising that English language eContent is among the most frequently used). This, in part, also explains a certain lack of eLearning activities in primary and secondary education. There, the implementation of open source platforms (e.g. Moodle) does not seem to be user-friendly enough for widespread use by teachers.

eLearning Pursued by Individuals

Lifelong learning in Slovenia is particularly well developed according to standard Eurostat LFS measures of the formal and non-formal educational activities. In this area, Slovenia ranks 6th among EU27 (European Commission, 2008a). These high levels of lifelong learning are accompanied by a relatively intensive individual use of ICT for educational purposes, as 22% of individuals used Internet for training and education in a 3-month period (http://epp.eurostat.ec.europa.eu/).

The reasons for these high figures are threefold:

- More than 5% of the total population participate in tertiary education. This is also in tune with the fact that private educational spending (in large part directed to the fees for tertiary education) is among the highest in EU27.
- Non-formal education is common. The certifications from educational companies (most typically this is related to some specific computer or language skills) count as a potential employment advantage and promotion.

- Informal self-learning activities are linked to the high Internet usage. A recent survey on ICT use in 2008 revealed that 65% of regular Internet users (who have used the Internet in last 3 months) have used it for educational activities (http://www.stat.si/eng/novica_prikazi.aspx?id=2027). More specifically, those who fall in the younger age bracket (16–24) are increasingly computer literate and the share of 'very competent' ICT users is among the highest in EU27 according to the Eurostat survey on ICT households in 2007. These characteristics can be linked to the traditional openness to learn and to the willingness to use new technologies, which was discovered and confirmed on many occasions in international comparisons.

However, these figures alone do not tell the entire story. It is true that various educational activities are widespread and that Internet is intensively linked to these activities, particularly the informal ones. But it is also true that ICT usage in formal and non-formal educational system is still relatively low, considerably below EU average. Statistics show high figures in terms of eLearning applications in companies, but, for example, use of Virtual Learning Environments (VLE) is very rare among companies, even the large ones. On the other hand, companies usually have complex Intranets where they store many resources, manuals, instructions, descriptions of work, etc. which can be used for ad hoc training and informal learning among employees.

Among the advantages of eLearning developments in Slovenia we should include a core of enthusiastic teachers at all levels of formal education who have developed and disseminated their eLearning solutions. For example, Empirica (2006) showed that Slovenian teachers are well above EU25 average in their interest and willingness to apply eLearning in their teaching activities.

Country Specific Challenges

The study report (Vehovar, 2008) recognises the following challenges as the most critical for further developments of eLearning in Slovenia:

The future of domestic eLearning tools and domestic eContent. It is very difficult to compete in this field with global solutions. A lack of tailored and friendly eLearning tools in Slovenian has already caused considerable delay in eLearning developments. While this may be slowly overcome, the production of good quality domestic eContent will remain expensive (compared to global content) in the long run. In part, the balance between global and domestic production can be solved on the market, however, the question is whether the market outcome would have positive consequences for the public education sector.

The problem of the Slovenian language. The eLearning products in the Slovenian language experience strong competition from English language tools and materials. This is particularly problematic because, throughout history, Slovenian identity was largely preserved by its language. Hence, Slovenian became a compulsory teaching language at all levels of formal education and is currently under legal protection. The extent to which the cheap and high quality English materials could be used in formal education is thus a very problematic issue.

The problem of a national eLearning strategy. A clear contradiction exists between having a high general involvement in educational activities, a high motivation among learners and teachers, a good ICT infrastructure, good ICT literacy, and considerable national educational investments on the one hand, and the increasing lag in eLearning usage in formal education on the other. This clearly points to the need for regulation and a national strategy. After the ambitious and successful school informatisation project 'RO' in the 1990's, more than a decade has now passed, where eLearning was a very national priority. Long term planning, integration and formalisation of national eLearning activities need to be linked with systematic motivation and promotion. Of course, an explicit national strategy might not be needed if enough systematic and coordinated activities can be evoked by other means and measures.

Policy Implications

The three country case analyses demonstrated some of the differences and similarities between the countries, indicating how EU10 averages can mask great differences. Structural changes and rapid economic growth have been drivers for ICT investments and for a demand in eLearning, but they have also been accompanied by deepening regional, income, and age divides, as well as employment disparities. These partly explain the widening digital divide, which has been one of the hindering factors of eLearning developments in EU10. As demonstrated by the Hungarian case, although indicators for ICT infrastructure and skills have been catching up with EU15 rapidly, investments are still needed. Public policies should continue to improve the ICT infrastructure and promote digital literacy initiatives in order to close the gap between richer and poorer regions and different social groups. In their financial decision-making, the states should take into account the expected expenditure on future maintenance and a renewal of ICT equipment in schools. They should also invest in both ICT and human resources for user support. EU structural funds provide an opportunity for the EU10 countries for these purposes.

The Slovenian case and several other national studies have pointed out that the lack of knowledge about the opportunities brought with eLearning as such is one of the biggest problems. There is a need to better inform learners, teachers, and organisations about the benefits of ICT. Furthermore, policy makers themselves are not necessarily aware of the opportunities of eLearning either. Improving the visibility of existing eLearning solutions could contribute to solving this. For example, public institutions should provide and administer public research grants supporting innovative projects on eLearning at different educational levels. The results could be then made visible in a central portal giving access to interested stakeholders and learners, promoting existing materials and eLearning approaches in general. This could also support networking between educational partners.

Although several developments have been taking place in many countries, the Estonian case demonstrates how the absence of a comprehensive approach in developing ICT for education can be considered to be a barrier. Without specific approaches, eLearning can be absent or receive little attention as only a part of related other policies. As dispersed policies have been seen as a major barrier for the developments so far, many country studies called for national eLearning strategies or better coordination and focused effort for developing eLearning. Most experts in the project shared the opinion that there should be one institution with a comprehensive responsibility for eLearning and support of Internet and broadband penetration.

Lack of ICT skills and requirements for students, teachers and principals has been seen as a regulatory barrier, as these factors could improve the proficiency and interest in ICT-enabled learning approaches in educational institutions. Where present, mandatory basic informatics courses at schools have been considered as a means of encouraging ICT use, both for the young learners themselves and their families. Those who apply ICT in education become better prepared for eLearning after their formal education. In addition to the lack of ICT skills among older teachers, all teachers often lack the opportunities to develop new learning and teaching approaches that would be possible with ICT. The institutions should be able to provide flexible curricula and financing systems, which would enable and encourage teachers to develop ICT-enabled learning approaches. Attention should be paid to embedding eLearning aspects in teacher training curriculum and to promoting in-service training on ICT skills and eLearning didactics, possibly as part of a promotion system. Teacher networks, guidance materials, and best practice exchanges should also be developed in order to support teachers in implementing eLearning approaches and in being innovative with regard to developing new ones.

Research challenges for eLearning in EU10 are often not specific to these countries, but arise from the needs shared with other countries to develop and pool resources in the following: good practices, research on quality learning approaches, personal data management, material interoperability and sustainable models for partnerships. Specific EU10 R&D challenges arise mainly from the fact that these countries have inherited old models for their educational systems. Additionally, the business environment in EU10 is different from that of EU15, and the EU10 countries are mostly small nations with their own languages, which makes it difficult to find a critical mass of users for the services provided. The study suggests that more (although not only) EU10-specific research issues are:

- Access to technologies and learning opportunities is the main problem for a large number of potential learners in EU10. Research efforts should therefore concentrate on finding easily usable and achievable solutions, which, for example, take advantage of the opportunities offered by mobile technologies, and use the local language. Open source software may provide a cost-efficient solution for more easily obtainable tools that could be tailored to the target audience.
- Approaches to evaluating the impact and quality of eLearning projects need to be developed, as these would help in making investment and financing decisions. Quality certification systems for courses could increase the attractiveness of lifelong learning and eLearning solutions among the adult population.
- Lifelong learning participation is very low in EU10 despite a high basic educational attainment. Research is required to determine how ICT-enabled learning could be best used to reach new groups of lifelong learners in EU10. Furthermore, developing ways to collect and store information on adult learning is needed to support research and investments in this area.

Conclusion

Overall, eLearning is progressing in the EU10 countries, although information society developments started much later in most of these countries than in EU15. The take up of the Information Society has been fast and the development of other eServices (eGovernment, eHealth) has also increased capabilities and interest in using ICT for learning. Because the expanding service sector is labour intensive and requires highly-qualified employees who have a growing need for ICT knowledge and skills, the demand for learning both to use ICT and ICT as a tool for lifelong learning has also been rising.

The three country cases presented here, as well as the overall study, show dispersed IS and education policy approaches to eLearning developments in EU10, which often lack coordination and common objectives. The policies have mainly concentrated on developing ICT infrastructure and digital literacy, and have considered eLearning mostly in terms of developing digital materials for online (often self-learning) courses. ICT has not been considered as a means to enable educational innovations, which was highlighted recently by the European Commission (2008) as a challenge for the whole of Europe. However, the countries do show many positive developments in this area, rising from individual actors or specific projects.

Compared to EU15, eLearning lags in its development in the E10 countries more than economic development, general educational achievements or even general ICT developments. As using ICT for learning is new (compared to education in general) and much more sophisticated and complicated than basic ICT diffusion, it cannot emerge just by itself, but needs active support by policies. The study shows that EU10 countries have been following EU15 policies, but a more active and proactive approach is needed to stimulate eLearning developments. However, the study suggests that eLearning is now receiving more policy attention in all these countries and its importance is starting to be recognised in connection with reforming educational systems.

Research challenges for eLearning in EU10 are often not specific to these countries, and collaboration and sharing of research developments should be encouraged. Specific challenges rise from the deep regional and social divides threatening to exclude a large portion of the population from the Information Society. The younger population is often on par with EU15 in ICT usage and skills and therefore demonstrates capabilities for new learning opportunities. Yet a specific effort needs to be made to engage new groups of people so that they benefit from the potential ICT offers for lifelong learning.

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APPENDIX (Articles V – VI)

Article V

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Industrial Restructuring and Innovation Policy in Central and Eastern Europe since 1990

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1. Introduction

Until very recently, economic development in Central and Eastern European (CEE) countries[2] has been seen by most analysts in both academic and policy circles as a largely positive if not a very positive story. For example, at the end of 2005, *Business Week* ran a cover story titled "Central Europe – Rise of a Powerhouse". It has become commonplace to argue that the success of CEE development is mainly due to neoliberal economic policies (liberalized markets, balanced public budget, price stability, low tax burden, and strongly market oriented reforms in all socio-economic sectors) pursued by these countries since the early 1990s. In other words, CEE countries have been poster countries for Washington Consensus policies. Indeed, as we show below, during the entire decade of the1990s, industrial restructuring and embryonic innovation policies in CEE were largely dominated by Washington Consensus thinking. We aim to show that, **first**, these policies have been a double-edged sword: on the one hand enabling fast and furious industrial restructuring while, on the other hand, locking CEE economies into economic activities with low value added/productivity growth and thus undermining future sustainable growth. However, the impact of accession into the European Union (EU) has been equally pivotal for industrial restructuring and innovation policy making in CEE countries in the 2000s and this process can be summed up as a strong Europeanization of innovation policy in CEE. We aim to show, **second**, that also Europeanization has been largely a double-edged sword for CEE countries. Since joining the EU in 2004 or 2007, and already during the accession process, there is a strong change in innovation policies in many CEE countries towards a much more active role of the state. In this change there is a clear and strong role of EU's structural funding, particularly the negotiations and planning that comes with it. However, these changes come with specific problems: first, there is an over-emphasis in emerging CEE innovation policies on a linear understanding of innovation (from lab to market) that is based on the assumption that there is a growing demand from industry for R&D (which is not the case because of the structural changes that took place in the 1990s via the Washington Consensus policies); and, second, increasing usage of independent implementation agencies in an already weak administrative capacity environment lacking policy skills for networking and long-term planning. We argue that such Europeanization of innovation policy in CEE, while highly positive in directing CEE to reorient economic and innovation policies towards more sustainable growth, is in its implementation often only deepening and exasperating the existing problems of networking

[2] In the context of this article, Central and Eastern European countries are the following ten most recent member states of the European Union: Bulgaria, the Czech Republic, Hungary, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia.

and coordination. However, both Washington Consensus policies and the process of Europeanization created fertile ground for significant financial fragility to develop in CEE countries during the second half of the 2000s which contributed to the financial woes these countries experience in the current global recession. Underlying both Washington Consensus policies and the impact of the EU on CEE is the assumption that the best intellectual and policy framework to integrate CEE countries into the world economy and secure sustainable growth is a Ricardian comparative advantage framework that assumes that all economic integration are more or less symmetrical and integrative. We show that this is deeply misleading and that this misunderstanding led to deep-rooted cognitive dissonance between policies employed for industrial restructuring and innovation in CEE and actual developments taking place in the private sectors of these countries. This cognitive dissonance is also one of the key reasons why financial fragility was not recognized early enough to counteract it.

2. Methodological note

Following a broadly Neo-Schumpeterian approach, we assume that companies innovate in order to hedge their balance sheets; that is, companies innovate in order to generate revenues and outcompete their competitors, and they do so in a number of ways, e.g. by developing new or improved products, services or by introducing organizational or marketing changes, etc. (See also OECD and Eurostat 2005). In trying to hedge their balance sheets through innovations companies rely on skills and routines they have developed, or as Alfred Chandler called this, companies rely on "learned organizational capabilities" that include technical know-how, management and marketing skill, established networks etc. (Chandler 2005; also Nelson and Winter 1982). These capabilities, however, develop and evolve in a wider context that can be called a national system of innovation that can have a huge variety of features from the legal system to particularities of education and R&D. (See in particular Freeman 1974 and 1987)

We use innovation policies to denote a set of public sector efforts that aims to enable private sector upgrading in terms of technology and skills, but also in terms of a wider set of activities, such as organizational change and capabilities. In other words, innovation policies aim at changing and upgrading patterns and features of private sector learned organizational capabilities.

In what follows, we try to track the evolution of main features of CEE company-level organizational capabilities and of national innovation systems since the 1990s. These concepts serve as rough approximations and heuristic devices to organize actual historical events. We do so largely by using stylized facts, and we are fully aware that such an approach abstracts diverse actual developments. (See also footnote 14 below) However, we hope to show that – particularly in comparison with East Asian development – CEE countries followed a similar path since 1990 and look surprisingly alike.

The following is divided into 4 parts: in the first three sections we depict the stylized facts of industrial upgrading, changes in the R&D system, and corresponding innovation policies in CEE since 1990. The final part of the essay summarizes the previous sections and draws conclusions about evolution of the main features of organizational capabilities and national systems of innovations in CEE since 1990.

3. Stylized facts of CEE industrial restructuring in 1990s

Perhaps the key assumption behind how Central and Eastern European countries should go about reforming their economies in the late 1980s and early 1990s was the belief that, as Martin Wolf argues, "new opportunities were at last opening up for developing countries to export manufactures and a range of relatively sophisticated services competitively" (Wolf 2007). Indeed, it can be argued that economists of almost all persuasions seemed to share one common view: globalization in the form of global financial markets and trade liberalization would greatly benefit CEE countries. Globalization was seen as the main factor in delivering fast economic restructuring spurred by global capital in form of foreign direct investment (FDI) inflows. This enthusiasm was largely based on the classical Ricardian assumption of comparative advantage defined, in a classic textbook formulation, as follows: "trade between two countries can benefit both countries if each country exports the goods in which it has a comparative advantage." (Krugman and Obstfeld 2005:26) Krugman's work in the 1990s that included economies of scale into the Ricardian framework, assumed that the mutually beneficial trade takes place between countries possessing increasing returns activities. (See Krugman and Obstfeld 2005:110-146; and Krugman 1996) Thus, as CEE countries exhibited high levels of industrialization at the end of the 1980s (comparable to East Asia), it seemed correct to assume that globalization would indeed greatly help these economies to restructure the industry and to become vastly more efficient in production through trade and increased competition. (See also Radosevic 1998 and Guerrieri 1998 for discussion).

However, the augmented Ricardian framework failed to take into account two phenomena: first, the 1990s saw the onslaught of what has been termed a new techno-economic paradigm that completely changed the nature of industrialization and essentially stripped many maturing and increasingly foot-loose industrial activities of significant (dynamic) scale economies; second, the Ricardian framework assumes that all economic integrations are alike (integration works always through comparative advantages) and provides the same economic strategy in all contexts and at different points in time ('one size fits all'). We shall attempt to show, however, that qualitatively differing forms of economic integrations exist, some of them highly successful and some of them exactly the opposite. This phenomenon could potentially have enormous impact on how developing countries integrate into the world economy. Thus, before we discuss innovation policy in CEE since 1990, we need to very briefly explain the general impact of the new techno-economic paradigm in order to understand how CEE economies were integrated into the global economy. The latter process, in turn, is crucial for innovation policy developments during the entire period under discussion.

Carlota Perez, the author of the concept, has briefly summarized the idea of techno-economic paradigms as follows:

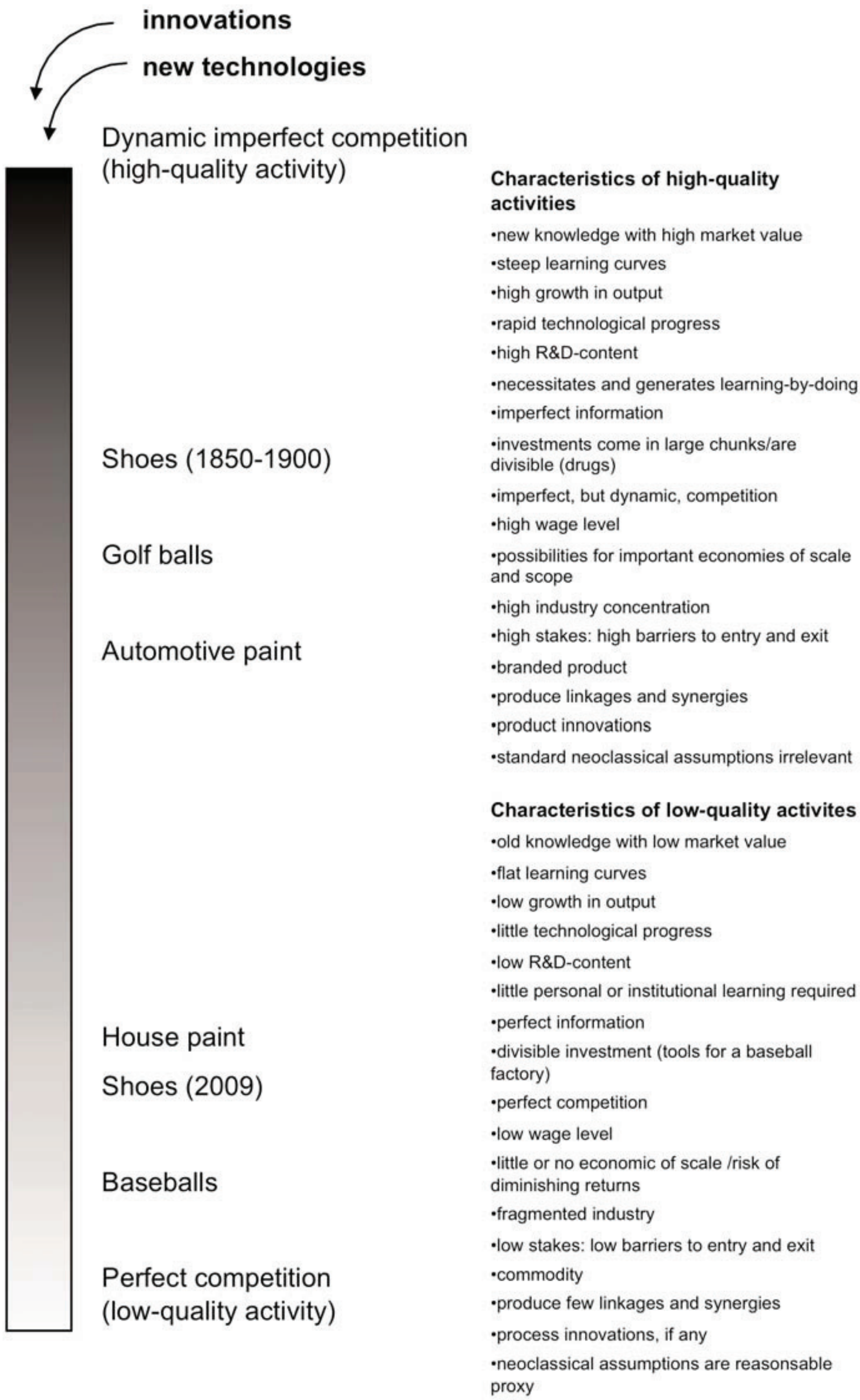
> There has been a technological revolution every 40 to 60 years, beginning with the Industrial Revolution in England at the end of the 18th Century; each has generated a great surge of development, diffusing unevenly across the world from an initial core country. ... The great wealth creating potential provided by each of them stems from the combination of the new technologies, industries and infrastructures with a set of generic technologies and organisational principles capable of modernizing the rest of the economy. The resulting best practice frontier is superior to the previous one and becomes the new common sense for efficiency –a new techno-economic paradigm– that defines the guidelines for innovation and competitiveness. ... The propagation is highly uneven in coverage and timing, by sectors and by regions, in each country and across the world. (Perez 2006; see also Perez 2002)

The paradigms describe how technological change and innovation of a given period are most likely to take place: organizational forms and finance that are conducive to innovations, what technological capabilities and skills are needed etc. Accordingly, the new ICT-based techno-economic paradigm, coming to full force in the 1990s, has engendered key changes in production processes in almost all industries (including many services and agriculture): outsourcing and the resulting geographical dispersion of production functions. This is based on significantly enhanced technological and organizational capabilities in introducing "modularity" into production processes and networks (Berger 2006). These changes have enabled very fast growth in FDI inflows into developing countries as well as industrialization (e.g., in terms of growth rates of manufactured and high-tech exports), at least on the surface, in many developing countries.

Consequently, particularly in the late 1990s it seemed as if the Ricardian gamble was paying off for CEE: technology-intensive exports were growing, and catching-up seemed relatively likely (see for empirical data and discussion, e.g., Landesmann 2000; Hotopp, Radosevic and Bishop 2005).

However, in many cases the outsourcing activities do not exhibit the same dynamics that used to be associated with them in the originating countries: fast and sustained productivity growth, raising real wages, forward and backward linkages, but rather the opposite. (See for detailed discussion and data, e.g., Palma 2005, Cimoli, Ferraz and Primi 2005, Tiits et al 2008) The underlying cause why so many policy analysts and economists missed what is going on in these activities is hidden in the very nature of modularity in production. What is statistically captured as a high technology product may in reality be very different in nature: it can be touch screens for iPhones or it can be assembled mobile phones for any brand mobile producer. Both show up as high technology statistics, yet the former is a product at the beginning of its life cycle and the latter has clearly reached maturity. Indeed, when iPhone was introduced in 2007, Balda AG was the only company in the world able to produce the high number of innovative touch displays used by Apple in iPhones (Business Week 2007). This is manifestly not the case in mobile phone assembly as such. Thus, the key assumption of comparative advantage trade models and theories fell away: even if high technology exports have been growing in developing countries, this does not mean that we deal with similarly dynamic sectors with significant increasing returns (See also Krugman 2008a). Due to changing techno-economic paradigm, integrating CEE (and other developing countries) has become in many ways an increasingly asymmetrical matter. In fact, the CEE countries seem to have specialized in activities that exhibit the 'low quality' characteristics in a dynamic Quality Index of Economic Activities in Figure 1.

Figure 1. The Quality Index of Economic Activities



Source: Reinert 2007.

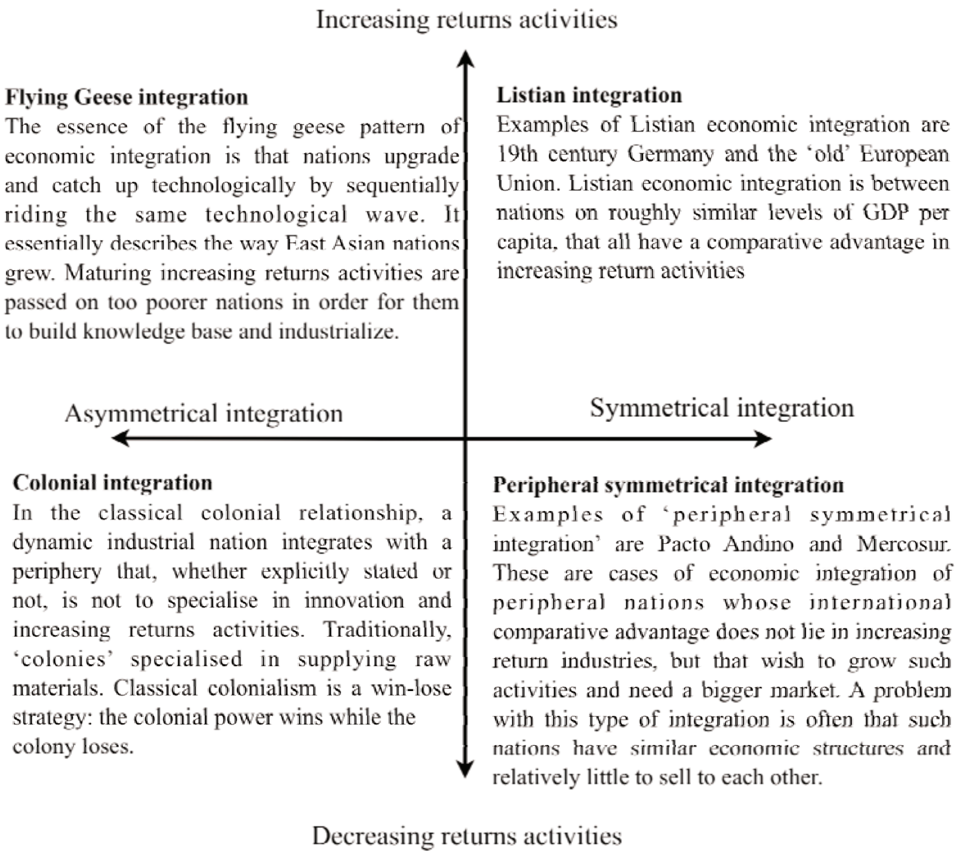
Yet, from 1990 up to today policy environment for industrial restructuring and innovation in CEE assumes the opposite: CEE integration is based on symmetrical integration. Partially this was so because of the assumptions implicit in the Ricardian model, partially the actual statistics looked misleading (high technology bias) and most actors involved were engaged in reasonably high levels of wishful thinking. In fact it may be argued that Europe's relation to its own periphery shows very similar characteristics of asymmetry that the world economy as a whole does to the global periphery (Reinert 2006). This may mean a tendency towards factor-price polarization rather than factor-prize equalization.

It can be argued that much of the pre-Smithian history of economic thought is filled with treatises trying to understand why certain types of trade with certain regions bring beneficial results and other types do not, i.e. being concerned with the dangers of asymmetrical integration. The clearest early statement of this theory is found in the first pages of Charles King's three-volume work (1721), a compilation of works published in the previous decade, which was to enjoy unique authority for decades. It is important to note that his theory is based on a possible discrepancy between the interest of the merchant and the interest of the nation itself: "There are general Maxims in Trade which are assented to by every body. That a Trade may be of Benefit to the Merchant and Injurious to the Body of the Nation, is one of these Maxims." (1721:1) This is, of course, very different from the later teachings of Adam Smith, who assumes an automatic harmony of interests between merchant and nation. In King's scheme, the normal pre-Smithian scheme, the vested interests of some economic actors will coincide with those of the nation-state – mainly those of the manufacturers – while the vested interests of other economic actors will be at odds with the interests of the nation-state.

The pre-Smithian taxonomy of 'good' and 'bad' trade was based on the observation of the obvious urban bias of economic development that was found everywhere in Europe. The taxonomy is based on the fundamental understanding that economic development is activity-specific, at any point in time available in some economic activities rather than in others. Development was seen as a goal created by increasing returns and innovations in manufacturing and not in agriculture, where stagnant productivity, diminishing returns and monoculture, and absence of synergies prevented growth (see as examples Botero 1590, Serra 1613 & 2009, and Reinert 2007 for in-depth discussions).

As a continuation of King's principles, and with the experience of 300 more years of economic history, we can establish the taxonomy – based on 'ideal types' – of economic integrations (see Figure 2). There are two main types: symmetrical free trade areas (i.e., integration among nations at a similar level of economic development and economic sophistication), and asymmetrical free trade areas (i.e., integration of nations with widely different economic structure at different levels of development).

Figure 2: Taxonomy of Economic Integrations

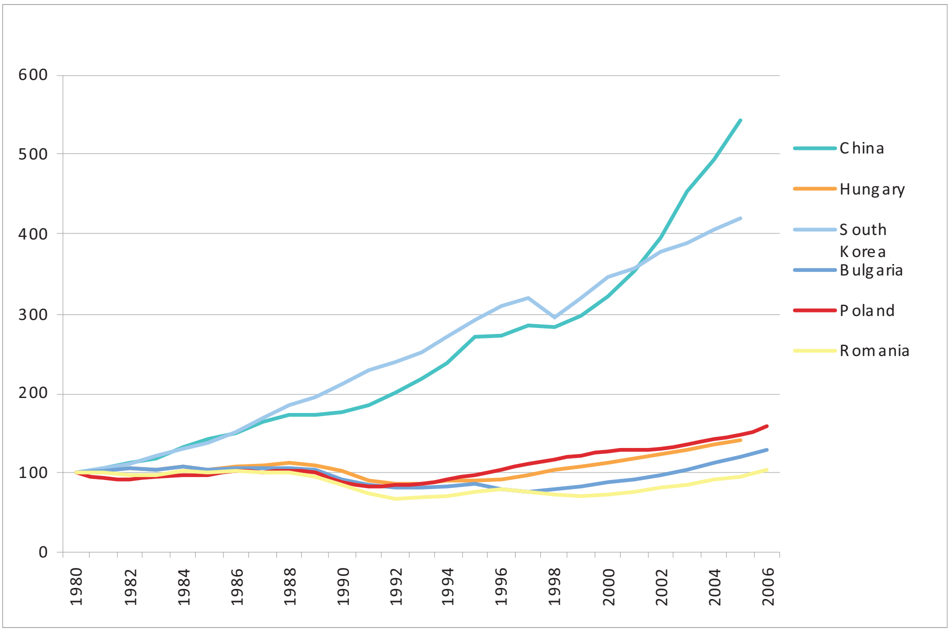


Source: Reinert and Kattel 2007, modified.

There are two further, essentially mixed types of integration: First, the welfare colonialism type of integration. The term "welfare colonialism" was coined by anthropologist Robert Paine, who described the economic integration of the Arctic population into Canada (1977: esp. 1-52), and may partly well be applied to the integration of the Saami people in Norway. The essential features of welfare colonialism are: 1) the classical colonial drain is reversed, the net flow of funds is to the colony rather than to the mother country; and 2) the native population is integrated in a way that destroys their previous livelihood, and they are put on the dole. Second, there can also be an integrative and asymmetrical type of economic integration. This is a type of economic integration that differs from the classical colonial version above in that it attempts to integrate the asymmetrical partners – countries at different levels of economic development – into a welfare state. If we look at the way CEE countries have been integrating into the European Union, it can be argued that this process is largely falling under this heading in terms of economic integration. We base this judgement on three fundamental stylized facts that can be observed in CEE development since the 1990s:[3]

First, while CEE and other key developing countries experienced an exhilarating rise in FDI and exports, there is a stunningly obvious divergence in income growth between Asian economies, on the one hand, and CEE economies on the other hand (Figures 3 and 4). While China and Korea have seen their GDP per capita multiplied at least 4 times since 1980, CEE economies have struggled throughout the last decades to stay above the 1980 level.[4]

Figure 3: GDP per person employed, index (1980 = 100), 1980-2006.[5]



Source: World Bank WDI Online database.

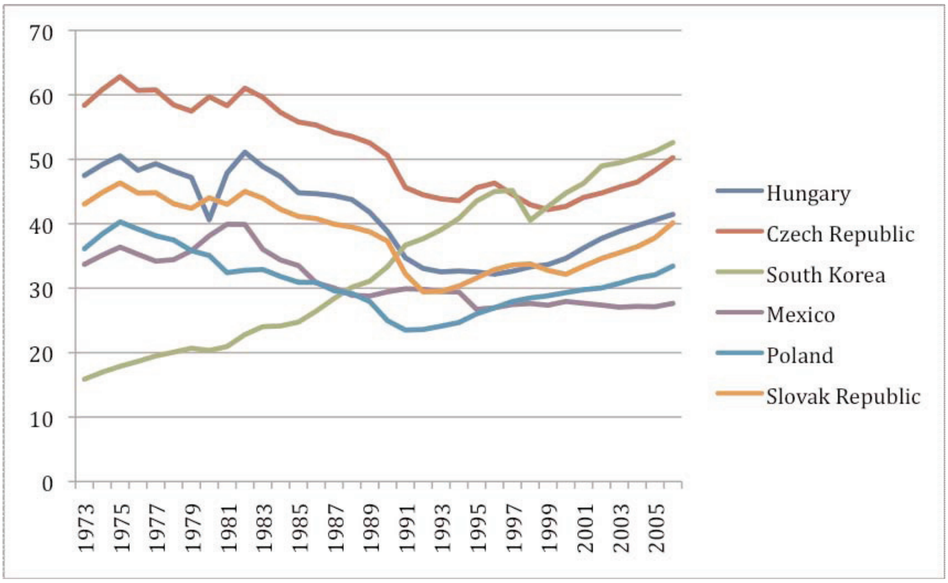
3 For more detailed arguments, see Reinert and Kattel 2007, and Tiits et al 2008.

4 According to the World Bank's calculations, the recession many former Soviet republics experienced during the 1990s, and are still experiencing, is worse than the Great Depression in the USA and the World War II in Western Europe (both recovered considerably quicker). In fact, for example, "even if Ukraine managed to grow steadily at 5 percent a year, starting in 2002, it would take until 2017 to regain its previous peak – implying a transformational recession of more than a quarter of a century at best." (World Bank 2005) Of course, the financial meltdown that reached many CEE countries starting in 2008 will certainly significantly prolong the process of catching-up.

5 Data is not available for all CEE economies.

As Guerrieri argued already in 1998, the East Asian economies "have surpassed Eastern Europe in many industries, not only in traditional product groups, but also in more technologically sophisticated sectors" and this is particularly so in "R&D-intensive (science based) sectors". (1998:20) While CEE countries' share in world trade grew from 0.73% in 1980 to 0.95% in 1995, East Asia's share grew in the same period from 3.80% to 10.83%. (Guerrieri 1998:29)[6] This trend is particularly pronounced for science based industries: CEE grew from 0.29% to 0.39% in the period from 1980 to 1995, East Asian economies grew from 4.83% to staggering 17.82%. (1998:38)

Figure 4. Income and productivity levels relative to the United States: GDP per capita, 1973-2006.



Source: OECD databases.

Particularly after the fall of the Berlin Wall, most CEE and other former Soviet economies saw deep dives in their growth rates and in industry as well as service sector value added. It took more than a decade for most CEE countries to reach the growth and development levels of 1990; many, however, still severely lag behind their development levels of 1990.[7] (Tiits et al 2008)

6 Guerrieri counts under CEE Hungary, Poland, Czech and Slovak Republics; under East Asia Singapore, Korea, Taiwan and Hong Kong.

7 For instance, countries like the Ukraine, Moldova, and most central Asian countries fell from middle income economies to poor countries and by now represent failed or fragile economies; see further Reinert, Amaïzo and Kattel 2009.

The main reason behind such a deep dive was, **second**, rapid deindustrialization and primitivization of industrial enterprises (Reinert 2007, Chapter 5) or even the outright destruction of many previously well-known and successful companies (see also Mencinger 2007; Landesmann 2000; Rodrik 1992). This happened because of the way Soviet industrial companies, and the industry in general, were built up and ran in a complex cluster-like web of planning and competition.[8] (On corresponding Soviet R&D system, see below in the next section). A sudden opening of the markets and abolition of capital controls made these industrial companies extremely vulnerable. The partially extreme vertical integration that was the norm in such companies meant that if one part of the value chain ran into problems due to the rapid liberalization, it easily brought down the entire chain. However, foreign companies seeking to privatize plants were almost always interested in only part of the value-chain (a specific production plant, infrastructure or location) and thus privatization turned into publicly led attrition of companies and jobs.[9] Liberalization of markets and prices meant that for many domestic companies demand was cut down, and thus companies with the highest relative fixed costs to variable costs (these tend also to be the technologically most advanced ones) were hit the hardest as their balance sheets worsened very quickly. If a company had a lot of machinery and equipment to be amortized, i.e. there have been recent investments into upgrading, then it is particularly harshly hit if its demand drops and if it is under financial stress because of liabilities to newly founded banks. Thus, by definition, the most advanced industries were hit by rapid liberalization first and also the hardest.[10] The last sector to survive is subsistence agriculture. This is called the Vanek-Reinert effect[11] and it could be observed in the unification of Italy in the 19th century, in Latin America in the 1980s, and again in the 1990s in CEE and other post-Soviet countries. One underlying cause was the particular nature of industrialization of CEE economies. In the last instance this process creates outward migration. The sequence may be described as de-industrialization, de-agriculturization, de-population.

Third, such a drastic change made it relatively easy to actually *replace* Soviet industry: with the macroeconomic stability and liberalization of markets, followed by a rapid drop in wages, many former Soviet economies

8 Radosevic 1999 is a good overview, see esp. 287-289; also Chandler 1993. For studies of Soviet industry, see Berliner 1976, Bergson 1978, and case studies like that of Skoda by Margolius and Meisl 1992, of East Germany's industry by Stokes 2000, and of Czech industry by Kosta 2005. For case studies on company level transition to capitalism, see Radosevic and Yoruk 2001.

9 Frost and Weinstein 1998, and Young 1994 offer excellent examples of how Western companies such as ABB, Gerber and others privatized CEE companies.

10 For instance, Radosevic shows how in higher-end computers, "where domestic demand is not growing and where finance requirements are high, the ex-socialist producers have closed down in all CEEC." (1999:299, also 303)

11 First articulated in Reinert 1980.

became increasingly attractive as privatization targets and outsourcing of production (we will return to policies in the next section). Indeed, one of the most fundamental characteristics of CEE industry (and services) since 1990 has been that the majority of companies have actually engaged in process innovation (e.g. in the form of acquisition of new machinery) in seeking to become more and more cost-effective in the new market place.

In sum, the key to understand why CEE seem to stand still or even fall behind when compared to Asian economies such as South Korea is the way many industrial companies were integrated into the world economy in the 1990s. CEE strongly embraced the idea of FDI-led restructuring which worked, however, in a highly specific way because of the simultaneous change in the techno-economic paradigm, and brought specialization at the lower end of the Quality Index and the value chain with grave difficulties of upgrading and, most importantly, strong enclavization, de-linkaging and primitivizing tendencies. The key why FDI-led strategies worked in such a way lies in a historic coincidence of techno-economic paradigm change and the onslaught of Washington Consensus policies taking place more or less at the same time. CEE countries were essentially flooded with FDI that was seeking to set up activities without significant increasing returns and this turned the integration of CEE into European and global markets into an asymmetrical but integrative type of integration. However, crucially, as we will show in the rest of the essay, the specific nature of CEE integration plays virtually no role in CEE innovation policies during the entire period from 1990 until today. Or to put it differently, the nature of CEE integration into global markets was mistaken to be a symmetrical and integrative type and the innovation policies followed from this assumption.

4. Disintegration of the Soviet R&D system in transition

However, in order to fully appreciate the changes in policy and their impact on innovation and economic development in general, we shall give a very brief overview of Soviet science and technology, and research and development system, and how these were initially influenced by the transition process.

Perversely mirroring the above-described cluster-like characteristic of Soviet industrial activities, the R&D system was based on similar vertical integration of R&D into specialized institutions: "Under socialism, most technical change was pushed from one institutional sector … which was essentially a grouping of R&D institutes and other related activities … This sector involved in activities far beyond R&D including design, engineering and often trouble-shooting activities." (Radosevic 1999: 282) These institutions were usually also the originators and carriers of patents and forms of intellectual property rights. (Ibid.: 285) This means that the Soviet-style R&D system had very low level of company in house R&D. (Radosevic 1998: 80-81) Industrial conglomerates were effectively cut off from various potential learning and feedback loops; production and actual innovation (in particular in the form of new products and processes) took place in different institutions, both however highly concentrated and integrated. Thus, in general the system was highly linear and supply-based.

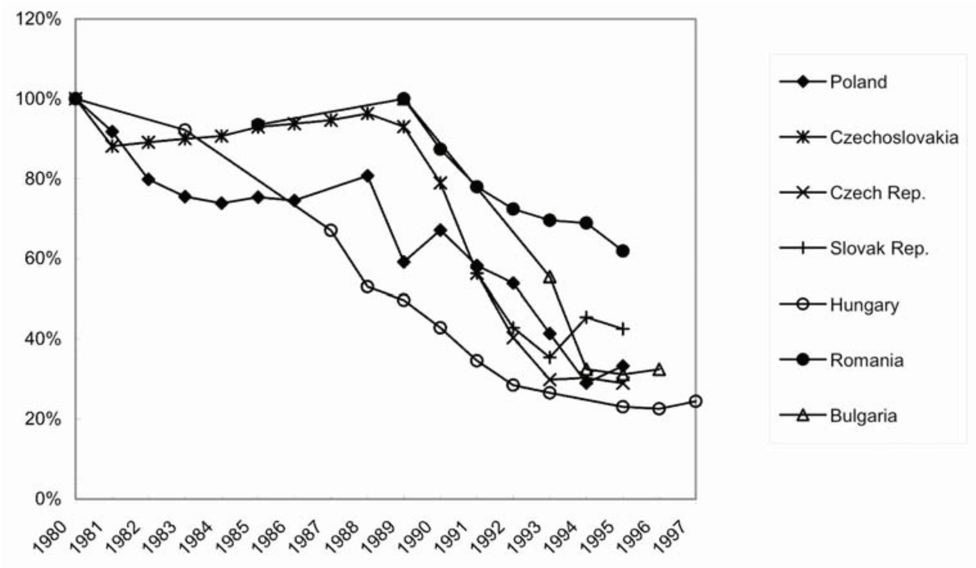
The R&D institutes concentrated often on 'grey' literature (manuals and the like) and overwhelmingly on mechanical engineering, which means that mostly these R&D capacities had little if any experience with competitive environment and imperfect competition prevalent in technologically and innovation-driven markets. These characteristics together with the Vanek-Reinert effect led in transition to "the fast marginalization of once hyper-developed R&D; the collapse of industrial demand for R&D; changes in industry demand for R&D; polarization of the R&D spectrum; and a changing institutional landscape." (Radosevic 1998: 84)

Indeed, the once complex tasks of engineering, designing and similar tasks were very rapidly replaced by significantly simpler commodified support activities as many companies were wiped out, privatized or restructured. The former R&D institutes could have played a key role in bridging academic research with industry needs as they were essentially the only existing link between the two. With the collapse of the institutes system, the link between academy and industry became, as Radosevic suspected in 1998, the weakest link in the CEE R&D system. (1998: 90) Indeed, in "conditions of high uncertainty and prolonged privatization, the intangible assets and know-how of industrial institutes, primarily embodied in R&D groups, probably erode much faster than production skills in industry." (1998: 100)

Massive onslaught of FDI, in particular since the second half of the 1990s and privatization of enterprises gave foreign enterprises a key role in industrial restructuring and innovation. This, in turn, only reinforced the severing of linkages between former R&D institutes and the enterprise sector. (See also Radosevic 1999: 297).

This change can be seen in all basic S&T and R&D data. The rapid decline in R&D employment after 1990 took on partially enormous proportions with employment dropping by a third or more in CEE as shown in Figure 5. (Radosevic 1998: 86; also Meske 1998)

Figure 5. R&D personnel in CEE countries, 1980-1997; 1980 = 100.[12]

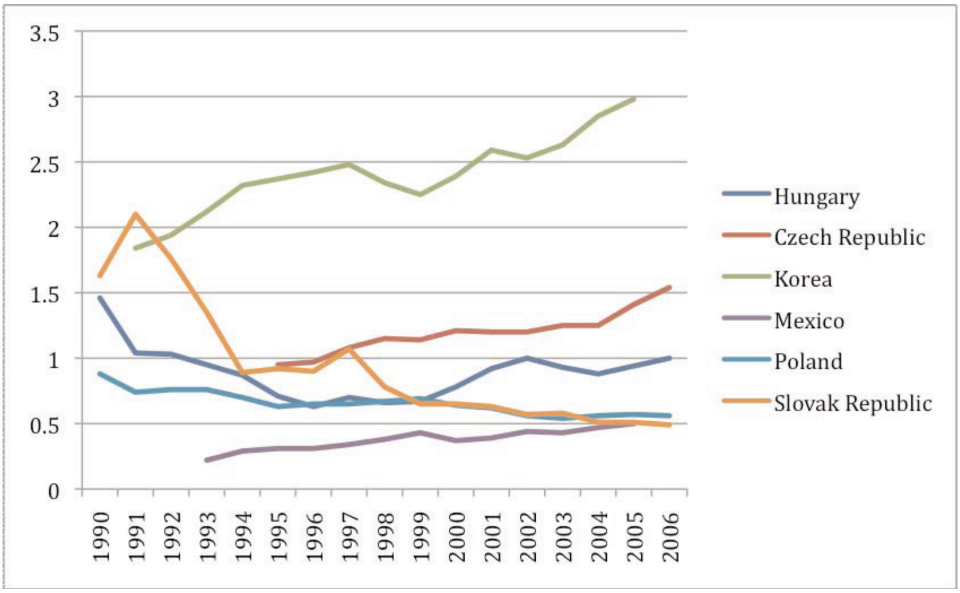


Source: Meske 1998.

In particular when compared to East Asia's developments over the same period, CEE transition in the 1990s is in many ways a lost decade in terms of basic R&D indicators. In Figures 6-8, South Korea is used as a proxy for East Asian countries and Mexico for Latin America. The Figures show that CEE countries converge with Latin American trends and not with East Asian ones.

12 Meske 1998 brings similar figures with similar tendencies also for the Baltic states, Russia and other former Soviet republics.

Figure 6. General Expenditure on Research and Development as % of GDP, 1990-2006.

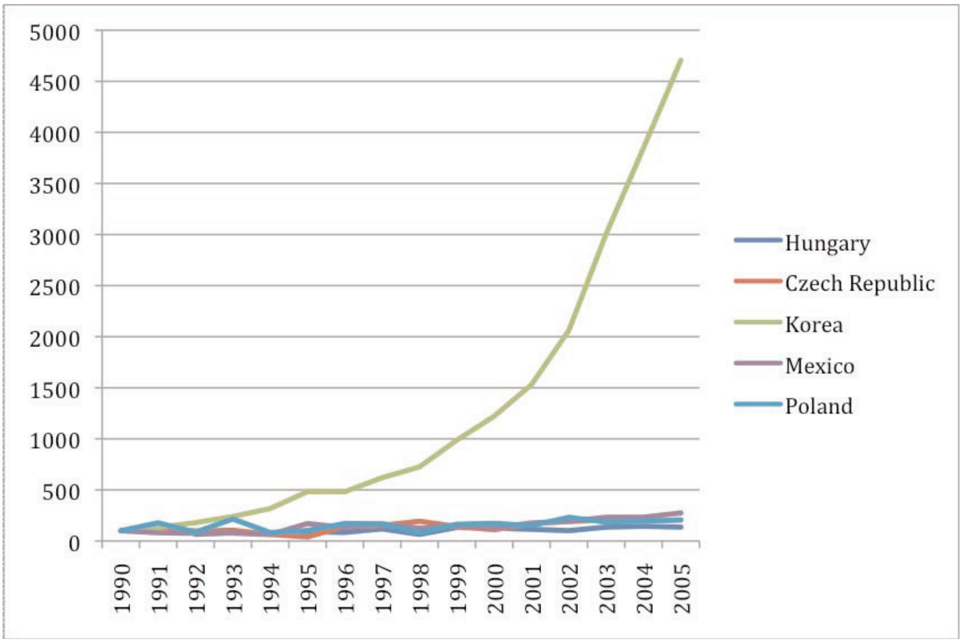


Source: SourceOCED database.

The decrease in GERD from 1990 onwards until the end of the decade coincides, as we will show below, with big divides in CEE innovation policies. With the beginning of the accession negotiations and increasing funding from the EU, CEE countries' investments into R&D start to increase while the preceding decades mirror the ideas of Washington Consensus policies that market initiaties (also in form of R&D investments) are more important and efficient than public sector intervention.

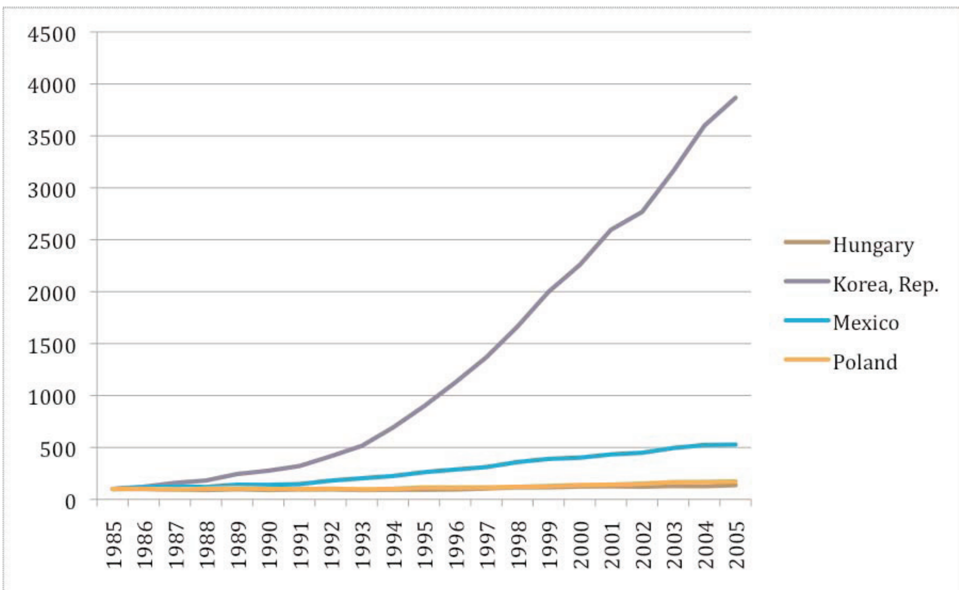
Figures 7 and 8 indicate very similar tendencies in patent applications and scientific publicatons in CEE compared to East Asia and Latin America. While CEE and Latin America are more or less flatlining since 1990 or 1985 respectively, South Korean development is qualitatively highly different.

Figure 7. Patent application at European, US and Japanese patent offices, 1990-2005; 1990 = 100.



Source: SourceOCED database

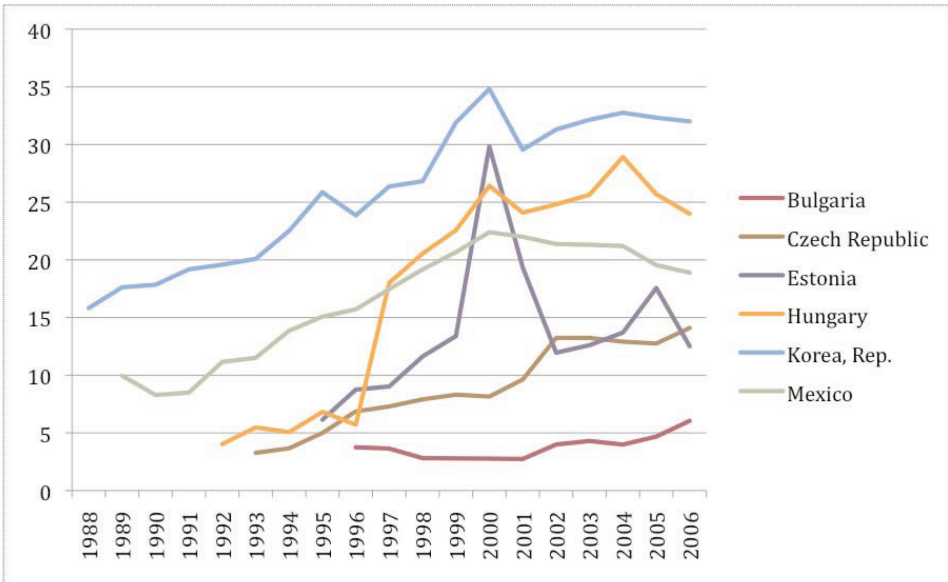
Figure 8. Scientific and technical articles, 1985-2005; 1985 = 100.



Source: World Bank WDI Online database.

Against this background the significance of rapid increase in high technology exports also in CEE countries becomes clearer (Figure 8). In high technology exports CEE and Latin America are clearly following the same path as East Asian economies.

Figure 9. High technology exports as % of all manufactured exports, 1988-2006.



Source: World Bank WDI Online database.

Yet, dissonance between disintegrating R&D system, much slower catching up pace and rapidly growing high tech exports are perhaps the best indicator of how importantly the change in techno-economic paradigm and the rise of modularity and outsourcing production changed the perception of what is happening in CEE countries. As we will see in the next section, innovation policy in CEE was a key driving factor in initiating changes in the R&D system and also cementing the perception of high-tech based growth.

5. Innovation policy in CEE since 1990

If we look at the CEE innovation policy developments since 1990, we can divide these into three rather distinct periods:

1) Killing the Geese, 1990-1998;

2) Harmonization with the EU 1998-2004;

3) Awakening, since 2004.

Killing the Geese, 1990-1998

The flying geese metaphor (see above, Figure 2) for economic integrations first appears in a 1935 article by Kaname Akamatsu published in Japanese. His views became known to the West in his 1961 article in *Weltwirtschaftliches Archiv*, and during the 1980s Japanese economist and foreign minister Saburo Okita propagated the concept. The essence of the flying geese pattern of economic integration is that nations upgrade and catch up technologically by sequentially riding the same technological wave. It essentially describes the way East Asian nations grew.[13]

To illustrate the process, follow a product: a hairdryer is produced in Japan and exported to the rest of the world. When Japan upgrades its technology and wage level, the production of hairdryers passes on to Korea and is exported from that country. As Korean production after a while also gets more sophisticated, the production of simple hairdryers passes on to Taiwan, where the phenomenon is again repeated. Hairdryer production moves on to Malaysia and Thailand, and finally to Vietnam. On the way all nations have increased their wealth and upgraded technologically, based on the same product.

We argue that CEE countries followed essentially the opposite strategy of killing the geese: trying to restructure their economies, and in particular industries, through a very rapid replacement (not gradual upgrading) of Soviet style companies.[14] This pattern is extremely different from the very successful integration of Spain into the EU starting in 1986: The strategy towards Spain was based on a gradual reduction of tariffs aiming at assuring the survival of the *existing* Spanish industrial sector, including the activities with a high score on the dynamic Quality Index of Economic Activities (Figure 1). The EU integrated with Spain in a way that provided a Schumpeterian creative destruction that upgraded the existing industrial sector. In contrast, the EU strategy towards the CEE countries – certainly partly as a result of the market *triumphalism* following the fall of the Berlin Wall – created a form of 'destructive destruction': the high value ('high quality') sectors were destroyed and were replaced by low value added sectors.

[13] The model builds on Friedrich List's stages of integration. Its dynamics are similar to Michael Porter's stages of national development (Porter 1990) and to Ray Vernon's life-cycle theory of international trade (Vernon 1966) and to Jane Jacobs' import-replacing development of cities (Jacobs 1984).

[14] It is clear that we are abstracting here from the actual policy developments in CEE. Drahokoupil 2007 offers a very interesting way to group different strategies followed by CEE countries in the 1990s: "The competition states in the Visegrád four can be called *Porterian*, aiming at attracting strategic FDI through targeted subsidies … The Baltic competition states can be called *macroeconomic stability-driven neoliberal states with monetary institutions at their core*. … Finally, Slovenia has developed a distinct type of competition state, which can be characterized as *balanced neo-corporatist*." (2007: 90).

The CEE story is similar to that experienced by Mexico in its integration with its Northern neighbors in NAFTA (see Cimoli 2000). The 'destructive creation' in financial markets added an additional blow to the peripheral countries both in the EU and NAFTA. In both cases the adjusting factor is outward migration: the comparative advantage of the periphery becomes the export of its people.

As we argued above, together with the change in the techno-economic paradigm, Washington Consensus policies (trade and capital account openness, increasing reliance on foreign direct investments and exports to drive growth, low inflation, balanced public budgets and generally rolled back state) were the key behind the fast and furious restructuring of the economies that CEE countries experienced in the 1990s. The Washington Consensus policies were considered by many CEE countries as *the* innovation and industrial policy measures and in essence there were no other policy initiatives.[15] During the 1990s innovation policy proper was considered as secondary to transition related concerns (Mickiewicz & Radosevic 2001: 10). Indeed, innovation, R&D or generally science and technology policies and funding schemes intact during this period were carry-overs from the socialism times and were rapidly disintegrating, as we showed above. In many ways this was a period of 'no policy policy'. The demand from the market was supposed to be the key driver of changes in R&D and innovations – and their funding. Rather, CEE countries were enjoying productivity growth mainly in the realm of "reallocations" that turned out be only of highly temporary nature (Radosevic 2002a: 355; Radosevic 2006). This also suggests, as we argue above, that innovation in CEE during the 1990s is mainly about equipment and the mastery of production capabilities, and is not related to R&D (Radosevic 2006: 37-38).

During this period, almost all economic policy capacity building was directed towards macro-economic skills (at central banks, ministries of finance, also think tanks). This was greatly helped by the advice and assistance from the Washington institutions such as the World Bank and IMF, but also from OECD and the EU. Policy networking, coordination and cooperation were almost completely ignored. As there were no innovation policies proper, there was also essentially no institution building in this area.

Coupled with the change of techno-economic paradigm, Washington Consensus policies emphasizing FDI-led growth have created for CEE a truly toxic situation where initially liability destruction was strong and quick but

[15] As Weissenbacher 2007 argues, Hungary, Poland and Yugoslavia had experiences of dealing with IMF already during the 1980s, when they borrowed money from it and applied standard austerity programs (2007: 71-71).

followed by slow asset creation. Thus, "the failure of the Consensus reform policies lies in the fact that they provided support for the 'destruction' of inefficient domestic industry, but failed to provide support for the 'creative' phase of 'creative destruction' of a real transformation of the productive structure through higher investment and technological innovation." (Kregel 2008)

In sum, the Washington Consensus or the killing the geese period (up to late the 1990s) left CEE countries with an almost completely changed economic and industrial structure that is deeply different and much less skill- and technology intensive than the previous structure. This explains fast growth but also the not- catching-up with the Asian economies in terms of productivity and income growth as the productivity growth in CEE in the 1990s goes back to significantly decreased employment in industry (see Landesmann 2000). In addition, there was essentially no innovation or industrial policy and policy making competencies and institutional development centred around macro-economic realm, networking, coordination and cooperation were almost completely ignored.

Harmonization with the European Union, 1998-2004

While EU's importance for CEE countries economic policies was visible already during the early 1990s, the change that increased EU's impact considerably was the beginning of accession talks with most CEE countries in 1998 and later. Indeed, Havlik et al. 2001 argue that the adoption of the EU *acquis communautaire* has had a much stronger impact on the modernization of CEE industry than the official (often rudimentary) innovation policy during the 1990s. The introduction of new regulation (usually with significantly higher safety, health and other standards) meant that CEE industry "was forced to choose whether to modernize their products and production facilities rather drastically, to subject themselves to mergers with bigger players with greater economies of scale, or to close down altogether". (See Tiits et al 2008: 76-77) However, while harmonization with European standards is a distinct driver of changes in the private sector and also in legal infrastructure, it is also important to note that such harmonization made outsourcing and relocation of production much easier. On the one hand, the harmonization process was a continuation of restructuring processes that started during the previous period and were even significantly enforced. On the other hand, through so-called pre-structural funding and its management, many CEE countries started to develop first strategic documents and policies related to innovation and R&D proper.

The EU played a considerable role in setting the criteria for accession into the Union and actively participated in building up capacities to meet these criteria already since the early 1990s (Bruszt 2002: 121; also Bruszt and McDermott 2008). This is expressed in particular by the EU financial aid through the PHARE programme that became the key instrument of the harmonization period and also the first wave of Europeanisation. PHARE was launched in 1989 as EU's financial instrument to assist the CEE countries (initially only Hungary and Poland) in their political and economic transition from a centralised communist system to a decentralised liberal democratic system. In its initial phase, PHARE remained a project-based financial assistance scheme: it paid for inputs, rather than for results in terms of effective adoption and implementation of the *Acquis* (Martens 2001: 37; Grabbe 2006: 80-81).

As PHARE was reformed profoundly during 1990s, also the grasp of the EU became stronger: 1) PHARE was expanded to additional 11 countries eligible for support, and 2) PHARE's goal as the EU's main financial instrument for support changed considerably: away from transition issues and economic restructuring towards support of the accession process (Martens 2000; Martens 2001; Bailey & de Propris 2004). As a result, since 1998 (through the Accession Partnerships) PHARE can be considered as a legal basis to secure transposition of the *Acquis* in deeper scale and scope (Martens 2000: 5).[16]

In the late 1990s, due to the progressive decentralization of the PHARE management structures as well as EU requirements for creation of regional and local institutions to administer the EU funds after the accession, a system of implementation agencies linked to the National Funds was created and pursued in CEE (EC Regulation 1266/99; Commission Decision on the Review of the PHARE Guidelines for the period 2000-2006; Grabbe 2006: 82). This marks the first step in CEE towards managing economic policy, and thus innovation and industrial restructuring in a distinctly different manner from the previous period where the free market and external forces were seen as key drivers of change. However, it is also important to see that these newly established agencies are mostly for managing external funding, policy creation and respective capacity building play almost no role in these agencies. Yet, this decentralization and in particular the existence of autonomous state agencies have been seen as a positive feature in state-market relationships due to multi-level accountability (Bruszt 2002), but also due to the ability of this kind of policy-making system to reflect and affect adequately the dynamic, global and technology-driven economy (e.g. Goldsmith & Eggers 2004; for Central and Eastern European countries, see

[16] In 2000, PHARE's support was extended to economic and social cohesion and institutional capacity building (preparation for management with structural funds) (PHARE Annual Report 2001).

here Drechsler 2004). However, the compartmentalized and structured nature of EU support (PHARE Consolidated Summary Report 2007) on the one hand, and the lack of tradition of partnership and inter-institutional coordination and cooperation between administrative levels on the other hand, meant that most positive effects of such agencies were not reaped and that they created in some cases more difficulties and problems than they solved (ESPON 2005).

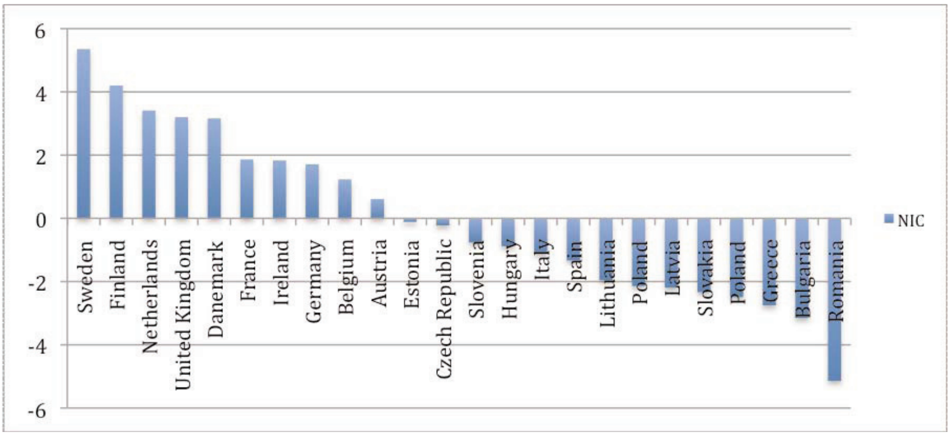
In addition, due to considerable time pressure – harmonizing the legal infrastructure and preparing for accession in 6 years – meant that adoption of EU's legal infrastructure was done hastily and without much attention to local context. (PHARE Consolidated Summary Report 2004; PHARE Consolidated Summary Report 2007; see also Schimmelfennig & Sedelmeier 2004; Goetz 2001).

The need for implementation capacity was in particular relevant in the areas where the *Acquis* was not specific and well defined and where implementation of *Acquis* needed complex and relatively well developed public administration systems with a high degree of strategic policy development capacities (PHARE Consolidated Summary Report 2004; PHARE Consolidated Summary Report 2007; see also Martens 2001: 40 and Martens 2000: Annexes). This was compounded by the fact that labor- and resource intensive sectors forming most of the CEE industry were the ones most affected by the *Acquis* (see Havlik et al. 2001; Havlik 2005: 123). Thus, CEE industry went through another restructuing process that was again led by external factors and again local context played little if any role in policy considerations.

In sum, in many ways the harmonization with the EU rules is a period where policies supported the restructuring of the industry that began in the 1990s under the Washington Consensus policies; on the other hand, during this period EU's influence on funding and administrative schemes brought creation of novel governance structures that play up to today key part in innovation policy in CEE.

However, if we look at what Radosevic calls "national innovation capacities", then these were by 2000 clearly underdeveloped in all CEE countries compared to the 'old' member states (Figure 10; Radosevic 2004).

Figure 10. National Innovation Capacity (NIC) index for EU member states, 2000.[17]



Source: Based on Radosevic 2004.

Thus, the disintegration of the R&D system that began with the transition was still in full force during the harmonization period. And while it can be argued that by 2000, the CEE economies and in particular their innovation capacities grouped these countries into two groups of stronger and weaker performers (Radosevic 2004: 660), most CEE economies start to recover from the transition losses by 2000 (see Figures 3 and 4 above). However, in particular with increasing flows of FDI into CEE and growing high technology exports, the recovering was interpreted as imminent catching up or convergence with the 'old' Europe. This misconception became the key driver of innovation policies in CEE from 2004 onwards.

Awakening, since 2004

While harmonization with the EU legal infrastructure was important both in terms of the actual changes it brought to industry and in terms of policy implementation agencies that were created to manage EU's financial help, the key changes in innovation policy proper came with EU structural funding[18] that

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[17] The index is built from 4 sub-indexes that are in turn based on the following data (in parenthesis): Absorptive capacity (Expenditures in education in % of GDP; S&E graduates (% 20–29 population); Population with 3rd level education; Participation in life-long learning; Employment medium/high-tech manufacturing; Employment high-tech services); R&D supply (Public R&D expenditures (% GDP); Business R&D expenditures (% GDP); R&D personnel per labour; EPO high-tech patents; USPTO high-tech patens; Resident patents per capita); Diffusion (Training enterprises as % of all enterprises; CVT in % of labour costs of all enterprises; ISO 9000 certifications per per capita; Internet users per 10,000 inhabitants; PC per 100 inhabitants; ICT expenditures (% GDP); Demand (Stock market capitalization in % GDP; Domestic credit provided by banking sector; Share of FDI in GDP; Share of trade in GDP; Index of patent rights; Registered unemployment). (Radosevic 2004)

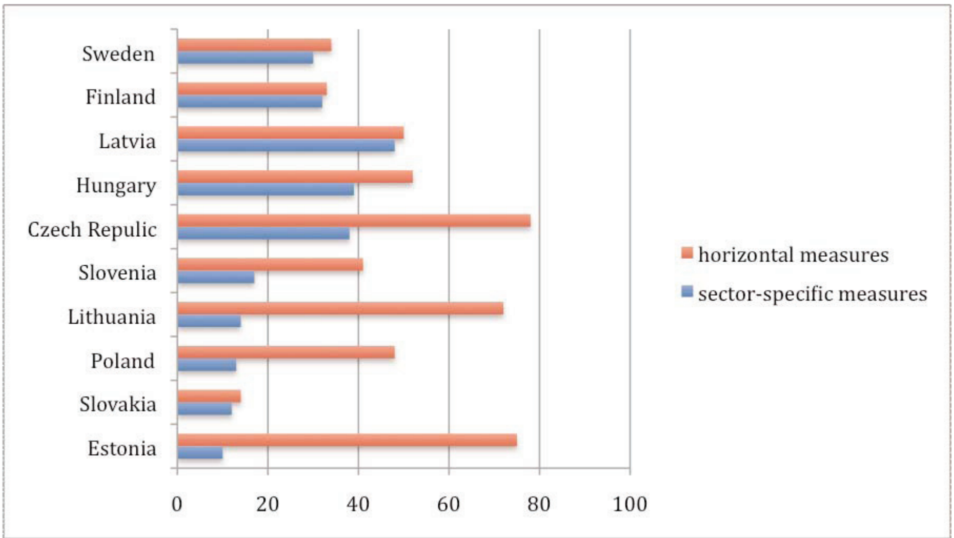
[18] For a general overview, see the EU's official homepage for structural funding, http://ec.europa.eu/regional_policy/funds/prord/sf_en.htm.

started in 2004 and is set to continue at least until 2013. Indeed, as we will see below, the EU structural funding significantly changed both the policy content and implementation. However, as we will also see below, the key problems that emerged during the harmonization period (low networking, weak administrative capacity, coordination and cooperation problems) have been in fact deepened during the current period.

The key content for many innovation policy initiatives in CEE emerging after the accession was the underlying assumption that similarly to 'old' European countries, also the new members need to overcome the so-called European paradox (good basic research, low commercialization of the research results).[19] This is mostly due to miscued policy transfer from the EU to the member states (See also INNO-Policy TrendChart Country Reports 2006 and 2007). Accordingly, innovation and R&D policies emerging in CEE in the mid-2000s were based on a linear understanding of innovation. Innovation is seen as something close to science and invention, and that there is a more or less linear correspondence between scientific discovery and high innovation performance; and that innovations behave like Nokia's mobile phones and thus search for the latter became the holy grail of CEE innovation policy. Thus, CEE innovation policies emerging in early and mid 2000s tend to concentrate on high technology sectors, on commercializing university research, technology parks for start-ups and similar efforts (Radosevic 2002a: 355; Radosevic & Reid 2006: 297; also INNO-Policy TrendChart Country Reports 2006 and 2007 for comprehensive overviews of CEE countries' policies and challenges). In contents, an overwhelming number of policy measures concentrate upon innovation programmes and technology platforms (Reid and Peter 2008). At the same time, the CEE emerging innovation policies are characterized by their horizontal nature: policy measures typically do not specify sectors but are rather open to all sectors. (See Figure 11) Arguably, this has to do with they way CEE policy makers understood EU state aid regulations (Reid and Peter 2008). We argue that this has to do with both a general neo-liberal outlook (i.e. let the Ricardian comparative advantage work through markets rather than to rely on government interventions through priorities etc) carried by most CEE policy makers by the early 2000s and also their particular skills that concentrated into macro-economic areas. (See also Drahokoupil 2007)

[19] An excellent discussion of the paradox is Dosi, Llerena and Labini 2005.

Figure 11. Innovation policy measures in CEE, sector-specific measures vs horizontal measures.[20]



Source: Based on Reid and Peter 2008.

Figure 11 also shows that compared to their EU neighbors CEE countries have typically significantly more innovation policy measures (especially if deflated by the size of respective econonomies). This can be interpreted as a growing fragmentation of the policy arena between multitudes of measures and implementation agencies.

In addition, as a majority of CEE measures are financed through EU structural funds, these instruments are mostly competition and project based. Interestingly, CEE countries exhibit significantly more innovation policy measures than the 'old' member states that. These aspects – project based implementation, multitude of horizontal measures – point to high fragmentation of the entire innovation policy field as well as to lack of policy priorities or the ability to set the latter. It is also evidence of the strongly market-driven understanding of innovation that is at odds with the underlying assumption that innovation policies need to alleviate the 'European paradox'. That is, a typical CEE innovation policy measure aims to commercialize a certain R&D result, typically in a high-tech area, but the result and thus the initiative have to come from the market. This, however, has scarcely any justifications in reality: first, CEE R&D systems and their performance

[20] Sector-specific are policy instruments that deal with one sector (e.g. biotechnology) only; horizontal measures are allocated to multiple sectors or do not specify any sector at all. See for details Reid and Peter 2008.

disintegrated heavily during the 1990s and fell noticeably behind East Asia; second, this was complemented by the strong specialization into the low-end of various value-chains, meaning that the demand for R&D and skills remains relatively low.

However, particularly since mid 2006 and 2007 there is a noticeable change towards including existing (low/mid-technology and outsourcing) industries into innovation policy making. In some countries, for instance Estonia, EU accession triggered a very significant policy change which brought innovation policy onto the agenda very strongly; in others, for instance in Slovenia and Hungary, the changes in policy focus occurred earlier and were more vocal. However, the changes were and are often accompanied by relatively little increase in actual funding and, as importantly, by relatively little public attention and discussion of policy strategy. (Tiits et al 2008; also INNO-Policy TrendChart Country Reports 2006 and 2007)

The impact of the European Commission (EC) in creation of these policies and in influencing their content has been enormous. One of the best ways to follow how the EC negotiated with the accession countries, and influenced innovation policy after the accession, is to follow the so-called negotiating mandates (essentially communications and feedback from the EC about the accession countries' plans how and for what to use the EU's structural funding). These documents are not public, thus we will quote here from various negotiating mandates in a way that countries will remain anonymous. All quotes pertain to 2004-2006 documents.

Example 1:

the Commission distinguishes three core areas of intervention [that are needed]:

- business infrastructure, improvement of institutional structure for business development and improvement of facilities for technology transfer and co-operation mechanisms between research departments and industry in order to boost the innovation capacity of the private sector and to increase the added value and labour productivity;
- active labour market policies in order to reduce the gap between (qualitative) demand and supply on the labour market and to upgrade the training infrastructure in order to adapt to demands on the labour market in a flexible way;
- upgrading of the quality of transport, environment and other technical infrastructure.

Example 2:

The description of the priorities is insufficiently selective. Formulation of objectives, priorities covers a very wide "sector of interests" and do not define priority (preferential) needs and solutions.

...

Therefore the EC recommends the **** authorities to seek for further reduction of priorities and prioritization of actions.

Example 3

The current structure of Priorities does not seem to reflect the real needs of the business sector. There is e.g. very little said on the development of research environment, facilities, and infrastructure and there are only a few references to investment in research infrastructure. No clear measure is foreseen on how to establish links between R&D and Industry, though the importance of this type of relationship is stressed.

Example 4

In this regard, the NDP is effectively silent on the country's use of Foreign Direct Investment as an element of its industrial policy and makes no reference to industrial specialization and emergence of clusters where ***** may have a competitive advantage.

Example 5

One of the most prominent features in the structure of the **** economy is the wide disparity that exists in sub-regional development. ... The NDP does not analyse this as a separate entity, and this is needed.

Example 6

As well as a national strategy for catching up, a comprehensive approach is needed to provide more favourable conditions for employment creation, by, for example, improving the functioning of the labour, product, and housing markets, especially in areas of high unemployment.

These examples stem from different negotiating mandates and different countries, but it is noticeable that most of them are distinctly similar in the following aspects:

1) The EC goes to great lengths to emphasize the need to manage both creation of new knowledge (through FDI and knowledge transfer as well as through domestic industry and R&D) but also the alleviation of obvious negative effects of the rapid restructuring that took place in the 1990s (addressing regional strong imbalances, need for active labour market policies etc).
2) One of the biggest problems in EC mandates seems to be low administrative capacity in the then accessing countries (from analytical capabilities to financial management problems); in particular long-term strategic management issues are emphasized. Indeed, this is perhaps the key problem in the emerging CEE innovation policy framework. (See more below)
3) Next to providing funding for various activities that should enhance upgrading, the EC stresses the need for 'function markets' in various areas. This development is paralleled in the way the Lisbon strategy was transformed around 2005 from a clearly Schumpeterian innovation-oriented strategic framework into very wide strategic guidelines that seek to deepen EU's common market and see in the latter (that is, in the increased competition) main driver for innovation and growth. (See Reinert and Kattel 2007)

It is also evident that at least among some experts in the European Commission there were growing doubts over the entire nature of CEE integration. That is, while the overall assumption of symmetrical integration still holds, there are obviously some areas where CEE countries have suffered during the integration process and accordingly need specific measures to remedy this.

In terms of implementation, the trend initiated during the harmonization period through creation of financial and management agencies has been intensified with the structural funds. (See INNO-Policy TrendChart Country Reports 2006 and 2007 for an overview) It is fair to say that the problems with these agencies that started during the harmonization period are partially deepened since 2004. Indeed, it can be argued that most problems summarized above in CEE innovation policies in one way or other go back to the institutional framework of agencies. Almost all CEE innovation policy implementation problems go back to very weak and disorganised actors, coordination problems are rampant in policy design and implementation (see also Radosevic 2002a: 355). On the one hand, there is a clear separation of policy responsibility between education/science and innovation/industry on the ministerial level and its delivery system (Nauwelaers & Reid 2002: 365; also see INNO-

Policy TrendChart Country Reports 2006 and 2007). On the other hand, this kind of fragmented policy-making system has in its turn resulted in the lack of inter-linking and cooperation between different innovation-related activities and actors such as research organisations, government and industry (see INNO-Policy TrendChart Country Reports 2006 and 2007).

While the creation and role of innovation policy agencies is praised in very positive terms by the official European Innovation Progress Report (2006: 65), we argue that precisely this agentification is at the root of many CEE innovation policy problems.

The main driver behind the engagement of agencies in policy-making is believed to be in the specific knowledge and expertise carried by these agencies (so-called "best of breed" providers) (Goldsmith & Eggers 2004: 29), but also the agencies' ability to be more in touch with certain specific circumstances and environment, and hence also with the needs of clients ("increased reach") (Goldsmith & Eggers 2004: 28, 34). Due to its emphasis on efficiency, this kind of innovation policy implementation model favors outsourcing of programme management and is generally highly market friendly as signals from the market are believed to be best policy guide (see European Innovation Progress Report 2006: 65-66). However, many CEE countries have seen their economies massively restructured during the 1990s that resulted, as we saw above, in an economic structure oriented towards outsourcing and low value added activities or sectors where networking and linkages are naturally very low. Indeed, under the circumstances where the ICT-led paradigm is enforcing de-agglomeration effects upon such economic structures and where macro-economic competencies in policy making have been a priority throughout the previous decade, most CEE countries have almost no experience in creating long-term policy frameworks that deal with networking, sectoral upgrading and so on. Thus, it is clear why the EC went to such great lengths to influence what the CEE countries are doing with the EU structural funding. It is, however, also clear that to create implementation agencies into such a situation is bound to complicate the problems. Indeed, agentification in these kinds of circumstances does not foster networking practices, but rather may cause severe problems in policy design and implementation as agencies are by definition at arm's length to government offices. Such tendencies tend to cause instability in a system as a side effect (see here case studies about the old member states by Pollitt et al. 2004). That is why the issue of agentification and particularly in innovation policy has been heavily raised by OECD in one of its latest reports (2005). Besides fragmented policy coordination together with goal congruence, contorted oversight, communication meltdown, capacity shortages and relation instability (for the most fundamental overview in these issues, see OECD 2005; but also Goldsmith & Eggers

2004), the delegation of public authority may be seen as a way to shift the responsibility away from government, and hence cause severe accountability problems. Indeed, as the EC's impact on CEE innovation policy making, while probably the key force in shaping these policies, is largely unofficial (the negotiating mandates we quoted from are not public, nor are they discussed in the respective parliaments), the accountability problem may become more and more important.

Thus, to sum up, while with the introduction of structural funds and through strong influence from the European Commission, CEE innovation policies are significantly changing since the mid-2000s, there are also serious problems that emerged with this trend. First, as we argued, the emerging innovation policies tend to be based on rather linear understanding of innovation (from lab to market) whereas most CEE countries are specialized into low end production activities virtually void of any research and with low demand for high skills; in addition, the R&D system as such has been under constant pressure since the transition and its performance has been clearly lacking. Thus, CEE innovation policies tend to solve problems not existing in the respective economies. Second, through creation of innovation policy implementation agencies (for structural funding and beyond), the innovation policy landscape is fragmented and previous problems in policy creation (lack of strategic skills and capacity, networking and coordination non-existent) and implementation (competitive grant-based programming that relies on market signals without being able to follow set priorities and goals) are only deepened. One can argue that the innovation policies emerging in the process of Europeanization are based on the assumption that policy design and implementation follow a public-private partnership model, yet in reality CEE countries singularly lack the ability to implement such a model, and what is more, actual developments in industry seem to suggest that such a model is particularly ill-fitted to the CEE context.

In addition, there is an essential problem that CEE economic and innovation policy making ignored throughout the 1990s and 2000s in devising policies to deliver economic restructuring and growth. A stable macro-economic environment envisioned to enable FDI inflow – in which CEE were indeed spectacularly successful – also encouraged massive private foreign lending (mostly through foreign banks settling into CEE markets that borrowed in foreign currency). This drove in particular since the mid 2000s consumption and real-estate booms in all CEE countries (see e.g. Fitch 2007a, 2007b and 2007c; see also Krugman 2008b in this context). Indeed, most CEE countries are highly dependent on foreign investments and private borrowing and thus they were caught in a macroeconomic dead end with appreciating exchange rates, negative current account balances and growing private indebtedness. This led to increased financial fragility through deteriorating balance of payments account and left CEE countries starving for new foreign lending and investments that however stopped in the aftermath of the global financial meltdown in 2008. In essence, CEE industrial restructuring and innovation model became a giant Ponzi scheme. As global, especially inner-EU demand slows, so do CEE exports and by early 2009 most CEE currencies have seen massive drops in their value and foreign investors seem to flee en masse (see also Fitch 2009). At the same time, in particular Central European countries such as Slovakia, Hungary and the Czech Republic have achieved high levels of integration with the EU: merchandising exports in worth of up to 60% of GDP goes in these countries to the EU (IMF DOTS database). Debt deflation looks very likely. Fragmented innovation policy seen, inherited from the accession into the EU, paralyses CEE countries' policy inaction as there seems to be no serious policy evaluation capacity present and coordination problems prevent quick reaction to a radically changed environment.

Conclusion

It is important to note how two key variables have shaped what kind of companies thrive in CEE: the new techno-economic paradigm (including a new 'common sense' as to the creation, organization, and management of knowledge in companies) and the global macroeconomic environment created by the Washington Consensus policies. These two variables also shape what kind of innovations take place in many CEE companies and have had a huge impact on local education, R&D, and S&T. Thus, the neo-liberal policies of the 1990s were a double-edged sword delivering a very fast industrial restructuring, but also leaving CEE economies with a primitivized economic structure, locked into low value added activities with a low score on the dynamic Quality Index of economic activities. Drawing on the parallel between 'old' EU vs. CEE in Europe and US vs. Mexico in NAFTA, the CEE a sense provided a low-skilled/low increasing returns *maquila* sector to 'old' EU just as Mexico did to the US. In both cases – in the CEE and in Mexico – the loss of the traditional diversified and potentially highly linkaged industrial sector provided incentives for outward migration. This migration was directed toward the areas with an industrial sector exhibiting higher quality activities from a dynamic Schumpeterian point of view. In both cases the surge of China made it very difficult – both for NAFTA and the EU – to create a win-win flying geese pattern of sequential industrial upgrading with its industrial periphery.

The influence of the European Union, first through accession talks in the form of a harmonization of legal infrastructure and creation of first innovation policy implementation agencies and later massively through structural funds, is equally a blessing in disguise. It has brought, on the one hand, creation of the first long-term innovation policies in CEE, which are, on the other hand, poorly tailored to local circumstances and implemented in a way that only made the situation worse.

Table 1 summarizes the main developments in CEE innovation policies since 1990.

Table 1. Changes in innovation policy models.[21]

Period	'Soviet' system	Washington Consensus	Europeanization
Main perspective	Public sector main R&D provider Public institues as source of innovation	Private sector main R&D provider Economic restructuring as source of innovation	Overcoming 'European paradox': commercialize research
Policy regime	Linear supply model	Linear demand model	Public private partnership model
Knowledge origin and diffusion	Top-down	Bottom-up	Networks
Key policy elements	Selective and centralized supply R&D policies	No policy policy FDI and increased-competition	Horizontal and demand oriented R&D policies Commercialization
Governance	Public institutions and companies	Privatization, creation of independent agencies	Agencies

The Washington Consensus policies, helped by the techno-economic paradigm changes, pushed the CEE economies unto a very different track of economic integration (an asymmetrical and integrative one) than initially envisioned by the overwhelming majority in the developing community and CEE policy makers: Ricardian comparative advantage was supposed to help restructure CEE economies and lead to symmetrical and integrative integration. In fact, we would argue that the greatest benefits from trade are a result of a large division of labour in activities with a large potential for innovation and subject to increasing returns (Reinert 2007). In this perspective, both CEE and Mexico specialized in the ‘wrong’ comparative advantage, locking them into technological dead-ends. In such a setting successful R&D projects are very difficult to match with the existing productive sectors: poor peripheral countries are in fact likely to subsidize R&D that materialize as innovations and increased added value in the core ‘old’ industrial countries.

21 This builds on Cimoli, Ferraz and Primi 2005.

The EU accession initially only deepened the path dependencies of specialization into the lower end of value chains through the harmonization process. The accession proper, following in 2004, brought policy advice from the European Commission that often assumed that the industrial restructuring had been mostly successful and that CEE is by now a smaller version of the 'old' EU. This, however, is largely misleading and also the European Commission shows signs of recognizing this misconception about CEE development and it pressurizes CEE countries to adopt a much more active role of the state in economic restructuring and innovation policies, in particular through structural funding.

Thus, we can summarize CEE industrial restructuring as evolution in organizational capabilities and national system of innovations into two rough periods, the 1990s and the 2000s (the period of harmonizations from 1998-2004 can be seen here as a transitional period that carries over many features into the next period and yet also paves way for the new period). Table 2 summarizes this evolution.

Table 2. Evolution of organizational capabilities and national innovation systems in CEE in the 1990s and 2000s.

	Main features of organizational capabilities	Main features of national innovation system
1990s	- Productivity increases through slashing liabilities and employment; - Replacement of products and machinery; - Foreign ownership provides key access to management and marketing know-how and production networks; - Modularity in production enhanced by ICT paradigm and harmonization with the EU regulations	- Privatization programs and other measures to attract FDI; - Emphasis on macro-economic stability; - Erosion and partial disintegration of the previous R&D system; - Harmonization of legal environment with EU requirements; - Prevalence of macro-economic policy skills; - Policy initiatives assume symmetrical integration of CEE into global economy
2000s	- Contract work for European companies; - Process innovations prevail through cost-cutting initiatives, new machinery; - Marketing and brand creation for home markets in certain industries (media, food); - Speculative real-estate activities	- Increasing fragmentation of policy arena through agencies that results in strong coordination problems; - Growing mismatch between R&D system, high-tech biased innovation policy and actual industry needs; - Increasing foreign lending and consumption booms that result in financial fragility

We showed that integration into the EU has brought a clear change into the innovation policy environment. Since joining the EU in 2004 or 2007 respectively, and already during the accession talks, there is a strong but almost not publicly discussed change in innovation policies in many CEE countries towards a much more active role of the state. In this change there is a clear and strong role of EU's structural funding, particularly negotiations and planning that come with it. However, these changes come with specific problems: first, there is an over-emphasis in emerging CEE innovation policies on linear innovation (from lab to market) that is based on the assumption that there is a growing demand from industry for R&D (which is not the case, because of the structural changes that took place in the 1990s), and, second, increasing usage of independent agencies in an already weak administrative capacity environment lacking policy skills for networking and long-term planning. We argued that such Europeanization of innovation policy in CEE, while highly positive in directing CEE to reorient economic policies towards more sustainable growth, is in its implementation often only deepening and exasperating the existing problems of networking, clustering and coordination.

Both key phases in industrial restructuring of CEE industry and evolution in respective policies, Washington Consensus and Europeanization respectively, created in enforcing each other's negative impacts (specialization into low-end production and policy fragmentation and weak administrative capacity) heavy financial fragility for CEE countries on the brink of global financial crisis in 2008. As the crisis unfolds in 2009, it becomes clear that CEE economies are particularly vulnerable to global recessions and the reasons lie with the development model chosen by these countries since the 1990s. 'The chickens are coming home to roost': past mistakes are returning with a vengeance. The key task CEE countries face now – apart from surviving the gathering tsunami in and around these countries – is to bring about a new indigenous form of capitalism with significantly less financial fragility and much more sustainable organizational capabilities and much changed national innovation systems.

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Working Papers in Technology Governance and Economic Dynamics

The Other Canon Foundation, Norway, and the Technology Governance program at Tallinn University of Technology (TUT), Estonia, have launched a new working papers series, entitled "Working Papers in Technology Governance and Economic Dynamics". In the context denoted by the title series, it will publish original research papers, both practical and theoretical, both narrative and analytical, in the area denoted by such concepts as uneven economic growth, techno-economic paradigms, the history and theory of economic policy, innovation strategies, and the public management of innovation, but also generally in the wider fields of industrial policy, development, technology, institutions, finance, public policy, and economic and financial history and theory.

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18. Reinert, Erik S., Yves Ekoué Amaïzo and Rainer Kattel. *The Economics of Failed, Failing and Fragile States: Productive Structure as the Missing Link*
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20. Carlota Perez, *Technological revolutions and techno-economic paradigms*
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23. Rainer Kattel, Erik S. Reinert and Margit Suurna, *Industrial Restructuring and Innovation Policy in Central and Eastern Europe since 1990*

The working paper series is edited by Rainer Kattel (kattel@staff.ttu.ee),
Wolfgang Drechsler (drechsler@staff.ttu.ee), and Erik S. Reinert (reinert@staff.ttu.ee),
who all of them will be happy to receive submissions, suggestions or referrals.

Article VI

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The mission of the IPTS is to provide customer-driven support to the EU policy-making process by researching science-based responses to policy challenges that have both a socio-economic and a scientific or technological dimension.

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ICEG EC team

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IPTS team

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Contractor:

International Center for Economic Growth, European Center (ICEG EC), leading a consortium of 10 other institutes in Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia.

Contract title:

Next steps in developing Information Society Services in the New Member States: The case of eLearning

Contract number: 150342-2005 F1ED HU

PREFACE

Policy context

At the European Council held in Lisbon in March 2000, EU15 Heads of Government set a goal for Europe to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. The renewed Lisbon goals of 2005 emphasize working for growth and jobs, and include plans to facilitate innovation through the uptake of ICT and higher investment in human capital.[1]

Information and Communication Technologies, and related policies, play a key role in achieving the goals of the Lisbon strategy. In 2005, the new strategic framework for Information Society policy - i2010[2] - identified three policy priorities: the completion of a single European information space; strengthening innovation and investment in ICT research; and achieving an inclusive European Information Society.

Education and training systems play an important role in reaching these goals. As ICT is a driver of inclusion, better public services and quality of life, all citizens need to be equipped with the skills to benefit from and participate in the Information Society. Enabling lifelong learning[3] for citizens with the facilities that ICT can offer is an important way of fostering their competitiveness and employability, social inclusion, active citizenship and personal development. Policy actions such as the Education and Training 2010 Work Programme[4] and Lifelong Learning Programme[5] have set objectives for education and support the development of learning in the knowledge society. One of the special focus areas of the Lifelong Learning Programme is developing innovative ICT-based content, services, pedagogies and practice in order to promote better education and training throughout a citizen's life.

Research context

IPTS[6] has been researching IS developments in acceding countries[7] since 2002.[8] The outcomes of this prospective research, which aimed to identify the factors influencing Information Society developments in these countries and the impacts these developments have on society and the economy, point to the need for better understanding the specific contexts in each member state for the take-up of e-applications, in particular eGovernment, eHealth, and eLearning. These key application areas have an impact not only on the relevant economic and public service areas but also on the development of the knowledge society as a whole.

Taking the above into account, IPTS launched a project to support eGovernment, eHealth and eLearning policy developments managed by DG INFSO and DG EAC. The research, which was carried out by a consortium led by ICEG EC in 2005, focused on the three application areas in the ten New Member States[9] that joined the European Union in 2004, in order to build up a picture of their

1 http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm
2 "i2010 – A European Information Society for growth and employment" COM(2005) 229
3 Lifelong learning means all learning activity undertaken throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and/or employment-related perspective.
4 http://ec.europa.eu/education/policies/2010/et_2010_en.html
5 http://ec.europa.eu/education/programmes/llp/index_en.html
6 Institute for Prospective Technological Studies, one of the seven research institutes that make up the Joint Research Centre of the European Commission
7 Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Turkey
8 For a list of complete projects and related reports see http://fiste.jrc.es/enlargement.htm
9 Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia

current status and developments in the field, the most important opportunities and challenges they face, the lessons other member states may learn from them, and the related policy options. National experts from each country gathered the relevant qualitative and quantitative data for analysis, in order to develop a meaningful assessment of each country's current state, and trajectory, and to find out the main factors. This allowed them to derive the relevant conclusions in terms of policy and research.

The IPTS team designed the framework structure for the research, the research questions and methodology. This team and the consortium coordinator jointly guided the national experts in their work through workshops, extended reviews and editing of the various interim reports. Data sources such as international and national survey data, literature, policy documents, and expert interviews were used to capture the most recent situation of the country.

In addition to national monographs describing eGoverment, eHealth and eLearning developments in each country, the project has delivered a synthesis report, based on the country reports, which offers an integrated view of the developments of each application domain in the New Member States. Finally, a prospective report looking across and beyond the development of three chosen domains was developed to summarize policy challenges and options for the development of the Information Society towards the goals of Lisbon and i2010.

eLearning in Estonia

This report was produced by Tallinn University of Technology, the consortium member from Estonia, and it presents the results of the research on eLearning in Estonia.

First, the report describes Estonia's educational system and the role played by eLearning in it. Then, the major technical, economic, political, ethical and socio-cultural factors of eLearning developments, and the major drivers and barriers for them in Estonia, are assessed. These provide the basis for the identification and discussion of policy options to address the major challenges and to suggest R&D issues for facing the needs of the country. The report reflects the views of the authors and does not necessarily reflect the opinion of the European Commission. Its content has been peer reviewed by national experts, ICEG EC, and IPTS.

In this study, eLearning is defined as encompassing both learning through the use of ICT and learning the necessary competences to make use of ICT in the knowledge society. Hence, the study considers the use of ICT in formal education[10] (schools and higher education), the use of ICT in training and learning at the workplace (professional education), the use of ICT in non-formal[11] education (including re-skilling and training for jobseekers) and the use of ICT in everyday life (digital literacy/digital competences and informal learning[12]).

All reports and the related Annexes can be found on the IPTS website at: http://ipts.jrc.ec.europa.eu/

[10] **Formal Education** is typically provided by an education or training institution. Formal learning is structured (in terms of learning objectives, learning time or learning support) and leads to certification. Formal learning is intentional from the learner's perspective.

[11] **Non-Formal Education** is provided by any organised, structured and sustained educational activities outside formal education. Non-formal education may take place both within and outside educational institutions and cater to persons of all ages. Non-formal learning is intentional from the learner's perspective, but typically does not lead to certification.

[12] **Informal Learning** is learning that results from daily life activities related to work, family or leisure. It is not structured (in terms of learning objectives, learning time or learning support) and typically does not lead to certification. Informal learning may be intentional, but in most cases it is non-intentional (or "incidental"/random).

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ADSL	Asymmetric Digital Subscriber Line
ASPA	American Society for Public Administration
BEACON	Potential socio-economic impact of broadband access and use on new forms of pan-European trading, collaborative work and advanced public service provision, a project in the "Information Society Programme" of the European Commission
CEE	Central and East Europe
CMS	Content Management System
CP	Credit Point
ECDL	European Computer Driver's Licence
ECTS	European Credit Transfer and Accumulation System
EEA	European Economic Association
EEK	Estonian kroon
EEIS	Estonian Educational Information System
EFTA	European Free Trade Association
ERDF	European Regional Development Fund
ESF	European Social Fund
E&T	Education and Training
eTEN	Trans-European Telecommunications Networks
EU	European Commission
EU10	The new member states joining the European Union on 1, May, 2004
EU15	The member states of the European Union before 1 May, 2004
EU25	The member states of the European Union before 1 January, 2007
EUR	European Currency Unit
eUSER	Public Online Services and User Orientation, a project in the "Information Society Programme" of the European Commission
DNS	Domain Name System
FTP	File Transfer Protocol
GDP	Gross Domestic Product
ICA	International Council for Information Technology in Government Administration
ICEG	International Center for Economic Growth
ICQ	Instant messaging computer programme
ICT	Information and Communication Technologies
IEA	International Association for the Evaluation of Educational Achievement
IEEE	Institute of Electrical and Electronics Engineers
IMF	International Monetary Fund
IMS CP	IMS Global Learning Consortium: Content Packaging Specification
IMS LIP	IMS Global Learning Consortium: Learner Information Package Specification
IMS QTI	IMS Global Learning Consortium: Question & Test Interoperability Specification
INNOVE	Foundation for Lifelong Learning Development
INTERREG IIIA	European Commission’s Community Initiative designed to encourage cross-border cooperation between adjacent regions aiming to develop cross-border social and economic centres through common development strategies
IPR	Intellectual Property Rights
IS	Information Society
ISCED	International System of Classification of Education
IT	Information Technology
ITL	Estonian Association of Information Technology and Telecommunications
LMS	Learning Management System
LOM	Learning Object Metadata

MSN	Instant messaging computer programme
MST	Maths, Science and Technology
NATO	North American Treaty Organisation
NDP	Estonian National Development Plan 2004-2006
NGO	Non Governmental Organisation
NMS	New Member States, see EU10.
OECD	Organisation for Economic Cooperation and Development
OSCE	United Nations and the Organisation for Security and Cooperation in Europe
PC	Personal Computer
PHARE	Pologne-Hongrie Aid a la Reconstruction Économique, the European Union's financial and technical cooperation programme with the countries of Central and Eastern Europe before the accession
PHARE ISE	The PHARE Information Systems in Education Programme
PIAP	Public Internet Access Points
PPP	Public Private Partnership
PPS	Purchasing Power Standard
PRAXIS	Center for Policy Studies, an independent not-for-profit think tank based in Tallinn, Estonia
R&D	Research and Development
REDEL	A project funded by European Union's structural funds to support the developments in eLearning in Estonia
RISO	Department of State Information System in Estonia
SAIS	Admission Information System
SCORM	Shareable Content Object Reference Model
SIBIS	Statistical Indicators Benchmarking the Information Society, a project in the "Information Society Programme" of the European Commission
SITES	Second Information Technology in Education Study
SME	Small and Medium Sized Enterprises
SMS	Short Message Service
SOE	Statistical Office of Estonia
SPD	Single Programming Document
TOEFL	Test of English as a Foreign Language
UN	United Nations
UNDPEPA	United Nations Division for Public Economics and Public Administration
UOE	Joint statistics of UNESCO Institute for Statistics, OECD, Eurostat
WAI	Web Accessibility Initiative
WTO	World Trade Organisation

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Estonia's economic transition to a market economy started with a relatively low GDP per capita and low productivity. Since the restoration of independence, Estonia has intensively pursued integration with the West, aiming to achieve a free market economy with a balanced budget, a flat-rate income tax, a free trade regime, a fully convertible currency, a competitive commercial banking sector, and a friendly environment for foreign investment. Today, the Estonian economy is characterised by one of the highest GDP real growth rates in the EU which, in turn, has created favourable conditions for achieving a high employment rate. In addition, economic growth has been supported by continuous growth in productivity. Productivity, however, has not kept up with wage growth. In recent years particularly, the latter has outpaced productivity growth and Estonia still lags far behind the EU average. In addition, economic growth has been concentrated in larger cities and towns; this is also illustrated by internal migration trends.

The adult population's level of formal education in Estonia is relatively high compared to that of the rest of the EU. In 2005, 89.1% of people aged 25-64 had at least upper secondary education – whereas in the EU25, the equivalent figure was 69.1% and in the EU15, 66.2% (Eurostat, 2007). There is a high enrolment level in higher education and hence a relatively high level of education of the employed population. At the same time, similar to many other developed and developing countries, the population of Estonia has constantly declined since the 1990s. The decreasing population will have a considerable impact on the Estonian educational system as a whole – the number of potential students at educational institutions will start to decrease after 2007. At the same time, the Estonian school system is also suffering from an increasing number of students dropping out of school or having to repeat a school year at the basic educational level. There is a need to increase participation in lifelong learning and company-provided training, and to cope with the digital divide.

ICT skills and ICT usage in Estonia have been influenced by several factors. There has been continuous economic growth and a rising standard of living. ICT markets are highly developed, there is a telecommunications network and Estonians have reacted positively to eServices. The political will to build up an Information Society and a knowledge-based economy has been strong since the late 1990s. However, the downside is that regional development has been unbalanced and the social groups which most use ICT and particularly the Internet, are students and employees.

Various international comparisons made over the years measuring Estonia's e-readiness rank Estonia very high, not only among the EU10 countries but also among the 'old' EU member states and the leading ICT countries. Estonia's progress is illustrated by the fact that Estonia has (1) one of the highest broadband penetration rates in the EU. In 2006, 37% all of households had broadband access, compared to 34% in EU25 (Eurostat, 2006); (2) Internet usage – the most characteristic indicator of Information Society development — has been growing rapidly over the years. The share of individuals aged 16-74 regularly using the Internet in 2006 was 56% in Estonia, compared to 47% in EU25 and 49% in EU15 (Eurostat, 2006); and (3) eServices provided in co-operation between the public and private sectors are easily available and usable. The percentage of online availability of 20 basic public services (eGovernment) is 79% in Estonia and 50% in EU25 and 56% in EU15 (Eurostat, 2006). Consequently, new technical, intellectual and social skills are becoming essential for living, working and participating actively in the society. So far, however, ICT developments in Estonia have not had a positive enough spillover effect into related fields such as education. This is especially evident when considering the great digital divide and e-exclusion apparent among the elderly, the population with a low level of education and income, and the Russian-speaking population groups.

Interest in ICT-supported learning has been strong in educational institutions as well as in the private sector since the end of the 1990s. eLearning developments have mainly been concentrated on the formal education and the strongest interest in eLearning is at the higher education level. However, the idea of eLearning is very much limited to and closely associated with web-based courses and material delivery.

There is no single policy document that combines all the aspects of eLearning in Estonia. Both in the formulation and implementation of policies, Estonia has relied upon non-profit organisations, schools, universities and local initiatives rather than upon the Government. This, in turn, has led to the establishment of various foundations and consortiums that implement policies independently, though technically they are under Government supervision. These institutions are [a] the *Tiger Leap Foundation* (focusing on general education); [b] the *Estonian E-university* consortium (focusing on higher education) established on the initiative of universities; and [c] *E-VocationalSchool* (focusing on vocational schools). In effect, the Government has not played a central role in developing eLearning, which means a legal framework for the initiatives is lacking. Therefore, several basic questions and significant issues such as standards, qualifications, training, infrastructure and content have not been mandated by the state and, hence, addressing them remains voluntary. The missing legal environment for eLearning means, above all, that there is no clear legal basis for financing eLearning initiatives. In terms of financing, the EU structural funds are of great importance and have strongly affected eLearning developments, especially at the higher and vocational education levels.

Several projects undertaken by the public sector together with some of the leading actors in the private sector such as ICT companies, banks, and telecoms, have immensely improved the ICT infrastructure and skills at schools and in regionally remote areas. In particular, these developments include (1) implementation of various *Tiger programmes* to provide schools and universities with computers and Internet connections; and (2) implementation of projects such as *Look@World* to contribute to the improvement of people's basic ICT skills.

Developments at the general educational level include in-service teacher training, introduction of eLearning services such as a web-based grade-book *eSchool*, Learning Management Systems (LMSs) and Course Management Systems (CMSs), and availability of digital learning materials and learning object repositories such as *Miksike* and *Koolielu*. ICT-supported learning is an increasingly popular form of study, especially in higher and vocational education where institutions develop web-based courses, materials and curricula, but also create and employ LMSs and CMSs for distributing materials, submitting homework and providing information on study results. At the higher educational level, however, ICT is also extensively used for administrative purposes, e.g. for enrolment in a course or a school and for communication with the school and teachers.

In the private sector, ICT-supported learning is mainly used by large companies, especially in the financial and telecommunications sectors. In the private sector, in-house LMSs have been developed. However, the eLearning applications for training and education of employees are quite often combined with traditional learning, using ICT mainly to deliver learning materials.

In lifelong learning, the main developments of eLearning include web-based courses for adults provided by educational institutions. To date, however, web-based courses have remained limited both in number and scope of content. Important developments for lifelong learning opportunities include, for example, ICT skills training, making the Internet available in libraries and the introduction of public Internet access points.

In sum, the progress in the field of eLearning in Estonia has been more demand-driven than policy-led. There is a great need to include eLearning in the educational and training systems, not as a goal in itself but as both a *goal* which aims to improve the quality and variety of learning methodologies and a *means* for building and supporting the Information Society and the knowledge-based economy. This is about supporting the use of new learning approaches in line with the ICT developments. In terms of educational practices, it is a challenge for the knowledge society that students, teachers, professionals, designers and researchers take part not only in knowledge acquisition, but also in shared knowledge and object creation for learning.

In Estonia, there is a need to find a consensus about the role of eLearning in the educational system and also, more broadly, the role of eLearning in the society as a whole. Here, legal and regulatory issues are of utmost importance. The goals of eLearning should be stated in a specific strategy, interconnecting ICT development at different educational levels. This strategy would be important to ensure the stability of eLearning developments and to make it possible for educational institutions to better plan their activities. In order to support the achievement of these goals, a favourable environment also needs to be established. This environment should be composed of elements such as sufficient financial resources, ICT infrastructure, a quality insurance system for digital learning materials, involvement of the current actors in the fields of education and culture in digitizing content, establishing centralised brokerage systems with digital rights management support as well as measures against piracy, and supporting further the training of teachers. It should be considered seriously whether there is a need for a special autonomous entity to co-ordinate eLearning concerns in all fields. A very important aspect in working out the framework for eLearning development in Estonia is that there is no single solution available for different problems, i.e. in developing policy options, distinctions must be made between different educational levels, including lifelong learning and workplace training.

There are two principal R&D challenges for eLearning in Estonia. Firstly, there is a need to implement mechanisms that will positively support the development of eLearning. These would include measures and institutions for organisational set-up, policies and strategies, and financial support for the field. And secondly, the question of how to support the usage of new learning approaches in line with current ICT developments in formal education and in lifelong learning needs to be addressed. These issues concern technological developments and the challenges posed by their application, financing schemes required in the use of eLearning and solutions for current IPR and data security problems.

INTRODUCTION

General data

Official name: Republic of Estonia

Area: 45 227 sq km

Administrative divisions: Estonia is divided into 15 counties, 227 rural municipalities, and 33 towns. Tallinn, its capital, has 0.4 million population.

Population: 1 344 684 (SOE, 2007)

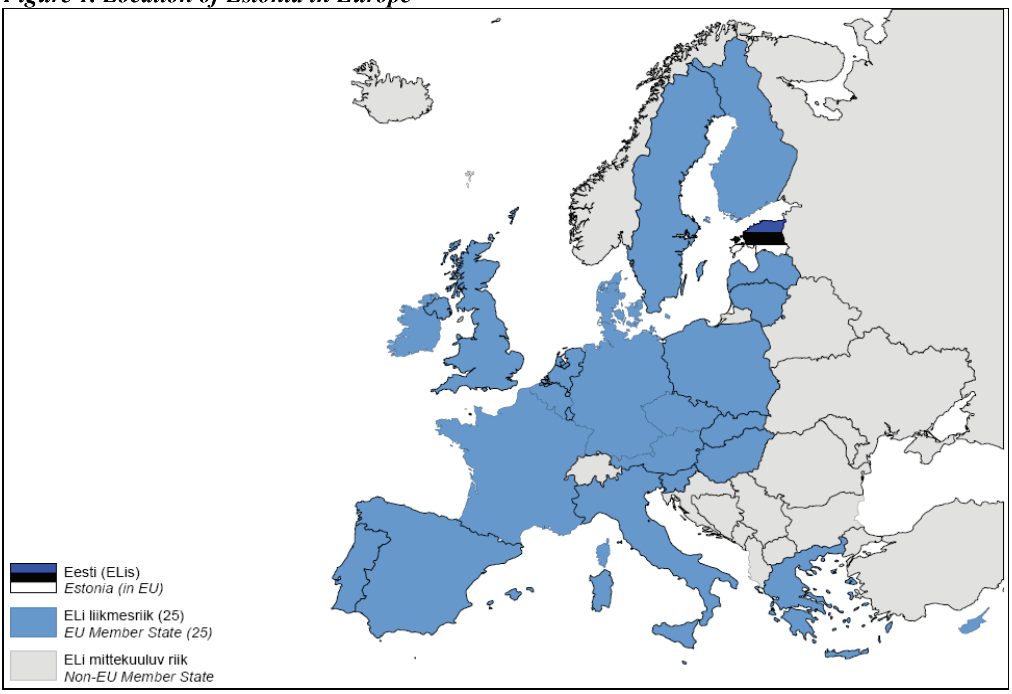
Households: 566 847 (SOE, 2006)

Ethnic divisions: Estonians (69%), Russians (26%), Ukrainians (2%), Belarussians (1%) and Finns (1%) (SOE, 2007)

Languages: Estonian (official), Russian, and others

State system: Estonia is a democratic parliamentary republic. Its Constitution was adopted in 1992.

Figure 1. Location of Estonia in Europe



Source: Statistical Yearbook of Estonia, 2006

The people elect the *Riigikogu* (parliament) and executive power is vested in the *Government*. The *President of the Republic* is the head of State.

Currency: The national currency is the Estonian kroon (1 kroon = 100 cent), which was issued on 20 June 1992. The Estonian kroon is pegged to the Euro at a rate 1 EUR = 15.6466 EEK.
International Organisations: Estonia is member of the *UN* and the *OSCE* since 1991, the *Council of Europe* since 1993 and the *WTO* since 1999. Estonia became a member of the *NATO* on 29 March 2004 and acceded to the *European Union* on 1 May 2004.

Brief History: In 1918, Estonia achieved its complete independence from German-Russian occupations. In 1940, Estonia was incorporated by the *Soviet Union*. In 1991, Estonia restored its independence from the *Union of Soviet Socialist Republic.*

Table 1. Key macroeconomic indicators of Estonia:

Indicator	Value	Reference
GDP (at current prices), billion EUR	13 073.5 (204 555.9 EEK)	2006 (SOE)
GDP per capita, EUR	9 732.1 (152 274.0 EEK)	2006 (SOE)
GDP real growth, %	11.4	2006 (Eurostat)
GDP per capita in PPS, EUR	59.8	2005 (Eurostat)
Economic structure, %	Services: 67% Industry: 29% Agriculture: 4%	2005 (World Bank)
ICT industry turnover, billion EUR	1.11	2005 (ITL)
Employment rate (15-64 years), %	68.1	2006 (Eurostat)
Unemployment rate (15-74 years, %)	5.9	2006 (Eurostat)
Labour productivity per person employed[13]	58.5	2005 (Eurostat)

Sources: SOE; World Bank, World Development Indicators Database; Eurostat; ITL

Estonia in some indices:

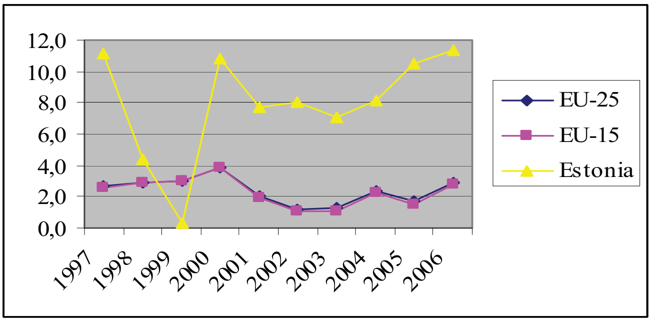
- World Economic Forum Country Competitiveness: Rank 20 in 2005, Rank 20 in 2004
- UN Human Development Index: Rank 38 in 2005, Rank 36 in 2004
- Transparency International Corruption Index: Rank 27 in 2005, Rank 31 in 2004
- World Economic Freedom: Rank 7 in 2006, Rank 4 in 2005
- UNDPEPA and ASPA E-government Index: Rank 32

Estonia's economic transition to a market economy started with a very low GDP per capita as well as productivity (European Commission, 2006a). Since the restoration of its independence, Estonia has aggressively pursued integration with the West as well as a free market economy, with hallmarks of a balanced budget, a flat-rate income tax, a free trade regime, a fully convertible currency, a competitive commercial banking sector, and a hospitable environment for foreign investment.

Since 1995, the Estonian economy has grown by an average of over 6% a year, making it a star performer in the EU together with Ireland, which averages 7.4%. The GDP real growth in 2006 was 11.4% compared to the EU25 average of 1.7% and to the EU15 average of 2.8% (Eurostat, 2007; see also Table 1 and 2). Furthermore, the economic growth in Estonia has been supported by continuous rapid growth of productivity, which has been in compliance with the wage growth. As a result, the Estonian GDP per capita, taking into account the purchasing power parity, has increased from one-third to one-half of the EU average (it was 51% of the EU average in 2004) (Action Plan for Growth and Jobs 2005-2007; Eurostat, 2006).

[13] GDP in PPS per person employed.

Figure 2. Real GDP growth rate in EU25 and Estonia (1996-2006)



Source: Eurostat, 2007

However, since productivity and wage growth started remarkably low, the high growth rates at the beginning of the new millennium have not significantly decreased differences in terms of productivity between Estonia and the leading EU25 countries. Even in such high growth areas as ICT, Estonia's productivity has been falling behind EU member countries such as Denmark, Finland, and Sweden (for statistics on industry, see Eurostat databases). With its relatively low productivity of 50.6% in 2004, Estonia trails EU25 in the area of productivity as an economic indicator (Estonian Information Society Development Plan for 2013).

The economic growth in recent years has mostly been supported by remarkable increase in exports. In 2004, around 80% of Estonia's total trade was with EU member countries (Bank of Estonia, 2006) and real growth in exports of goods and services has increased to 17.4% in the first half of 2005 (Action Plan for Growth and Jobs 2005-2007). Especially impressive has been the growth in industrial production, which shows an upward trend starting from the year 2000. By January 2005, industrial production as a whole grew 12%, with manufacturing growing 11% (SOE, 2006).[14] Domestic demand has also contributed significantly to economic growth, even though its expansion rate slowed down in 2004. But the growth of investments has slowed down due to decreasing private consumption and the completion of large one-time projects (Action Plan for Growth and Jobs 2005-2007; see also Table 2).

Table 2. Share of components of GDP by expenditure approach (by consumption)* (1995-2006)

	1995	2000	2001	2002	2003	2004	2005	2006
Private consumption expenditure	54.7	55.7	55.9	56.8	56.4	54.3	52.1	51.0
General government final consumption expenditure	27.4	20.2	19.3	19.2	19.4	19	18.2	16.7
Consumption expenditure of non-profit institutions serving households	1	1.1	1.3	1.6	1.6	1.7	1.7	1.4
Gross fixed capital formation	25.9	25.6	26.9	28.7	28.9	28.4	29.1	33.8
Change in inventories	0.7	2.2	2.2	3.1	3.1	2.8	2.7	4.3
DOMESTIC DEMAND	109.7	104.9	105.7	109.3	109.4	106.2	103.8	107.3
Exports of goods and services (f.o.b.)	68.5	88.4	84	74.3	74.3	78.4	84.2	79.8
Imports of goods and services (f.o.b.)	76.1	92	87.4	81.4	81.9	86.1	90.3	89.5
Statistical discrepancy	-2.1	-1.2	-2.3	-2.2	-1.9	1.5	2.3	2.4
TOTAL	100	100	100	100	100	100	100	100

*Note: *At current prices, in percentages* Source: SOE, 2007

Estonia is one of those countries in the EU, which has already achieved a balanced or surplus fiscal position as determined by the *Stability and Growth Pact* (Action Plan for Growth and Jobs 2005-2007). In 2006, Estonia achieved a fiscal surplus of 3.8% of GDP, with -1.7 as EU25 and -1.6 as EU15 level indicator (Eurostat, 2007). The development of its fiscal position in recent years is characterised

[14] However, some studies show that the technological structure of Estonia's manufacturing industry has evolved towards less complexity since the mid-1990s. 'This... highlights that, despite an enviable record of economic growth, Estonia's industrial structure in 1996 was in better shape than in 2000' (Tiits, Kattel, and Kalvet 2005: 27).

by a rapid decrease in the deficits of the local authorities, as well as by the reduction in the surplus of the Social Security Funds and the government sector (Action Plan for Growth and Jobs 2005-2007). In addition, government's debt as a percentage of GDP is considerably small compared to EU average. In 2006, Estonia had the lowest ratio of government debt to GDP (4.1%) compared to EU25 62.2% and EU15 63.3% (Eurostat, 2006).

In the 4th quarter of 2005 survey on the Estonian labour force, 614 600 of the population aged 15-74 were employed, 46 500 unemployed, and 387 500 economically inactive (SOE, 2006). Employment rate of the population aged 15-74 in 2006 was 61.6% (SOE 2007; cf. Eurostat 2007 where employment rate of population aged 15-64 in 2006 was 68.1%, which is almost the same as the EU15 average of 66.0%). With 56.1% share of older workers in the employment market it is one of the highest as especially compared to the Scandinavian countries (in 2006). Further, the 5.9% unemployment rate in Estonia is lower than the EU25 average of 7.9% and the EU15 average of 7.4%. The situation has considerably improved since 2000 with an unemployment rate of 12.8%, (Eurostat, 2007) continued unemployment largely reflects a mismatch of skills. Workers laid off in traditional sectors have not been able to find jobs in the new service and high-tech sectors (World Bank, 2006), especially in the Northeast region with 12.1% unemployment rate (see Table 3).

Table 3. Unemployment rate in Estonia in percentages (1995-2006)[15]

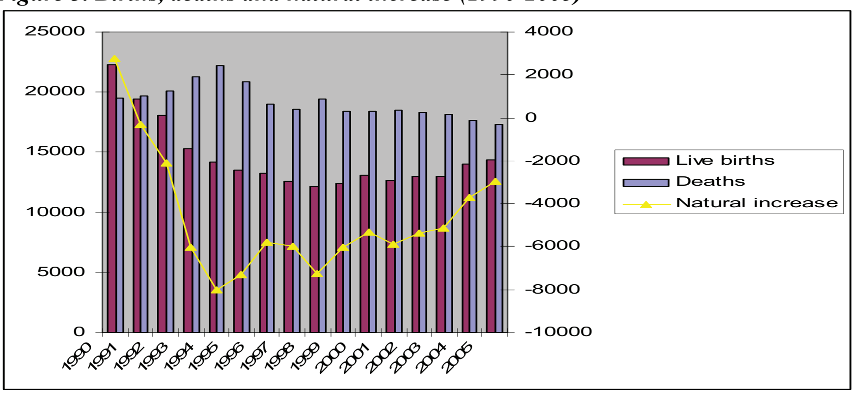
	1995	2000	2001	2002	2003	2004	2005	2006
Whole Estonia	9.7	13.6	12.6	10.3	10	9.7	7.9	5.9
Northern Estonia	8.4	11.5	11.6	8.6	9.6	9.6	7.5	4.3
Central Estonia	6.7	14.9	11	9.7	7.9	7.8	5.1	5.2
North-eastern Estonia	15	21.1	18	18.9	18.2	17.9	16.2	12.1
Western Estonia	5.8	11.8	11	9.2	7.8	5.6	5.7	4.0
Southern Estonia	12	13.4	12.8	9.3	8.3	8.1	6.3	6.6

Source: SOE, 2007

Demography indicators, population developments

The population of Estonia has constantly declined since the 1990s. If in the beginning the primary reason for this decline was migration, the age structure of the population has clearly changed in the last few years. The restoration of independence can be considered as the starting point for the ageing trend of the population through the constant increase of people aged 65 years old and older, and the sudden drop in birth rate (Action Plan for Growth and Jobs 2005-2007; see also Figure 3).

Figure 3. Births, deaths and natural increase (1990-2005)



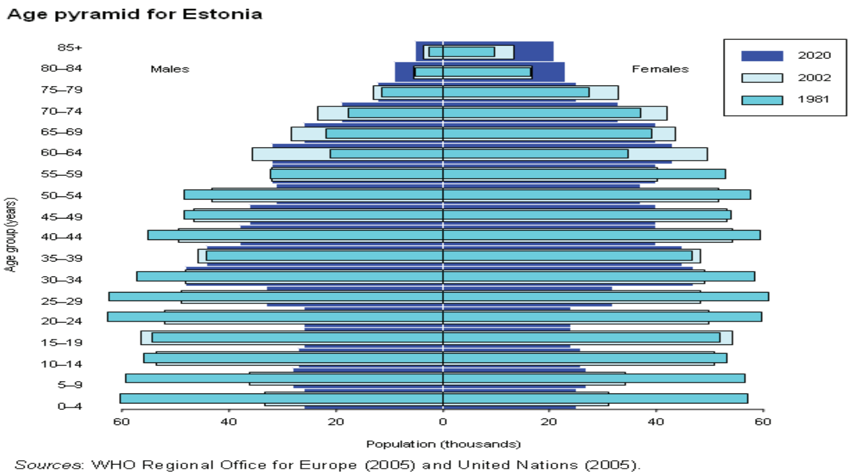
Source: SOE, 2006

15 See also Figure 1 in ANNEX III.

Decreasing proportion of young people is to a large extent due to a rapid decline in the birth rate from the 1990s. In 1995, people with the age of 0-14 formed 20.9% of the population, but by 2004 this percentage had sunk to 16.0%. At the same time, life expectancy has slightly risen since 1994, reaching 71.6 years in 2003 (Social Sector in Figures 2005). The decrease in the number of children and the increase in life expectancy have inevitably raised the number of older people in the population. If the percentage of people over 65 was 11.5% in 1990, recently they form 16.2%, and by 2050 it is estimated to increase to 27% of the population (Action Plan for Growth and Jobs 2005-2007).

According to the forecast of the *European Commission* and the *Estonian Ministry of Finance*, the population of Estonia will decrease approximately 17–18% within 50 years. The forecast assumes that the birth rate will increase compared to the current level, but it will not increase sufficiently to guarantee the 2.1 children per woman necessary to maintain the population (see also Figure 4). By 2050, the gross birth rate coefficient will reach 1.6 (in 2001 it was already 1.39). The average life expectancy of men born in 2050 will be almost 10 years longer than the ones born today. Women, however, will live 7 years longer. As a result of the low birth rate and sudden increase in the average life expectancy, the ratio of working people and pensioners is seen to decline (Action Plan for Growth and Jobs 2005-2007).

Figure 4. Age pyramid for Estonia for the year 2020



Source: World Health Organisation, Regional Office for Europe, 2005

In addition, there is a tendency of internal migration of the population towards bigger cities and towns of Tallinn, Tartu, and Pärnu. This internal migration is mainly for two reasons. First, the wealthier citizens are looking for a healthier environment for living, moving to an area at a convenient driving-distance from their place of work. And, second, people from rural regions, which have high unemployment rates, move to these areas where they hope to get jobs. A more general tendency is the movement of the population from the rural regions of Southern Estonia to Northern Estonia. The so-called *commuting* can be considered as a growing trend in Estonia: 18% of the total number of working population, or 115 000 people, work outside their hometown or parish; and 7% of the working population have jobs requiring movement from one place to another (Eurodice, Eurobase; see also Table 4).

Table 4. Population, area and density, by administrative unit (2001, 2006)

	2001			2006		
	Population	**Area, km²**	**Density, inhabitants per km²**	**Population**	**Area, km²**	**Density, inhabitants per km²**
Whole country	1 366 959	43 432.31	31.5	1 344 684	43 432.31	31
Cities	921 298	674.41	1 366.1	866 907	643.38	1 347.4
Rural municipalities	445 661	42 757.9	10.4	477 777	42 788.93	11.2

Source: SOE, 2007

Major education indicators

The level of formal education among the adult population of Estonia is relatively high compared with the EU member states. In 2005, 89.1% of people aged 25-64 had at least upper secondary education[16] – given 69.1% as the respective indicator for EU25 and 66.2% as for EU15 (Eurostat, 2007). In 2004, 31% of the population attained tertiary education, making it higher than in most of the EU member states (Silla et al., 2006; see also Statistics in Focus, 19/2005). For the period 2000-2004, the overall literacy rate of adult (15 years and older) and youth (15-24 years) was 99.8%, where it was only lower (i.e., 99.7%) in the case of youth, especially male (Unesco, 2007).

Table 5. Key education indicators about Estonia for 2005

	Estonia	**EU25**	**EU15**
Youth education attainment level	80.9%	76.9%	74.1%
Total public expenditure on education as a percentage of GDP	5.67%	5.21%	5.20%
Enterprises providing training*	47%	53%	54%
Employees' participation in company-provided training*	19%	39%	40%
Overall participation in Lifelong Learning	5.9%	9.9%	10.6%

*Note: *Data for 2004, source: eUSER, 2005* Source: Eurostat, 2007

The high enrolment level in higher education manifests that education is highly valued in Estonia – for example, more than 70% of upper secondary general school graduates continued their studies at higher level in 2004 (Silla et al., 2006). Even though the number of graduates in tertiary education increased between 20% and 25% in the beginning of 2000s, it has slowed down in recent years. In 2005, however, the increase compared to previous years was about 15% (SOE, 2006). Yet, despite Estonia's comparability to other EU NMSs in terms of relative share of graduates (per 1 000 inhabitants aged 20-29) in the spheres of science, mathematics and computing and in engineering, manufacturing and construction as well (i.e., 8.8% in Estonia with 12.2% as the EU25 average); the country still falls short innovative countries such as Finland (17.4%) and Ireland (24.2%) (Kattel and Kalvet, 2006; European Innovation Scoreboard, 2005). According to *Eurostat*, the graduates in 2004 in the fields of MST composed 16.9% of all fields in Estonia – with the corresponding figures of 23.6% in EU25 and 25.4% in EU15 (Eurostat, 2007; see also European Commission, 2006b). Estonia is relatively weak in the number of doctoral graduates with only 0.88% aged 25-29, as compared to 2.9% in the EU25 (Kattel and Kalvet, 2006). Interestingly, Estonia had 42.5% female engineering graduates in 2005 – the highest in the EU (European Commission, 2006c).

The enrolment in vocational education has been quite problematic in Estonia for quite a while now due to the rather low reputation of vocational education. Although the relative share of students choosing vocational education has increased over the last years (see also Table 6), it is still considerably lower than in most European countries.[17] The inability of the educational system to adapt to the needs of the labour market is considered as a serious problem in the society – most of the young learners at both secondary and higher education levels decide for an academic branch of studies, while the society

[16] In Estonia, upper secondary education is divided into the general upper secondary education to acquire upper secondary general education (ISCED 3A), and the vocational upper secondary education to acquire upper secondary vocational education (ISCED 3B) (Silla et al., 2006).

[17] In 2004, the percentage of boys and girls in upper secondary education in Estonia enrolled in the vocational stream was: 40.8% boys (compared with 57.1% in EU-25) and 19.5% girls (compared with 53.9% in EU-25) (Eurostat, 2007).

needs more qualified labour force and specialists with acquired professional higher education (Ministry of Education and Research, 2004). This is also one of the reasons Estonia suffers simultaneously from unemployment (Estonian National Development Plan (NDP) 2004-2006).

Table 6. Pupils and students enrolled per 10 000 inhabitants in Estonia, by level of education (1995-2005)

	1995	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Total	1 931	2 233	2 229	2 197	2 166	2 140	2 066
General education	1 539	1 596	1 567	1 522	1 472	1 416	1 344
Basic education	1 282	1 318	1 278	1 228	1 171	1 104	1 031
Secondary education	256	278	289	294	301	312	313
Vocational education	205	225	219	207	208	222	215
Higher education	191	412	443	469	485	502	507

Source: SOE, 2007

The decreasing population will have a considerable impact on the Estonian educational system as a whole – the number of potential students at educational institutions will start to fall from 2007.[18] At the same time, the Estonian school system suffers with increasing number of students dropping out of school or having to repeat a school year, which is especially problematic at the basic education level (*Ibid.*). The percentage of early school leavers (i.e., aged 18-24 who have left education and training (*E&T*) with a low level of education) was 13.2% in 2006 – compared with 15.1% in EU25 and 17.0% in EU15 (Eurostat, 2007). The decreasing number of students will cause serious financial problems (as providers are funded through a capitation system) and will affect the quality of instruction (since having modern and high-quality facilities and teachers requires a certain number of learners). One of the serious problems is the closing down of small rural general schools. On the other hand, the need for further training and retraining will be growing (Silla et al., 2006). This is even more important today despite the high level of formal education in Estonia because participation in lifelong learning or in company-provided training has been below EU's average (see Table 5).

Still, the education level of the employed population is relatively high. The share of tertiary educated labour force has grown from 30% in 2000 to 34% in 2006; at the same time, the share of labour force without secondary education has fallen from 12% to 11%. The increasing number of higher education graduates (reaching 10 thousand per year) entering the labour market is surely the cause for such changes (SOE, 2007). At the regional level, the labour force in the counties of Harju and Tartu, which are also the main centres providing tertiary education, have the highest educational attainment (NDP 2004-2006).

The relative share of educational costs in GDP has been increasing over the years. Table 5 above shows that Estonia's expenditures in the educational sector are also relatively high compared with other member states (Silla et al., 2006). However, considering the low level of GDP, the absolute value of the expenditures is still lower than the respective figure in the EU (NDP 2004-2006).

General ICT usage indicators

Over the years various international comparisons measuring Estonian e-readiness have ranked Estonia very high, not only among Central and East Europe (*CEE*) countries, but even among old EU member states and leading ICT-countries (see Krull 2003). The picture remains similar in latest overviews (see, for example, *Information Society Benchmarking Report 2005*; *eEurope+ Final Progress Report, 2004*), although a lot of countries that have caught up can be found.

[18] Furthermore, Estonia has not gained enough from inflow of foreign students to improve national demographic pressure on the educational system – in 2004, the number of foreign students (at tertiary level) from EU-25, EEA or candidate countries was 600, compared with 438 300 students in total in EU-25. The number of outgoing students from Estonia is a bit larger – 2 300 students compared with 353 300 students in total in EU-25 in 2004 (Eurostat, 2007).

Text Box 1: The *Global Information Technology Report 2004-2005* uses a comprehensive tool for measuring the progress of and identifying the obstacles to ICT development worldwide and has ranked Estonia generally on the 25th position among the observed 104 countries[1], but on the second place in the area of Internet banking and third on e-government.

Economist Intelligence Unit has ranked Estonia 26th among the observed 65 countries, while considering Estonia the leader in CEE. However, the report also states that while Estonia is excellent in e-government and online services, bottlenecks are related to limited infrastructure penetration and slow e-business and consumer adoption (The 2005 e-readiness rankings).

The 2005 Web Measure Index of the *UN Global E-government Readiness Report* placed Estonia among the top 22 countries (UN Global E-government Readiness Report, 2005: 88).

The major reason for this is not only the presence of a relatively well-liberalised market than the rest in the Baltic States,[19] but also the strongly focused projects by the government (ICEG, 2005: 10, 13). In addition, the efforts of governmental institutions to build an Information Society (IS) in Estonia have been coupled with those of NGOs. The banking sector has played at least as big a role as governmental structures (Kalvet, 2004: 17). As a matter of fact, the Estonian banks are considered to be the 'informal' leaders of the Estonian software industry.[20]

According to statistics from the *Department of State Information System in Estonia* (*RISO*) (under the *Ministry of Education and Communications*), 45% of Estonian households are equipped with a Personal Computer (*PC*) (RISO, 2007). According to *Eurostat,* in 2006, 52% of Estonian households are having computer access (Eurostat, 2007).

In 2002, Estonians spent about 5% of their income on telecommunications and about 3% on purchase of Information Technology (*IT*) equipment (BEACON, 2005: 2). According to the *SOE*, only 3.4% of respondents have a ready money to buy a computer (which amounts to about EUR 960) and 23.3% on installment basis in 2004. The most willing to buy a computer were urban households (24.2%; compared with 21% of rural households). The buyers were mainly in North-Estonia (30.1%) – the least in North-East Estonia (17.1%). Further, the most willing buyers were people with high education (35.1%), families with two or three children (42.7%), and even retired people (3.3%). Considering the relatively low living standards, Estonia stands out by the fact that 73% of households having a home PC have connected it to the Internet via broadband connection.[21] This makes Estonia, together with Slovenia, a leader in broadband penetration among EU NMSs (ICEG, 2005: 8). In 2006, 37% all of households are having broadband access, compared to 21% in EU10 and 34% in EU25 (Eurostat, 2007).

In Estonia, broadband take up is mainly discouraged by relatively high costs in comparison with the average income level – because of high access costs over 60% of households do not have access to the Internet (see also Table 3 in ANNEX II). At the same time, the participation in the labour market has improved, as the unemployment rate was only 5.9 in 2006 (compared to that of 7.9 in EU25 and 7.4 in EU15 (Eurostat, 2007)), which is the lowest since 1998 (BEACON, 2005: 2). Also, costs for broadband in Estonia are one of the lowest in the world and without government subsidies (see World Development Indicators, 2005). ICT development, including in the area of wireless Internet, will decrease the price even more. The cheapest cost for broadband per month is about 5% of average

[19] From 1 January 2001, the Estonian telecommunications market is completely open to competition and service is offered by a variety of companies (BEACON, 2005: 1-2). The major players include *Elion Ettevõtted*, *Uninet*, *Tele2* and *Microlink*, which have covered the entire country with mobile networks. In 2005, 473 400 households (87.3% of all households) are mobile phone subscribers (SOE, 2007). This makes good market for rapidly developing m-services like m-parking, m-tickets in public transportation, m-payments, m-banking, and m-learning.

[20] The software divisions of *Hansabank* and *Estonian Union Bank* have more personnel than the biggest Estonian software companies – approximately 250 of *Hansabank*'s 2 245 employees are IT specialists, and 139 IT specialists in *SEB Estonian Union Bank* (Kalvet, 2004: 17).

[21] The latest surveys show that already 81% of households with a PC have the Internet connection (Information Technology in Public Administration of Estonia Yearbook, 2005). The most popular is ADSL connection – 44%, 29% of homes having a PC have cable modem and 4% are using Wireless Internet (RISO, 2007; see also Table 1 in ANNEX II).

wage. In the beginning of 2005 over 90%[22] of Estonian households lived in places where it was possible to have broadband immediately at a cost of EUR 22 per month. There are counties where the situation is not so good, because of, firstly, the average lower salary in country regions than the state average, and secondly, the lack of competition between service providers (Estonian Broadband Strategy 2005-2007). Although the representatives of the *Ministry of Economic Affairs and Communications* have promised to support the building of ICT infrastructure in all counties, they are not going to support the usage of the Internet and eServices (Democracy in Information Society Conference, 2006).

[22] According to the Estonian version of the Information Technology in Public Administration of Estonia 2005, the present Internet penetration rate in the scope of all counties is over estimated (Information Technology in Public Administration of Estonia Yearbook, 2005).

I: CURRENT EDUCATIONAL SYSTEM AS THE PLACE OF ELEARNING

This chapter has two purposes. First, it gives a background on the E&T system in Estonia. And second, it gives an overview about the structure, functioning, major problems and issues of eLearning in Estonia.

I.1 Description of current education and training system

The principal objective in the development of the Estonian education system and policy is to advance the Estonian society into an open learning society where every person and institution adopts the principles of lifelong learning (INNOVE, National Resource Centre for Guidance, 2004). However, despite a decade of heated discussions and several (failed) initiatives over this objective, Estonia does not have a national strategy or policy for developing the educational system. Even political parties do not have respective educational reform agenda (Laanpere, 2006b).

The organisation, structure and management of the present education system were developed in the 1990s. The education system is administered by the *Parliament* (*Riigikogu*), *the Government of the Republic* (*Vabariigi Valitsus*) and the *Ministry of Education and Research* (*Haridus- ja Teadusministeerium*).

Text Box 2. The *Parliament* passes laws that determine the principles of forming, functioning and developing of education system. The government adopts national education programmes and, by providing guarantees for the implementation thereof, approves national curriculum for different levels of education (in the case of higher education, the government specifies general requirements for curriculum) and determines the bases for remuneration for the work of teachers. The main responsibility of the *Ministry of Education and Research* is planning, management and development of education, research, youth and language policy, the elaboration of national development programmes in the named fields, and the organisation of financing, implementation and evaluation of the results (The Education Act; Ministry of Education and Research, 2004: 17).

The *county governments* (*maavalitsus*) provide supervision at regional level of the educational activities of pre-school childcare institutions and schools. They formulate the education development plans of the county, provide information on public financing to the *Ministry of Education and Research*, and advise local government on educational concerns (*Ibid.*).

The *local government authorities* – a municipality or a town (*vald, linn*) – organize maintenance of pre-school childcare institutions, basic and secondary schools, hobby schools, school libraries and other local institutions. An important part of their work is to keep registers of children in the compulsory education age range and monitor the fulfillment of compulsory school attendance. They are also responsible for designing local development programmes (*Ibid.*).

In general, education (policy) development culture in Estonia can be characterised as highly de-centralised, with minimal interventions from the Ministerial level (Laanpere, 2006b).

The education system in Estonia is divided into the following parts (see also Figure 2 in ANNEX III):

1. Compulsory basic education (*põhiharidus*), which is the combined primary and lower secondary education. Compulsory school attendance generally begins at the age of 7 and lasts until pupils acquire basic education or reach 17 years of age. Basic education is acquired in basic schools, with classes from 1st to 9th (The Basic Schools and Upper Secondary Schools Act; Ministry of Education and Research).[23]

Schooling and education objectives, bases of organisation of studies, mandatory and optional subjects, subject volumes and syllabi, requirements to school levels and for finishing schools of the basic level

[23] Compulsory school attendance may also be fulfilled in special educational institutions or classes for disabled children as well as in the form of home study. Children in need of special conditions learn in specially created institutions or in classes for pupils with educational difficulties (European Agency for Development in Special Needs Education, 2005; Ministry of Foreign Affairs, 2005b).

have been provided for in national curriculum. Each school prepares its curriculum on the basis of the national curriculum (The Regulation of National Curriculum for Basic Schools and Upper Secondary Schools; Ministry of Education and Research).

2. Post-compulsory education has **upper secondary** and **post secondary level**. The first level is divided into the general upper secondary education (*üldkeskharidus*) for the pupils 16-18 years of age and the vocational upper secondary education for the pupils 16-18/19 years of age (*kutsekeskharidus põhihariduse baasil*) (studies last a minimum of 3 years). The second level is vocational post secondary education (*kutsekeskharidus keskhariduse baasil*) for students 19-21 years of age (studies last from 1 to 2.5 years) (Eurodice; see also the Standard for Vocational Education; Ministry of Foreign Affairs, 2005b).[24] The vocational education curriculum is developed by the schools on the basis of respective national curriculum (broad groups of study) as mandated in the *Vocational Educational Institutions Act* (1998), and is approved by the *Ministry of Education and Research* (Ministry of Education and Research, 2004: 18).

In the academic year 2005/2006, the total number of general education daytime schools[25] in Estonia was 598, including 91 primary schools, 225 basic schools, 236 secondary and upper secondary schools. From 598 general educational daytime schools, 32 are private. There are 46 schools for children with special needs. The importance of evening and distance learning schools/departments has risen from 31 in 1999 to 35 in 2005[26] (SOE, 2007). The number of pupils in basic and upper secondary schools where the language of instruction is Russian[27] is 42 530, which constitutes 23% of the total number of pupils in Estonia (Ministry of Education and Research). See also Table 8 in ANNEX II.

There are 48 vocational schools in Estonia, 11 of which are private in the academic year 2006/2007. The number of vocational schools has decreased considerably since 2001, when it was 84 (Ministry of Education and Research, 2007). A current administrative issue concerns the regulation of the school network and for this purpose a number of small vocational schools have merged to become a single regional vocational education centre.[28] 52% of the vocational schools (25 schools) are entirely based on the Estonian language. The number of vocational school where the language of instruction is Russian has decreased in the last years. Currently, the respective share is 15% (Ministry of Education and Research, 2007).

3. Higher education system is binary consisting of two branches – an academic branch (see Text Box 3) and a professional higher education. Institutions of professional higher education are offering applied higher education programmes (*rakenduskõrgharidus*). These programmes can be offered also by universities and vocational education institutions that operate on the basis of secondary education. The precondition for admission to higher education institutions is secondary education obtained in Estonia or qualification equal thereto obtained abroad (The Standard for Higher Education; Ministry of Education and Research; Eurydice).

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24 Afterwards these two levels on vocational education are dealt together.

25 In reality, many basic schools and general upper secondary schools exist together under the same name and in the same buildings. The statistical overview of these two educational levels is given in the same place. These levels are dealt together afterwards under the term **general education**.

26 In an upper secondary school, the provision of education may take place in the daytime, evening and distance learning study form. It is permitted to finish the school as an external pupil (Ministry of Education and Research).

27 Russian is the most common minority language in Estonia. In basic school, the medium of instruction may be any language; the choice of the language is made by the manager of the school. In upper secondary school, the medium of instruction is Estonian but it may be any other language if the *Government of the Republic* approves it according to a relevant application (Ministry of Education and Research; Eurodice, Eurobase). However, reforms are scheduled for implementation from the 2007/2008 school year. From this point onwards, it will be statutory for the state and local authorities to make provisions for non-Estonian medium schools to offer Estonian-language teaching in up to 60% of classes. Some schools are already participating in a language immersion programme in which at least 50% of teaching is carried out in Estonian (Education in the News, Eurodice, 2005).

28 The restructuring (merger) of vocational schools is claimed to be the only major structural change in educational system during the last 15 years, not to mention that these schools were state-owned – unlike basic, secondary and higher education institutions (Laanpere, 2006b). For other national priorities for reform in education in Estonia, see ANNEX III.

Text Box. 3. At a university, higher education is acquired at three levels: *Bachelor's Study*, *Master's study* and *Doctoral study*. The standard period of Bachelor's study is three to four years, 120–160 credit points (is equal to 180-240 ECTS), Master's study one to two years, 40–80 credit points (equal to 60-120 ECTS) and Doctoral study three to four years, 120-160 credit points. The standard period of Bachelor and Master's study is at least five years in total. The standard period of study in professional higher education is three to four years (120–160 credit points) (The Standard for Higher Education; Ministry of Education and Research).

There are no harmonised requirements set out for the content of particular curriculum at higher educational level and hence educational institutions are autonomous in compiling their curriculum and courses (Ministry of Education and Research, 2004: 18). The general requirements are laid out in the *Standard of Higher Education* (2002).

In 2007, there are 11 universities, including five (5) private universities, and 20 professional higher schools (11 of them private ones). Four (4) vocational education institutions are also providing higher education programmes (Ministry of Education and Research, 2007; see also Table 9 in ANNEX II). The most relevant trend in recent years, mainly as a result of the development of private universities and post secondary institutions, is the continuous growth in the number of students pursuing higher education. The enrolment in public universities has also increased.[29]

The medium of instruction for 6 891 students (or 10% of total enrolment) is Russian, and for 1 007 (or 1.5%) English. Two-thirds of those students are studying in private educational institutions. The proportion of Estonian, Russian and English as medium of instruction has remained nearly the same in the last years (SOE, 2006).

4. Adult education system provides the opportunity (1) to acquire **formal adult education** (from basic to higher education) in the form of part-time study, evening courses, distance learning or as an external student (the form depends on the level of education); (2) to acquire, develop and retrain professional, occupational and/or vocational knowledge, skills and experience (**professional E&T**); and (3) to develop knowledge, skills and abilities needed in life (**non-formal education**). Completion of formal and professional education acquired within the adult education system is certified by a certificate or diploma (Law of Adult Education). In-formal education means learning in informal situation (e.g., at home, at work, in free time activities).

Text Box 4. Adult education consists of the following options:
- In "adult upper secondary schools", basic education and upper secondary education in the form of distance learning, evening courses or as an external student can be acquired;
- In vocational schools, secondary vocational education on the basis of basic education in the form of evening courses or distance learning and secondary vocational education on the basis of secondary education in part-time study or as an external student can be acquired; professional training is also possible;
- Public universities and state institutions of professional higher education offer possibilities to study in the form of evening courses and distance learning; continuing education outside formal education may take place in these institutions;
- Adult education institutions offer continuing education or retraining courses or non-formal education. These schools are mostly privately owned. Private schools which organise professional E&T or non-formal education for adults whereupon the volume of study exceeds 120 hours shall apply for an education licence (Ministry of Education and Research).

The number of students in Estonia in autumn 2006 was 68 785 and 70% of these were splitting their time between university and work and/or other activities. In addition to this, tens of thousands of learners attend in-service training courses in institutions of higher education. The share of learners taking in-service training or retraining courses and adult learners participating in continuing training will increase in the future. Lifelong learning guarantees that many adult learners return to the acquisition of a formal education. More than 6 000 people study at adult upper secondary schools (Kiviselg et al., 2006).

[29] In academic year 2006/2007, 45% of enrolled students obtain higher education at state-financed study places, and 55% pay for their education themselves. The share of paid education is growing year-by-year first of all as a consequence of the change of proportions in public universities and higher schools (Ministry of Education and Research, 2006).

According to *Faktum* survey *Adult participation in education and training in 2004,* 22% of 15-74 year olds participated in professional training (i.e., approximately 230 000 people).[30] Non-formal education is less popular as only 16% (167 000 people) of 15-74 year olds participated in non-formal education (Kiviselg et al., 2006).[31] By the *Eurostat*'s statistics in 2005, the trends in lifelong learning are contrary and the highest is the participation in formal learning (25.1), compared to participation ratio in non-formal (14.8) and in formal education (3.7). When compared to EU15 and EU10 (43.9 and 31.5, respectively), Estonia is showing comparable rates for lifelong learning with 31.4 (Eurostat, 2006).

At the same time, the rate of the working age population (25-64 age group) taking part in training in 2004 was only 6.7% (even lower, 5.9%, in 2005) (Eurostat, 2006) – compared to *Employment Guidelines* issued by the *European Commission* suggesting that member states should reach a level of participation in lifelong learning at least 12.5% of the adult working age population by the year 2010 (The Employment Policy Guidelines 2003-2005). Because of decreasing population, the need for efficient re-training system for adults that is accessible to all is also growing at the domestic level (NDP 2004-2006).

5. Workplace training. In Estonia, companies may decide on the training principles applied in organisation, on training plans and on whether to organise training in the company or outside. They can also decide on employees' exchange and rotation according to their needs and possibilities (Kiviselg et al., 2006; for overall developments in company provided training, see Text Box 5).

Text Box 5. According to the 2001 survey *Continuing Vocational Training in Enterprises*, based on 2 315 companies, 63% of companies interviewed offered in-service training for their employees. There was a direct correlation between company size and willingness to train: 56% of companies with 10-19 employees offered in-service training; the situation is similar in companies with 20-29 employees. 85% of middle size companies (50-249 employees) and all companies employing more than 500 people (52 in the sample) offered in-service training. Training costs were EUR 448 per participant (*Ibid.*). At the same time, according to *eUSER*, 19% of employees were participating in company-provided training in 2004.

I.2 Place of eLearning in the educational sector

eLearning is increasing its popularity. Since using ICT applications in classes will increase the students' interest towards school attendance (therefore class repetition and dropping-out of school should decrease), it makes knowledge acquisition more effective and establishes preconditions for knowledge-based community (State Audit Office, 2003). In addition, eLearning creates better learning opportunities for people with special needs and for those who live far away from educational institutions (Kiviselg et al., 2006). However, it is claimed that as the educational institutions are mostly the content suppliers of eLearning in Estonia, the target group of eLearning is primarily considered to be students and people operating in the educational sphere (Massy, 2004).

The number of national surveys in the field of eLearning is very small. To date, the best overview of ICT developments in general education is available thanks to *Tiger in Focus* surveys and also the activities of the *State Audit Office*. However, the use of eLearning as such at local level is not yet assessed, including an assessment about the role of ICT literacy and the use of ICT in classroom in basic, secondary, vocational, higher and non-formal education. The only survey that has analysed specifically the ICT-related curricula in Estonian higher education is the *Knowledge-based Economy and ICT-related education in Estonia: Overview of the Current Situation and Challenges for the Education System* conducted by PRAXIS.

[30] Middle managers and specialists, officials, aged 25-34, people with higher education, people with higher income, and native Estonians are highest represented in the figures (Kiviselg et al., 2006).

[31] The participants were mostly 15-24 year olds, students, urban population, people with medium and high income, women and Estonians (*Ibid.*).

In the framework of the REDEL project (financed by EU's ESF), the political survey for universities is in the field of eLearning, which should be completed by the beginning of 2007 (Tammeoru, 2006b). eLearning study in vocational schools is still in the planning phase, and fresh data about primary and secondary schools is expected from IEA SITES study in 2007 (Laanpere, 2006b).

To date, eLearning is mainly understood as web-based courses, especially in vocational and higher educational level, lifelong learning and workplace training; and as the application of different web-based learning materials, especially in general education. In addition, eLearning practice is strongly associated with different learning and study information systems and e-applications.

Overall, the rate of computer-based learning in Estonia is 10.3, which is comparable to other EU10 countries, except Slovenia (showing participation rate of 29.9) (Eurostat, 2006).

At the general education level, the main aim has been the computerisation of Estonian schools – computers and Internet connections for schools, educational software development and teachers' in-service training. As a result of the different educational programmes (see overview of these in Chapter II.2), a number of interesting developments have been in place in 2006, to wit: all general schools in Estonia are connected to the Internet; several web-based learning materials in Estonian, and also local open source Learning Management Systems (*LMS*), Content Management Systems (*CMS*s), etc. have been created.

eLearning, particularly computer-based learning, is an increasingly popular form of study in higher, vocational and adult education. The main reason behind the success of eLearning at these levels is the initiatives of the *Estonian E-university* (*Eesti e-ülikool*), the consortium of universities and applied universities supporting developments in Estonian higher education, lifelong learning, and the field of eLearning as a whole since 2002.[32] Due to the positive outcome of these initiatives, the vocational schools have also created a similar network called *Estonian E-VocationalSchool* (*e-kutsekool*). A memorandum of *E-VocationalSchool* was signed in February 2005. Among people acquiring higher and vocational education, the consortium of the Estonian e-VocationalSchool forms 87% of the total number of learners and the consortium of the Estonian E-University forms 83% of the total number of learners (as of January 2007) (Strategy of the Estonian eLearning Development Centre 2007-2012). Certain pressure towards the further use of ICT-supported learning can be seen also from international organisations.[33] For example, *PowerPoint presentations* are used in on-campus courses to support lectures – with projectors being decreasingly used. In many cases, however, the usage of eLearning applications is dependent on teachers.

The in-house web-based training of personnel is not very widely used in Estonia (Piin, 2004: 41). Rather, the private sector has made a contribution to training of their employees for general ICT skills. For a couple of years, there has been a movement from basic ICT skills towards teaching of specific programmes. One reason private sector web-based learning has not acquired much attention is the fact that ICT is incorporated deeply in everyday life and employees need more communication possibilities. The latter is possible more in traditional training (Interviews with Kuusemets and Väravas, 2006). In the private sector, large enterprises (especially banks and telecom companies) extensively use eLearning applications for training and supporting learning of their staff.[34] There are however little data on companies that belong to international networks and are owned by larger international companies.

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[32] It should be mentioned that many universities have been developing and are practising web-based courses both in formal and in continuing professional education since 1995, and then through the *PHARE Multi-Country Programme for Distance Education* two training centres were established. The first initiatives to start offering courses via e-mail and then via Internet were made in 1996 in the framework of distance education (see Table 9) (Ruul, 2004; see more about the history of eLearning in Estonia in ANNEX III).

[33] For example, starting spring of 2006 the international tests for English language skills, *TOEFL*, would become only computer-based. This also means the need to change the orientation of special training courses for this exam – from traditional training towards more computer-based training (Educational Advising Center at Tallinn University of Technology, 2006).

[34] For example *Hansabank*, *SEB Estonian Union Bank*, *Elion*, *EMT*, *Eesti Energia* (see *Eprojekt*, at http://www.eprojekt.ee/).

In the public sector, the *Law of Adult Education* states that all employers (including schools) in Estonia should annually spend at least 3% of their general salary budget for professional development of their employees. Teachers are obliged to pass relevant in-service training courses of at least 160 hours – four (4) Credit Points (*CP*s) during five years in order to keep their rank (The Framework for Teacher Training). These courses are generally provided in a traditional way, although several teacher training programmes (at three different levels) in the field of using ICT in the learning process and design of digital learning materials are available in the web as self-study courses.[35] Different ICT related courses are provided regularly for senior managers and policy officials. In addition, there are several workgroups and seminars, involving ICT managers of ministries, ICT managers of counties, among others, which gather to discuss matters concerning them and to pass on good experience to one another. A positive development here has been the founding of *eGovernance Academy* (eGA) (ICA Country Report, 2005).[36] There are also a couple of web-based courses introduced in a year in the public sector – for example, on general things like information about the EU (Interview with Rits, 2006).

An important aspect of eLearning in the workplace is the fact that in Estonia the need to have and develop (at least basic) ICT skills is seen as one crucial qualification for work, although the recognition level is lower than in EU25 – 43% of employed persons in Estonia use computers in their normal work routine, compared with 51% of EU25 average in 2005 (Statistics in Focus, Eurostat, 17/2006).

In the framework of lifelong learning, the main eLearning opportunities for adults are provided by educational institutions – the most important seem to be the web-based courses provided by *Estonian E-university* and by other universities. These courses do not give the certificate to the learner, but are mainly in-service training courses (Sule, 2003). The number of courses ordered by the private sector is very low. It can be said that web-based courses are still gathering their popularity and participation in those has been low. To date, the web-based courses both in numbers and in scope of content have remained limited. However, many private training institutions are offering computer training for adult learning. Some computer projects in cooperation between the private and public sectors (e.g., *Look@World project*, which is coordinated by *Look@World Foundation*) have been initiated to create training network and to provide basic computer and Internet training free of charge. The *Look@World project* was very closely connected to the creation of Public Internet Access Points (*PIAP*s) together with 'internetisation' of libraries. The role of libraries and other cultural establishments as a new learning environment is becoming more important in promoting the idea of lifelong learning and in offering learning opportunities in in-formal training (Kiviselg et al., 2006). These developments have made possible to start using Internet in rural areas, where people do not have much possibilities to get a PC and Internet access (Puusep and Ehandi). According to *Eurostat*, the percentage of individuals who used Internet in the last three (3) months for post educational courses is only 2.3 (Eurostat, 2006). This is primarily due to the overall low recognition of the need of lifelong learning in the society.

I.3 Presentation of ICT skills and attitudes towards ICT usage

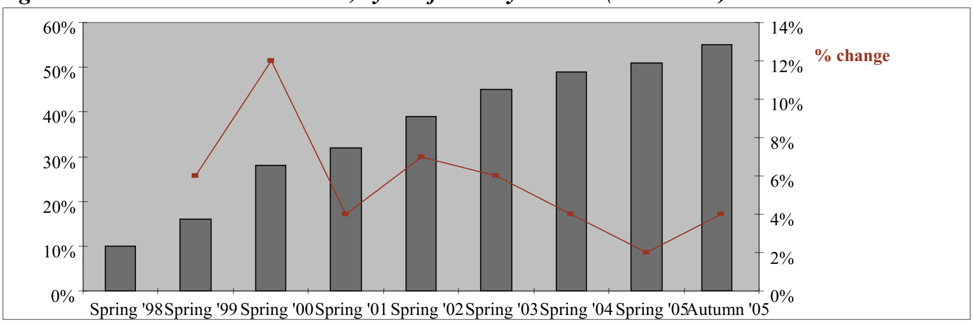
In the beginning of 2006, Estonia enjoyed a situation in which 54% of computer users (i.e., those who had used the computer in the last six months) were using it daily – with 50% of users saying the use of internet as the main motive in buying a computer, and 25% for studying purposes (RISO, 2007). The most characteristic figure on IS development – the Internet usage – has been growing rapidly over the years. Surveys from 2006 indicate that 58% of 15-74-year-old or 60% of 6-74-year-old Estonian inhabitants are using the Internet. Compared to the spring of 2005, the share of Internet users has increased by 65,000 people. In 2005, the growth of the group of Estonian population who became

[35] See also the web page of *Estonian E-university*, at http://www.e-uni.ee/index.php?main=101.

[36] The main objective of the *eGA* is to provide training in ICT coordination and use of IT for high-level officials, specialists, and representatives of the third sector of former Soviet republics, Southern and Eastern Europe, and Asia. The training project offers practical information and experience, know-how of EU experts, and exchange of experience between participants in training (ICA Country Report, 2005; also, see http://www.ega.ee/).

Internet users was 4% (TNS Emor e-Track survey, 2006; see also Figure 5). There are more than 700 000 Internet users in Estonia in June 2006. For young people, Internet has become an essential part of daily routine – practically all people (92%) aged 10-24 are using Internet and every second person in this age-group is a daily Internet user (TNS Emor e-Track survey, 2006; see also Table 2 in ANNEX II). In 2005, the share of elder people among Internet users has increased remarkably. At the moment, 43% of people aged 50-59 are using Internet, compared with only 29% of the same age-group who used the Internet in the previous year. Internet usage is lower among people over 60 – only every tenth among them has used the Internet (TNS Emor e-Track survey, 2006). The share of women among Internet users has also increased during the last years and there are more people aged 25-49, people with secondary education and inhabitants of smaller towns and rural settlements among Internet users (EMOR AS, 2005). According to the 2006 statistics, the share of individuals regularly using the Internet (all individuals aged 16-74 who access the Internet, on average, at least once a week) is 56% in Estonia, compared to that of 47% in EU25 and 49% in EU15 (Eurostat, 2007).

Figure 5. Internet users in Estonia, by % of 15-74 years old (1998-2005)



Source: TNS Emor, Gallup e-Ratings, 1998-2005

In 2006, the percentage of all individuals who accessed the Internet at home (as % of individuals aged 16-74) is 46% in Estonia and 43% in EU25 and 45% in EU15 (Eurostat, 2007). From the regional aspect, the share of home PCs and Internet usage are a bit higher in Tartu region and in Tallinn than in other parts of Estonia. The Internet connection of households in rural regions is in worse condition as in towns, especially in North-East Estonia. It is even claimed that while Estonia has been showing good computer and Internet connection penetration in the past five years, the digital divide between cities and rural areas has also increased – there are one-third Internet connections less in rural areas than in towns (Oviir, Eesti Postimees, 19.10.2006). The claims are illustrated by the statistics about having Internet connection and about Internet usage by place of usage (see Table 7). Overall, 72% of Internet users are using Internet at home; use of widely spread *PIAP*s has remained stable.[37] In addition, by the end of 2006 the number of *WIFI* areas should be increased to 1 000 (in October 2006 the exact number was 875). However, the most widespread is *WIFI* in Tallinn (326 areas), followed by other biggest counties like Tartu, Pärnu, Harju. In the worst situation is Hiiu County in West-Estonia (11 *WIFI* areas) (Eesti Postimees, 28.10.2006).

[37] In the beginning of 2001, there was about 200 PIAPs in Estonia (Puusep and Ehandi). Today, the number is over 700, 51 PIAPs per 100 000 people. Most of PIAPs are located in libraries and other municipal buildings across the country (Ministry of Foreign Affairs, 2005a), in which according to an agreement concluded between local government managers, citizens can use computers free of charge and all maintenance costs of leased lines are financed by local governments (ESIS, 2004).

Table 7. The share of home PC and Internet users in Estonia, by regions (2006)

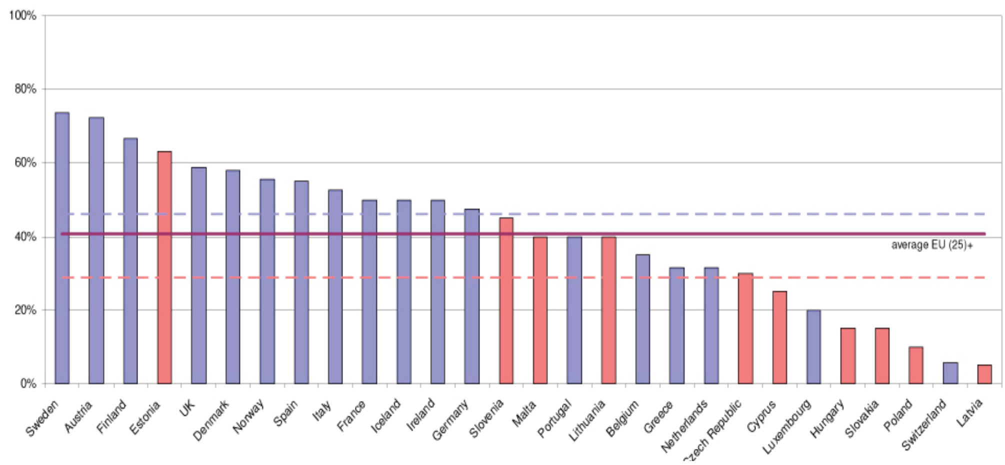
Regions	Home PC*	Home PC in house-holds*	Having no Internet connection*	Internet users*	Internet usage at home**	Internet usage elsewhere**, ***
Tallinn	58%	47%	6%	63%	76%	27%
North-Estonia	48%	41%	8%	57%	66%	39%
West-Estonia	53%	48%	17%	54%	71%	36%
Tartu region	62%	51%	11%	65%	79%	42%
South-Estonia	53%	39%	29%	55%	64%	46%
Viru County	50%	40%	15%	49%	71%	33%

*Notes: *% of all respondents; ** % of those having used the Internet in the last 6 months;* Source: RISO, 2007
**** besides usage of Internet at home, at workplace, at friend's home/work, at school, at PIAPs*

Surveys from 2006 show that Estonians use the Internet mostly for sending/reading e-mails (75%), using search engines (71%) and seeking specific information from databases/web sites (70%), using Estonian Internet portals (e.g., delfi.ee, everyday.com, etc.) (67%), reading Internet publications (62%), for random surfing (61%), and using communication software (MSN, ICQ etc.) (49%) (RISO, 2007).

Estonia is very advanced when it comes to the number and sophistication of public services available in the Internet.[38] The country is not only ahead of all other NMSs, but also scores better than the majority of EU15 countries including France, Germany and the Netherlands (see Figure 6). The major reason for this is the variety of eServices being developed both by private and public sectors. The percentage of services that offer a complete electronic case handling is also very high, more than 60% of the services can be handled fully electronically which is above EU25 average (40%). The percentage of online availability of 20 basic public services (eGovernment) is 79% in Estonia and 50% in EU25 and 56% in EU15 (see Eurostat, 2007).

Figure 6. Public services fully available online (October, 2004)



Source: Capgemini, 2004

Among the eServices, submitting personal income declaration as well Internet banking are very widely used; 76% of Internet users were submitting their income tax declarations over the Internet and 75% were using Internet banking service in the first half of 2006 (RISO, 2006). Estonia is also the first country in the world to enable its citizens nationwide to vote over the Internet for political elections –

[38] A four stage framework is applied according to *eGovernment indicators for benchmarking eEurope* to measure the level of online sophistication of the services: 1. Information: online information about public services; 2. Interaction: downloading of forms; 3. Two-way interaction: processing of forms, including authentication; 4. Transaction: case handling; decision and delivery (payment).

the local elections of 16 October 2005. ID-card based casting of ballots was available and the number of e-votes cast during the local elections amounted to 9 287, representing 1% of total votes.

The number of companies connected to the Internet is also on the rise. In the beginning of 2006, 76% of Estonian companies had a broadband Internet connection (Eurostat, 2007), whereas ADSL connection is the most popular. 79% of the companies connected to the Internet also maintain a homepage (RISO, 2007). In 2005, enterprises used the Internet actively for interaction with the public sector — 63% of enterprises used Internet for obtaining information from public sector web sites, 60% for submitting enterprise related documents to public sector agencies and 35% for electronic case handling (RISO, 2005). Among enterprises, the Internet is mainly used for searching information and for banking and financial services (94.5% and 96.6%, respectively, in 2006 (SOE, 2007)). Yet, overall, according to the surveys only 16%-18% of Estonian enterprises have benefited from ICT means in cutting expenses, increasing turnover and introducing new products and services (RISO, 2006).

The areas of Internet usage are expanding. The use of the Internet for entertainment has doubled by year-on-year numbers. While in the first half of 2004, 15% of respondents used the Internet for playing games, the respective share was 32% in 2006 (Information Technology in Public Administration of Estonia Yearbook, 2005). However, purchasing or ordering of products/services via the Internet is still quite modest in Estonia – only 9% of respondents have reported such activity in 2006 (RISO, 2007).[39] In 2005, as can be seen in Table 8, eLearning materials among books and magazines had rather higher position compared with other commodities; however, they seem to have lost their high position in 2006. Using the Internet for phone calls is also relatively new (14% used the service in 2006 and 6% in 2004), but the number of users has more than doubled over the years, showing the growing popularity of the service (Information Technology in Public Administration of Estonia Yearbook, 2005). ANNEX II gives an overview of Internet and computer use in different age-groups (Table 12) and purpose (Table 13).

Table 8. Individuals aged 16-74 by buying/ordering goods/services over the Internet (2005, 2006)

	Number of individuals, thousand		**Percentage of individuals using e-commerce, %**	
	2005	**2006**	**2005**	**2006**
Books, magazines, eLearning material	24.0	21.3	33.9	29.1
Clothes, sports goods	25.5	28.4	36.1	38.8
Travel and holiday accommodation	22.7	14.2	32.1	19.4
Tickets for events	29.2	23.8	41.3	32.5

Source: SOE, 2007

The general profile of Estonian Internet users and non-users is close to those of other countries. Among the barriers are motivational, access and skill aspects (Kalkun and Kalvet, 2002). In general, the image of ICT use is very positive in the Estonian society and that could be the result of several large-scale awareness-increasing events (e.g., *Tiger Tour*, 1997-1999, which has won the *Global Bangemann Challenge* prize). Also, a web page introducing ICT education in Estonia was opened in July 2006 – with 30 000 people visiting the web page in its first two weeks.[40]

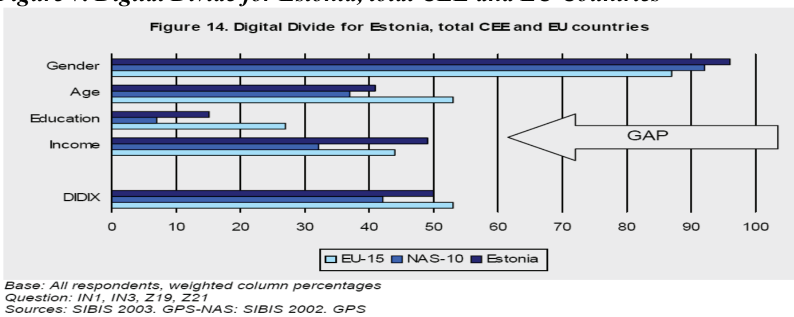
Although Estonia is showing rather good computer and Internet usage figures, there are still more than one in three (34%) of individuals who have never used a computer, and 46% who do not use the Internet regularly – the EU25 figures are 34% and 57%, respectively (see Figure 3 in ANNEX III). Accordingly, there are 37% of persons aged between 16 and 74 with no computer skills – the share of those with high skills in the same age range is 29% (Statistics in Focus, Eurostat, 17/2006).

[39] Generally, only 6.8% of persons who bought goods and services in the last 12 months purchased over the Internet (Statistics in Focus, 12/2006).

[40] See also http://www.startit.ee/. This promotion programme is initiated by the *Estonian Information Technology Foundation* (with support from *EMT*, *Elion*, *Skype Estonia* and *Tallinn University of Technology*) and is oriented to students to give overview of different learning possibilities in the area. It also gives overview of job possibilities in the field. The web page also contains tests and case studies.

According to *SIBIS*, digital literacy of the youth in Estonia is the highest *COQS index*[41] among CEE countries. The overall index of digital literacy in Estonia is 0.7 (SIBIS Pocket Book 2002/03). In the *digital divide index*, Estonia has the lowest in the area of gender gap, and the highest in education (see also Figure 7).[42] Furthermore, the education gap is considered to be two times lower than in CEE countries, but higher than in EU15 (SIBIS Country Report, 2003). Data from the *SOE* illustrate the differences in skills in using the Internet – the young and educated individuals have the most widespread and higher skills.[43] Moreover, according to the survey of Kalvet and Kalkun (2002), 26% of Internet non-users have reasoned out either poor skills or the complexity of use for not using the Internet.

Figure 7. Digital Divide for Estonia, total CEE and EU Countries



Source: SIBIS Country Report, 2003

The educational gap is also illustrated in a 2004 study that shows Internet usage to be highest among students (92%) and employees (59%) – the percentage of unemployed using Internet was 39% (Eurostat News Release, 2005). Furthermore, low levels of formal education appear to be the most significant reason people cannot participate in the IS (SIBIS Country Report, 2003). This is evident in statistics showing that the level of basic computer skills is highly dependent on a person's educational background (Statistics in Focus, Eurostat, 17/2006; also, see Table 12 and Table 13 in ANNEX II). However, the latest *Eurostat* survey shows that 24% of people with higher education do not have computer skills either (the respective average in EU is 11%), although those who have computer skills are better than EU's average level. The main reasons for that can be: firstly, the rather high age of Estonian population having higher education; and secondly, the state's modest financial support to enhance lifelong learning (Uusen, Eesti Postimees, 26.06.2006).

Since computer programmes are often in English, language is one important reason the Internet is considered to be difficult to use – that is, English for Estonians; Estonian and also English for non-Estonians in the case of content services. The language aspect is especially difficult for the elderly, and it is a very important concern for non-Estonians as well (Kalvet and Kalkun, 2002). In the education sector, principals are the ones especially very concerned about the deficit of educational software in the Estonian language – whereas using software in English worries only 4% of students (Toots, Plakk and Idnurm, 2004: 12). Yet, most web-based courses are in the Estonian language (The eLearning Strategy in University of Tartu; Content Village, 2005).

Finally, Estonia has been one of those among EU and CEE candidate countries as well (namely, Bulgaria and Hungary) with the lower level of concerns about data security and

[41] *The digital literacy index* (COQS) is a measure that combines four types of skills in using the Internet: communication with others (by e-mail and other online methods), obtaining (or downloading and installing software on a computer), questioning the source of information on the Internet, and searching for the required information using search engines (SIBIS Country Report, 2003).

[42] *The Digital Divide Index* (DIDIX) is a compound index that comprises four indices: gender, age, education and income. The lower the index value, the more severe is the divide (*Ibid.*).

[43] This relates to activities like using a search engine to find information; sending e-mails with attached files; posting messages to chatrooms, newsgroups; using the Internet to make telephone calls; using peer-to-peer file sharing for exchanging movies, music, etc.; and creating a web page. See more in Table 13 in ANNEX II.

privacy/confidentiality. Only 9% of regular Internet users are very concerned about data security in Estonia, compared with 24% in CEE and 26% in EU countries on average, 20% in Switzerland and 40% in the US. The situation is similar regarding concerns about privacy and confidentiality (SIBIS Country Report, 2003: 21). However, 64% of Estonian inhabitants have expressed distrust in the area of security of eServices, even though some have claimed to be very positive towards the eServices offered by public authorities (TNS Emor, 2005). The emerging security problems are also surprising because previous surveys have revealed that Estonians, both households and enterprises, are quite well aware of security issues in using computers and the Internet.[44] The occurrence of security problems should have decreased from 53% in spring 2005 to 44% at the end of 2005. This shows that Estonian Internet users have acknowledged potential risks to security and take measures to protect their computers. 79% of residents who have an Internet connection at home use antivirus software, while the respective indicator for enterprises was 84% (Information Technology in Public Administration of Estonia Yearbook, 2005). Nevertheless, the state (in cooperation with the private sector) has taken actions to address more actively IT security issues (see the Principles of the Estonian Information Policy).[45]

In the area of eLearning, the greatest challenge seems to be the security problems in private sector. Although the private sector has developed their own LMSs (the *eKool*), there is still very much paper-based training. This is mainly the result of the restriction of access to LMS and to the databases from home. The main concerns are technical safety (viruses) in particular and data security in general.

Summary of Chapter I

In sum, although several big steps have been made in developing eLearning in Estonia, these efforts are mainly concentrated at formal education level – i.e., in basic, secondary and higher education, and are mainly related to computerisation, to web-based courses and materials, and to learning and study information systems. Since the first initiatives in the area of vocational education have started only recently, it is at the moment difficult to assess the developments in the area. Developments in eLearning are particularly recognisable at higher education level where blended learning is the most preferred form (eUSER, 2005). Web-based courses are provided also in the framework of lifelong learning, but their role has remained limited. Important developments at the informal education level include, among others, ICT skills training, ‘internetisation’ of libraries and existence of *PIAP*s.

It is difficult to find reliable information about workplace training, and especially about eLearning usage in the area. In the private sector, eLearning is mainly used by larger companies and especially in the financial and telecommunications sector. The usage of their LMSs is considered an important eLearning activity. Blended learning is the most preferable form in workplace training.

Although Estonia is showing good in computer and Internet penetration rates, there are several problems related to the use of ICT by different age groups and by groups in different educational levels, or individuals in different activities. Language poses some problems. And security issues are in the agenda of the private sector.

[44] This has also been confirmed by a study among Internet non-users – 1% of non-users mentioned security concerns as the reason for not using the Internet (Kalvet and Kalkun, 2002).

[45] For example, in 2006, leaders of the largest banks and telecoms (*SEB Estonian Union Bank*, *Hansabank*, *Elion*, *EMT*) as well as *the Ministry of Economic Affairs and Communications* of Estonia signed a cooperation agreement to launch a nationwide *Computer Protection 2009* initiative, pledging to invest up to EUR 3.8 million to increase end-user PC protection and awareness in Estonia. The aim is to make Estonia a country with the most secure IS in the world by year 2009. As a first step, a gateway to PC protection related information and discussions at http://www.arvutikaitse.ee (currently only in Estonian) has been launched (RISO News, 2006).

II: OVERVIEW OF E-LEARNING IN ESTONIA

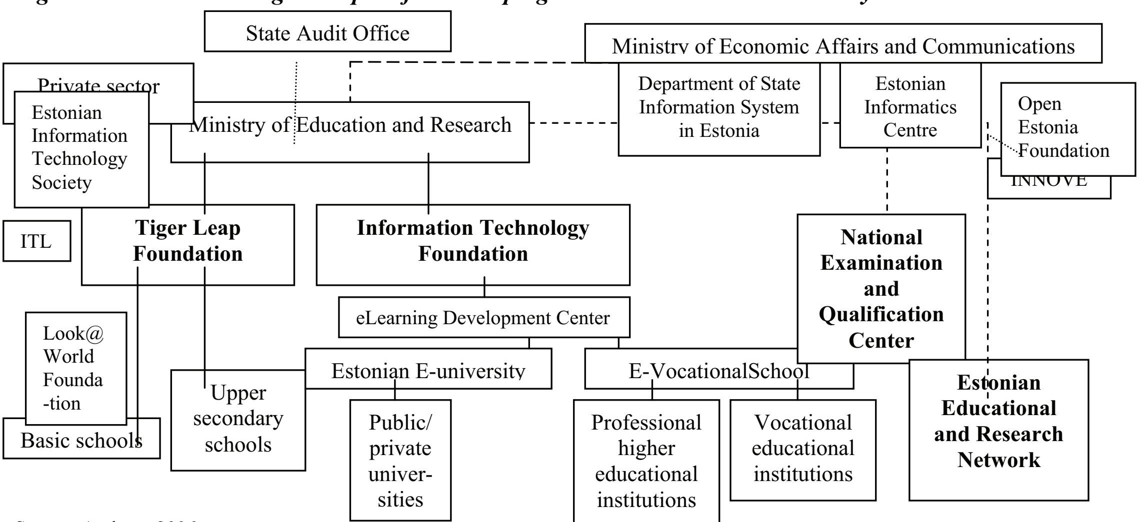
The purpose of Chapter II is to give an overview of the building blocks that affect the evolution of eLearning in Estonia. Within the broad range of the relevant factors, the country study focuses at assessing the institutional structure; current strategies, policies and projects; legal framework and dedicated specific ICT infrastructure in place and their significance in eLearning developments. Taking into account these factors, this chapter analyses the eLearning services available and their usage as well. Finally, it discusses the impacts of eLearning developments on the education system in particular and on IS in Estonia in general.

II.1 Institutional structures and resources for eLearning

II.1.1 Organisational structure for eLearning coordination

The importance of ICT and ICT-based education for governance and development is well-recognised in Estonia. **The *Ministry of Economic Affairs and Communications*** – specifically ***the RISO*** **– is responsible** for the overall coordination of IS in Estonia. The tasks of the department include the coordination of state IT-policy actions and development plans in the field of state administrative information systems: state IT budgets, IT legislation, coordination of IT projects, IT audits, standardisation, IT procurement procedures, and international cooperation in the field of state information systems. The *Ministry of Economic Affairs and Communications* also coordinates Estonian information policies which include, among others; e-educational issues (see Figure 8).

Figure 8. Tentative management plan for developing ICT in Estonian educational system



Source: Authors, 2006

The **Ministry *of Education and Research*** is the central coordinating unit of e-education in Estonia (see Text Box 6). The direct development of ICT-based education and respective ICT infrastructure falls mostly under the responsibility of **governmental non-profit organisations**, especially the *Tiger Leap Foundation* and *Information Technology Foundation*, both established under the auspices of the Ministry. Figure 8 shows that there is no concrete organisational structure and coordination system in place for eLearning activities, which are already rather decentralised at the ministerial level. A clear responsibility for dealing with eLearning issues is missing also at the level of the ***Parliament***.

Text Box 6. The *Tiger Leap Plus Strategy* defines the following tasks of the *Ministry of Education and Research*:

- The Ministry guides the implementation of the development plans in the field of eLearning and their further elaboration, relates them to the other strategic documents in the field of education and creates the legal environment required for achieving the plans' objectives.
- Hence, upon the initiative of the Ministry, the preparation of ICT competency standards for school managers, teachers, students and education officials is organised/re-organised (this is especially the case of general education). The Ministry is also responsible for establishing standards and a legal base for electronic administration of information.
- The Ministry comes up with a plan of the annual budget for respective eLearning development projects (The Tiger Leap Plus Strategy, 2001-2005).

The tasks of ***local authorities*** are to support schools to acquire ICT equipment, to take responsibility for providing ICT support for schools, to coordinate and finance Internet connection according to local specificities and needs, and to finance in-service training for teachers (State Audit Office, 2003; the Tiger Leap Plus Strategy, 2001-2005).

Schools are responsible for the creation of a functioning financial and organisational system for procurement, upgrading and servicing of ICT resources (The Tiger Leap Plus Strategy, 2001-2005; see also ICT@Europe).

The development of eLearning and its activities in ***higher education institutions*** depend on their own plans for the future. However, the crucial role is played here by the eLearning Development Center to enhance the developments of the field.

There is no certain scheme in regard to the involvement of **private sector** in the provision of services for eLearning; rather it is through one-time initiatives. Even though it can be argued that the main role of the private sector in these initiatives has been the provision of finance, it is also clear that especially in the late 1990s private sector's initiatives and willingness to provide finance served as catalyst for many public policy actions in the areas of IS and eLearning. The main reason behind private sector's involvement may be considered as self-interest and the desire to push developments in educational sector in order to keep up with success in IS as a whole.

II.1.2 Main public institutions involved in the provision of services for eLearning

The ***Open Estonia Foundation*** (*OEF*), a charitable foundation established in 1990 with the help and funding of Georg Soros, made a remarkable contribution to eLearning especially in the early stage during the 1990s.[46] *OEF* funded several extensive educational projects promoting ICT infrastructure in schools and universities and teacher training with a budget of about EUR 300 000 (The Tiger Leap Plus Strategy, 2001-2005).

As earlier mentioned, the main responsibility of implementation of services for eLearning is now in the hands of non-profit organisations – *Tiger Leap Foundation* and *Estonian Information Technology Foundation*. The activities of both institutions are based on special programs with respective budgets.

The ***Tiger Leap Foundation***[47] is established under the *Estonian Ministry of Education* in 1997 with the purpose to offer support in procuring ICT equipment for general education schools which, according to the *Basic Schools and Upper Secondary Schools Act*, are obliged to ensure that they have the necessary teaching aids. In recent years, the *Tiger Leap Foundation* has been promoting the use of ICT in everyday learning process. As a result, a remarkable number of Estonian web-based learning materials, simulations and ePortfolio are created in the framework of *Tiger Leap programmes*. The

46 See also http://www.oef.org.ee/en/.
47 See also http://www.tiigrihype.ee/eng/index.php, http://klient.ok.ee/tiigrihype/.

main activities of *Tiger Leap Foundation* have been carried out through programmes like *Tiger Leap* (1997-2000) and *Tiger Leap Plus* (2001-2005). At the moment, a new programme, *Learning Tiger,* is being developed for the period 2006-2009. From 2004, the *Tiger Leap Foundation*, in partnership with the *European Schoolnet*, is also coordinating and funding several educational programmes of the *European Commission* such as *eTwinning*,[48] *Springday Europe* and *Netdays Europe*.

The funds of the *Tiger Leap Foundation* come from the state budget, various fund sources, donations from the private sector and the activities of the Foundation itself. Some resources have also come from PHARE ISE (in 2003) and from EU's structural funds. In implementing its projects, the Foundation will proceed from a co-financing requirement, establishing that the funds allocated by the local government will be enhanced by 1/3 of the sum from the *Tiger Leap Foundation*.[49] At the general education level, the *Tiger Leap Foundation* has financed eLearning activities between 1996 and 2006 with a total of EUR 18.36 million, from which 70% have been used for maintenance and improvement of schools' ICT infrastructure (including Internet connection); 15% for teachers' training; 10% for web-based learning materials and learning software development; and 5% for surveys/public communication (annual conferences) and management of the foundation (Mägi, 2006b).

The ***Estonian Information Technology Foundation***[50] is a non-profit organisation founded by the *Ministry of Education*, *University of Tartu*, *Tallinn University of Technology*, *Eesti Telekom* and the *Estonian Association of Information Technology and Telecommunications* (*ITL*). The Foundation's aim is to assist the preparation of highly qualified IT specialists and to support ICT-related development in Estonia. For these purposes, the *Estonian Information Technology College* is established; in addition, the Foundation administers the National Support Programme for ICT in Higher Education *Tiger University*. The Foundation also has a great role in initiating and developing eLearning possibilities through the *Estonian E-university* and the *Estonian E-VocationalSchool* consortiums. Since 2 May 2006, the *eLearning Development Center* has led the activities of both entities (*Estonian E-university* and *E-VocationalSchools*). Both consortiums are oriented on the development of eLearning (the main strength has given on development of web-based study materials, courses, curriculums, LMSs, CMS, and usage of course management systems) and on providing respective support and training. The *Estonian Information Technology Foundation* is financed by state budget, different funds, and donations from the private sector and the activity of the foundation. In 2004, from all the financial resources totalling EUR 1.85 million, about EUR 984 000 came from state financing (Tiger University Plus Programme 2005-2008).

- The ***Estonian E-university***,[51] established in the framework of the *Tiger University*, is the central institution giving advice to people who seek web-based courses for self-study and is supporting provision of web-based courses. It was founded in 2002 and operates as a project organisation under the umbrella of the *Estonian Information Technology Foundation*. The members of the consortium are the *Estonian Ministry of Education and Research, Estonian Information Technology Foundation* and Estonian Universities (*University of Tartu*, *Tallinn University of Technology*, *Tallinn University*, *Estonian Agricultural University*, *Estonian Business School*, *Estonian Information Technology College*). The *University Nord* and *Audentes University* are associated members of the consortium. The *Estonian E-university* is financed by membership fees as well by the state budget and by the funds from both local and international sources (especially EU's Social Fund).
- The ***Estonian E-VocationalSchool***[52] was founded in 2005 in cooperation of six (6) professional education institutions, 31 vocational education institutions, the *Ministry of Education and Research* and the *Estonian Information Technology Foundation* to promote

48 *eTwinning* can be considered as an actor itself due to the collaboration in the framework of this project.
49 The Foundation also organises public competitions to support the development of the most appropriate ICT solutions for schools and the acquisition of softwares that promote the quality of learning. The task of the school administrator is to support the procurement of ICT means for schools following the principle of co-financing (The Tiger Leap Plus Strategy, 2001-2005).
50 See also http://www.eitsa.ee.
51 See also http://www.e-uni.ee/index.php?main=120. It is not a university in the usual sense.
52 See also http://www.e-vet.ee/.

lifelong learning under the principles of regional development and in the framework of the ten thematic networks. It functions under the *Estonian Information Technology Foundation* and is financed by the membership fees, the state budget and by Measure 1.1 of the EU's Social Fund.

For the period 2003-2005, eLearning projects at higher and vocational education levels have been supported with EUR 455 690. The two main consortiums of the *Estonian Information Technology Foundation* have been financed as follows:

1) *Estonian E-university* has been financed with a total of EUR 391 778 (i.e., EUR 127 823 in 2003; EUR 108 649 in 2004; and EUR 155 305 in 2005); and
2) *Estonian E-VocationalSchool* with a total of EUR 63 911 since 2005 (Anton, 2006a).

From the perspective of finance, the EU's structural funds are of great importance and have greatly affected eLearning developments at higher and vocational education levels.[53] In fact, the financial support for projects related to eLearning under ESF Measure 1.1 comprises one of the largest parts of the ESF budget where the *Estonian E-VocationalSchool* holds the biggest project financed with an overall cost of about EUR 2.288 million, from which EUR 1.7 million is covered by structural funds. The project is called *eKey* involving 33 vocational schools and will be for the period 01.07-2005 - 30.06.2008.[54] The ***Foundation for Lifelong Learning Development*** (*INNOVE*), for instance, selects the appropriate projects to be financed by EU funds under Measure 1.1.[55]

The main shortcoming of the financial system for eLearning activities in the public sector, chiefly relying on EU's structural funds, is its orientation on one-time projects. This suggests, considering the fact that the main activities in the field are organised by the Foundations and not by relevant ministries, that the clear responsibilities of ministries (especially of the *Ministry of Education and Research*) is missing in a supposed functioning organisational structure. In other words, the motivation of the state, upon which the availability of financial resources depends, is limited in the area of eLearning.

II.1.2.1 Academic institutions

The main providers of web-based courses in Estonia are the ***Tallinn University of Technology***, ***University of Tartu*** **and** ***Tallinn University*** (previously *Tallinn Pedagogical University*) together with the private universities ***Estonian Business School***, ***Estonian Information Technology College***, ***Concordia Audentes International University Estonia***, ***Academia Nord*** *and* ***Mainor Business School***. *Tallinn University* has a great role in developing LMSs, CMSs and ICT-supported learning methodology. *Tallinn University* has also developed teachers' support system in the field of web-based learning.[56] The universities develop several digital learning materials for general schools.[57] Aside from the universities, the general educational schools themselves have been very active in developing digital learning materials.

The *Tallinn University of Technology* and the *University of Tartu*, together with the *Estonian Information Technology College*, are also the main providers of ICT education in Estonia. A large share of the first two emerges in the field of academic higher education and the latter plays an

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53 EU's funds have been used at higher and vocational education levels in addition to central financial resources. For example, web-based courses and video lectures of the ***Tallinn University of Technology*** and ***University of Tartu*** were at first financed by the *Ministry of Education and Research*, but recently it is mostly financed by the *Estonian E-university* and *REDEL project* under Measure 1.1 of EU's Social Fund.

54 See also http://www.INNOVE.ee/ee/?p=2&op=page&pID=377&action=search.

55 See also http://www.INNOVE.ee. Basically, the tasks of *INNOVE* include consultancy to those who want to apply for EU's financial support, evaluation of applications, and monitoring and evaluation of both funded and accepted projects.

56 See also http://e-tugi.tlu.ee/esialgne_tegevuskava.htm.

57 For example, web-based learning projects in the natural science, in cooperation between *5DVision Llc* and *University of Tartu*. See more at http://mudelid.5dvision.ee/.

important role in the field of applied higher education (Kattel and Kalvet, 2006). For an overview about the main ICT education providing universities, see ANNEX III.

The universities are the main institutions (especially ***Tallinn University*** and ***University of Tartu*)** offering *initial teacher education*. Basic teacher training includes general courses on computer science, and instruction on methodology related to the use of ICT. *In-service teacher* training is mainly the responsibility of ***universities***,[58] **the *Tiger Leap Foundation***, **the *Estonian E-university*** and **the *Estonian E-VocationalSchool***.

The university level is also the level where much of the R&D is carried through.

II.1.2.2 Other public players

The ***Ministry of Education and Research*** takes on the administrative task. It develops ICT based information systems like ***Admission Information System*** (*SAIS*), which has been the service through which applications for higher education admission are submitted electronically since 2005. It has also developed the new educational information system, the ***Estonian Educational Information System*** (*EEIS*), which replaces several separate databases. The ***Estonian Informatics Centre*** is responsible for the middleware system *X-Road* project, which enables the graduates of upper secondary school to see their national exam results in the Web.[59]

In addition to governmental non-profit organisations like *Estonian Information Technology Foundation* and *Tiger Leap Foundation*, the ***Estonian Educational and Research Network*** (*EENet*), a governmental non-profit organisation established by the *Ministry of Education* in 1993, is active in the field of eLearning.[60] The state agency is responsible for a high quality national network infrastructure for the Estonian research, educational and cultural communities. The services of *EENet* also include permanent Internet connection as well as several other services – web hosting, e-mail services, FTP, DNS, consultations in case of security problems, hosting of teachers' digital learning materials, etc. (Standing Orders of Estonian Educational and Research Network). In 2004, the project *Estonian GRID* (*Eesti GRID*) was started.

The ***National Examination and Qualification Center***, under the Ministry of Education and Research, has to create the system to support the professional development of teachers – to guide their training, retraining and in-service training (Founding Articles of National Examination and Qualification Center). It has carried out an annual national standardised test since the year 2002 to assess the *9-graders' ICT competencies*, from which all schools can participate on voluntary basis.

The ***State Audit Office*,** which is an external auditor for the Government, has the objective to audit the use of funds in the public sector and its performance (economy, efficiency and effectiveness).[61] On the basis of audit results the Office advises the institutions of the public sector with respect to the use of public funds and performance of its tasks in an efficient manner. In the field of ICT, the *State Audit Office* has carried out six audits within the period 2001-2006. These audits mainly deal with evaluation, of which one of them is about ICT infrastructural issues in general educational schools (*The Tiger Leap Program in Estonian Schools of General Education*, 2003).[62]

There is no concrete system for monitoring activities taking place regarding eLearning issues due to the missing official system for eLearning in Estonia. As the main responsibility of implementation of eLearning activities are in the hands of the non-profit organisations – *Estonian Information Technology Foundation* and *Tiger Leap Foundation* – they should carry out surveys in the field of

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58 Universities have organised ICT courses within the framework of in-service teacher training.
59 See also http://www.ria.ee/. The subdivision of the *Ministry of Economic Affairs and Communications* which is in general responsible for the coordination and implementation of the development of state registers, computer networks and data communication, standardisation, IT public procurement, monitoring Estonian IT situation, etc.
60 See also http://www.eenet.ee..
61 See also http://www.riigikontroll.ee/.
62 See also http://www.riigikontroll.ee/audit.php?audit=312.

their responsibility. The main outcome has been annual reports. To date, only two (2) surveys have been carried out in the area of *Tiger Leap Foundation*'s responsibility by Tallinn University:[63] *Tiger under Magnifying Glass – Study on Information and Communication Technology in Estonian Schools in 2000* and *Tiger in Focus – A longitudinal survey on ICT in Estonian schools 2000–2004.*

There are no specific public control mechanisms in place for eLearning activities in the private sector.

II.1.3 Involvement of private sector to the provision of services for eLearning

At the national level, the official involvement of the private sector in the field of eLearning is through the ***ITL*,** as member of *Estonian Information Technology Foundation*, which is of major importance in the area of eLearning.[64] *ITL* is also cooperating with other important actors of eLearning, like the *Tiger Leap Foundation* and the *Ministry of Education and Research*. However, *ITL* is rather concentrated on *eGovernment* and *eBusiness*. The main activities of the association include popularisation of ICT, promotion of vocational education and amendment of legislation.

The ***Estonian Information Technology Society***, which is a union of professionals, is responsible for the improvement of the qualifications and professional level of IT specialists, especially through the organisation of the vocational certification system in the information technology sector and formation of good communications and information exchange practices between IT companies and users.[65] Under this institution is the *AO Center* (*AO Keskus*), an institution organised with the main aim of initiating *European Computer Driver's Licence* (*ECDL*) programme in Estonia.[66]

In practice, the major role of the private sector has been the financing of public sector's initiatives (e.g., *Tiger Leap programmes*). Some large companies have likewise initiated their own financial support for developing IS, as well as the provision of corresponding training. As a matter of fact, the first LMS was established due to the initiatives of the banking sector, especially the *Hansabank* (see section II.4.2).

The most important institution of private sector in the field of eLearning is the ***Look@World Foundation***, founded in 2001 by ten leading major companies in the Baltic countries such as *Elion*, *Hansabank*, *EMT*, *Microlink*, *Baltic Computer System*, and *IT Grupp* with the aim to increase the number of Internet users, and thereby raising living standards of Estonians as well as the competitiveness of the Estonian economy in Europe. The ***Look@World Foundation*** has invested in computerisation through its *Look@World Project* over the three-year period 2001-2004 about EUR 2.55 million (Look@World Foundation's Internet Training Project Report, 2004).[67] The Foundation also helped to provide *PIAP*s[68] with computers and establish Internet connections where needed (Look@World Foundation). *PIAP*s are especially important for developing the skills of the people in the rural areas. *Look@World Foundation* also supports financially the use of web-based gradebook service ***eSchool*** in general education. The *eSchool* communication tool itself is developed and provided by ***Koolitööde Ltd***.

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63 Surveys about the activities of the *Foundations*, especially the implementation of their development plans may be done by universities, research centres or companies selected in competition, and monitoring of different sub-projects can be executed by different institutions (The Tiger Leap Plus Strategy, 2001-2005).

64 *ITL* is a voluntary organisation with the objectives to unite the Estonian information technology and telecommunications companies, to promote their cooperation in Estonia's development towards IS, to represent and protect the interests of its member companies, and to express their collective positions on issues of common concern (http://www.itl.ee/english/general/index.asp).

65 See also http://www.eits.ee/index.php?section=ws_eits_eng.

66 See also http://www.ao.ee/keskus.htm.

67 See also http://w.hansa.ee/eng/supports_projects.html.

68 The Estonian government (the *Ministry of Culture*) has also been very active in the spread of *PIAP*s – *the Ministry of Culture* ordered the establishment of Internet connection in public libraries and the opening of *PIAP*s in all Estonian libraries during 2002-2004 (Village Road II). The money for the Internetization of public libraries came mainly from the *Ministry of Culture* (Siil, 2000).

An important player in the local market of eCommerce applications is ***Mindworks Industries Ltd***.[69] *Mindworks* is also an expert in eLearning and has developed corporate e-training environment *Edutizer*. However, the number of companies in the Estonian market that are able to design digital learning materials from usual word documents and create interactivity is very limited today (Interview with Tammiste, 2006). For example, ***eProject***[70] is considered to be the only professional company that develops SCORM-compliant educational/training content for private schools and industry (Laanpere, 2006b).

In the framework of different *Tiger Leap Foundation*'s programmes, the private sector (next to universities) is seen as one of the leading actors developing virtual learning objects and new digital learning materials, supporting further development of LMSs (especially those in Estonian) and the creation of web-based test environment for controlling ICT skills of teachers and students, and supporting the purchase of new modern technologies for schools as well (Learning Tiger Action Plan 2006-2009; see Text Box 7).

Text Box 7. One of the best examples in the production of new eLearning objects is a firm called ***5D Vision*** (http://www.5dvision.ee/tutvustus.pdf) established in 1999. Especially important for general education as well as for lifelong communities is a repository of e-worksheets established and provided by ***Miksike Llc*** (http://www.miksike.ee) since 1994. In developing digital learning materials, contributions have also been done by firms like *Hurmaster Llc*, *Sarrup Llc*, *ApsProg Llc*, *Mathema Llc* and *Edusoft Llc* (also, see http://www.tiigrihype.ee/projekt/valmis_opi.php). ***Microsoft*** (Estonia) provides licence for educational software *Academic Edition* and *Alliance* for Estonian schools (certain requirements of qualification is needed) at all levels (http://www.microsoft.com/eesti/). ICT firms like ***Jucotec Llc*** and ***Pro-STEP Llc*** (http://www.jukotec.ee; http://zope.eenet.ee/cnc/partnerid/jukotec) have also been involved in software provision (*CAD-CAM systems*).

However, the role of the private sector has in practice remained limited. A reason has been the private sector's high price in developing software due to a rather small market for Estonian digital learning materials. In other cases, private sector's involvement has been restricted due to the very essence of available local open source LMSs, CMSs, etc. – i.e., they are available without costs. An exception, to a certain degree, is the LMS *IVA*.[71] The private sector also provides scholarships for different IT real life projects in cooperation with the *IT College*, *Tallinn University of Technology* and *University of Tartu*. The projects are implemented by small groups under the guidance of the private sector (Interview with Tammiste, 2006). Interestingly, this development is very important since it is usually perceived that while the private sector is willing to fund different IT projects, it does not cooperate with the public sector on R&D initiatives.

There are also some training and software enterprises in the market whose activities include the provision of services for eLearning. However, the number of this kind of firms remains limited (for an overview of the respective providers in the market, see overview in ANNEX III). Overall private sector's involvement in the provision, control, and finance of eLearning services is also limited (see Table 11 for major services provided within eLearning). Private sector involvement in general education through financing and providing specific software is greater than in higher and vocational education, where public sector activities (above all, financial resources, digital learning materials and environments) continue to prevail.

ANNEX III provides a summary of Table 4 about the roles and responsibilities of different actors in the field of eLearning in Estonia.

69 See also http://www.mindworks.ee/.
70 See also http://www.eprojekt.ee/.
71 The financial support from *Hansabank* went to *Tallinn University*, rather than to *IVA* (Interview with Laanpere, 2006).

II.2 Current strategies, policies, action plans and projects/programmes

II.2.1 Description and evolution of the major government policies that focus on eLearning

eLearning developments in Estonia are quite often based on grassroot-level local initiatives, sharing of best practice, active involvement in European networks, etc. The weakness of this approach is that developments in eLearning and related policy decisions/priorities behind the actions are often not documented (Laanpere, 2006b).

The first IS strategy was prepared already in 1998 and IS technologies have been a priority field since 2000 according to research, development and innovation strategies.

The overall ICT policy framework in Estonia, the ***Principles of the Estonian Information Policy for 2004-2006***, approved by the Government in 2004, follows the objectives set out in the *eEurope 2005 Action Plan* and declares eLearning as a main priority **(**see the extracts of the strategy in ANNEX III; also, Text Box 8).[72]

Text Box 8. *Priorities in the field of eLearning*:

- to increase digital literacy of the population;
- to continue the development of PIAPs through the provision of basic computer skills;
- to increase the computerisation level of schools at all levels to the average of the EU;
- to introduce web-based study forms in higher education and lifelong learning;
- to publish reference books, study materials and scientific articles in Estonian in the Internet;
- to develop vocational and continuing education system for training IT support personnel and equipping all graduates of educational specialties with ICT skills necessary for teaching their subject (Principles of the Estonian Information Policy for 2004-2006).

Actions have been undertaken in all the aforementioned fields. As eLearning activities are mainly regulated by its own domain's development plans (especially by *Tiger Leap* and *Tiger University programmes*, and the *Estonian E-university Strategy* derived from the latter) the main outcomes are described under these programmes. At the moment, a new development plan, ***Estonian Information Society Development Plan for 2013***, has been accepted on the 30th of October 2006. Here, the eLearning objectives are stated more widely than in the previous one, concentrating on the further development of e-education (propagation of flexibility and individuality in the learning process, including enhancement of lifelong learning) and further developing knowledge about ICT and respective skills of the society.

Overall, the first documents mentioned above were rather oriented on state and state information system – that is, eGovernance, while the latest strategy (*Estonian Information Society Development Plan for 2013*) is rather oriented on society as a whole: 1) citizens and their ICT skills, 2) economy, 3) well functioning state.

The main driver for change at the general educational level is the action plan of ***Learning Tiger*** *for 2006-2009*. While the previous *Tiger Leap* programme (1997-2000) concentrated on computerisation of schools and its succeeding *Tiger Leap Plus* (2001-2005) focused on the modernisation of learning methodology and on increasing ICT competencies of teachers and students (see also overview of both development plans and their implementation in ANNEX III), the purpose of *Learning Tiger* is to

[72] The *Estonian Broadband Strategy 2005-2007* is also important in developing IS. Its main aim is to make available online services offered by both the private and public sectors for all citizens, as well as to contribute to competitiveness, creating new jobs and reducing costs of transportation and communications. Further steps are done to enhance access to the Internet and hence to increase digital literacy. One aspect of the strategy is to stress the importance of eLearning in Estonian education system.

highlight the sustainable development of LMSs, CMSs, etc. and ICT usage in learning process (see Text Box 9).[73]

Text Box 9. More specifically, *Learning Tiger for 2006-2009:*

- It gives emphasis to the creation and distribution of web-based learning materials and to the improvement of the access of schools to eLearning environments and to web-services with study-purpose.
- The other essential object is to develop further eLearning environments in Estonian and maintaining the free access to them of teachers and students.
- *Learning Tiger*'s aim is to increase the efficiency of studying through ICT and eLearning to become a natural part of everyday studies, giving great emphasis on *Virtual Learning Communities, LMSs*, *Learning Objects, Learning Object Repositories, Learning Object Brokerage Platforms* and *Virtual Community of Practice.* Researches foresee the need to promote the studies of design, technology and media on general education as the greatest challenge (Toots, Plakk, Idnurm, 2004).
- The stress is given to the creation of administrative and respective regulatory framework for eLearning (Learning Tiger Action Plan 2006-2009). More specifically, according to *Learning Tiger* programme the *Ministry of Education and Research* should assure through the amendments of respective legal acts that virtual learning (including financing) has a clear legal base during the next three years, and that the results of the virtual learning are accepted at par with traditional learning.
- In addition, school principals' competencies in the field of ICT should be stated and the students' and teachers' further developed. The training of teachers, school principals and ICT infrastructure are still among the other priorities. A crucial challenge is the need for updating the teacher training curriculum.
- Much attention should be given to teachers' networks to create the web-based courses, and also to establishing support centers in counties (Learning Tiger Action Plan 2006-2009).

At the higher education level, the trend is not only to support ICT-related education, but also eLearning (mainly in the form of web-based courses and curriculum). Another aim has been the development of web-based courses in distance learning and in-service training. However, the efforts in the latter cases have remained very limited. In addition, taking into account the small size of Estonia, there is a tendency not to design and use the courses based only on web-based learning very widely (Pilt, 2003). The strong goals have been stated towards internationalisation – the English web-based courses and the curriculum for international market.

The ***National Support Programme for the ICT in Higher Education Tiger University*** (2002-2004), which was approved in 2002 and continued by the programme ***Tiger University Plus*** (2005-2008), aims to support the development of the ICT infrastructure, the ICT academic staff, the degree courses and the ICT-related curriculum at higher educational establishments (see the overview about the implementation of the plan in ANNEX III; also, Text Box 10). A special section in this strategy is created for eLearning activities, the Estonian E-university.

Text Box 10. *The priorities of Tiger University are*:

- development of ICT infrastructure (upgrading the academic backbones and networks, PC procurements, equipping the labs, providing software);
- development of ICT-related curricula (new curricula, creation of study materials, E-university, eLearning, literature and electronic resources);
- motivating the academic staff (mentoring PhD students, academic sabbaticals, lecturers' and PhD students mobility scheme, internships, visiting lecturers)(The Estonian Information Technology Foundation).

The objective of the ***eLearning Strategy of the Estonian E-university 2004-2007*** is to increase the percentage of web-based courses as well as the percentage of modules and curriculum and the number of teachers involved in eLearning (see extracts of this strategy in ANNEX III). The strategy is followed by the ***Strategy of the Estonian eLearning Development Centre 2007-2012***, here in addition to these objectives stated in previous strategy, it is emphasized also the importance of available infrastructure to support the developments in the field of eLearning and the popularisation of

[73] On the basis of the *Tiger Leap* developmental plans all counties have worked out their own developmental plans. Also many schools have developed detail plans of their own (State Audit Office, 2003).

eLearning in terms of improving of people's awareness of eLearning (see Text Box 11). In September 2006, the ***E-memorandum*** between the Estonian higher and vocational educational institutions and the *eLearning Development Center*, was signed. It calls on **students and teachers** (not policy makers) to actively search for ways to take advantage of eLearning in Estonian education so as to raise the quality of the education provided.

Text Box 11. According to the *Strategy of the Estonian eLearning Development Centre 2007-2012*, the milestones for 2012 are:

- At least 80% of full-time teaching staff in institutions of higher education and at least 60% full-time teaching staff in vocational schools and institutions of professional higher education are on the basic level of education technology proficiency, at least 50% of those who have passed the basic level have progressed to the advanced level. All trainers are on the expert level.
- There is always a contemporary, functioning, secure and uniform eLearning infrastructure in Estonia, which guarantees that the objectives of the *Estonian eLearning Development Centre* are achieved and new learning methodology is implemented in higher and vocational education.
- To always have an overview of the situation of eLearning and trends in higher and vocational education both in Estonia and abroad.
- 80% of curricula in institutions of higher education and 30% of curricula in vocational schools have eLearning support (materials in the learning information system (LIS), learning environment, forum/lists, grade system/feedback, etc.).
- The curricula of least 8 *Estonian E-university* and 5 *Estonian e-VocationalSchool* consortium members can be fully taken in the form of eLearning.
- Good cooperation with educational institutions of different levels, eLearning development units and other organisations (companies, social partners) in order to guarantee improvement of the ability to compete.
- eLearning and possibilities of eLearning are well known in Estonia and abroad.

Additionally, the ***Estonian Higher Education Strategy for 2006-2015*** sets out as one priority the increasing use of web-based learning. It sees the necessity to establish regional learning colleges to enable studying under the curriculum of *Estonian E-university* and *E-VocationalSchool* all over Estonia, as well as the need to support tutoring of eLearning. However, these priorities have already been implemented mainly under the previous strategy – more specifically, through the *eLearning Strategy of the Estonian E-university*. At the regional level, the merging of vocational schools and the establishment of the vocational training centres (*School Network Development Plan for 2005-2008*) has had the impact on the creation of the preconditions necessary for the provision of eLearning in vocational education institutions.

The ***University of Tartu and*** the ***Tallinn University of Technology***,[74] the two largest universities in the country, have created their ***own strategies*** for developing web-based learning possibilities in the provision of E&T services. The main goal is to upgrade the quality of education services by improving the access to learning materials and study courses. In *University of Tartu* all curriculum in Open University system (distance learning) and 30% at stationary level require the inclusion of some form of web-based learning. In *Tallinn University of Technology* the amount of courses that include some form of web-based learning element is projected to rise to 90% by 2010. The ***University Nord*** has also worked out its own ***eLearning Strategy for 2006-2008***[75] and ***IT Strategy for 2005-2008***, with the main aims to enhance individual learning, create flexible learning opportunities for foreign students as well as for distance learning and therefore create its own web-based courses, do cooperation with *Estonian E-university* and train its professors in order to develop web-based courses.

74 See the web-pages of the respective universities here.
75 See also http://www.nord.ee/UserFiles/File/e-oppe_akava.pdf.

What can be seen from these strategies (except *Learning Tiger*) is that eLearning is treated only as web-based learning: 'eLearning is an interactive studying, where the learning process is generally based on the web and where most of the studies take place also on the web' (eLearning Strategy of the Estonian E-university 2004-2007). This kind of orientation has affected also the activities carried on in the field. However, today the change in this kind of approach may be seen and in the latest strategies of eLearning it is stated that: 'eLearning does not mean copying the current learning process with the help of ICT, but redesigning learning according to new possibilities. Introduction of eLearning does not mean that current good learning and teaching methodologies need to be abandoned, but it allows them to be updated and broadened (Strategy of the Estonian eLearning Development Centre 2007-2012).

From the financial aspect, one of the most influential strategies on higher and vocational education has been the ***Estonian National Development Plan for the implementation of the EU structural funds SPD 2004-2006*** and especially because of its ESF measure 1.1 (see Text Box 12). The strategy is going to be followed by the ***National strategy for using EU structural funds in 2007-2013***. Overall, the structural funds have financed the projects emphasising the developments at doctoral levels in higher education and the development of IT-related curriculum in vocational education (Interview with Targama, 2006).

Text Box 12.

- **Measure 1.1: Educational System Supporting the Flexibility and Employability of the Labour Force and Providing Opportunities of Lifelong Learning for all** (*ESF*) (*Riikliku arengukava meetme 1.1 "Tööjõu paindlikkust, toimetulekut ja elukestvat õpet tagav ning kõigile kättesaadav haridussüsteem" toetuse andmise tingimused*) foresees the availability of Internet-based application in education and in creating lifelong learning opportunities for adults. It also supports trainings in the field of ICT and digital technology for teachers and trainers to promote the implementation of ICT in the teaching process and development of eLearning materials (The Decree no 43 of the Minister of Education and Research, 24 October 2005).
- **Measure 4.3: Modernisation of Infrastructure for Vocational and Higher Education** (*ESF*) (*Riikliku arengukava meetme 4.3 „Kutse- ja kõrghariduse ning seda toetava infrastruktuuri kaasajastamine" toetuse andmise tingimused*) recognises the need for construction and renovation of buildings and research bases of vocational and higher educational institutions (regional colleges), including the development of the infrastructure of information technology (The Decree no. 29 of the Minister of Education and Research, 17 May 2004).
- **Measure 4.5: Information Society Development** (*ERDF*) *(Riikliku arengukava meetme nr 4.5 «Infoühiskonna arendamine» tingimused ja toetuse kasutamise kava koostamise kord)* is concentrated broadly on the further development of public sector eServices (The Decree no. 151 of the Minister of Economic Affairs and Communication, 9 June 2004).

With EU's new *Financial Perspective* and new *National Development Plan* for structural funds being currently discussed, new policy instruments are expected to be in place that will target eLearning as well (e.g., the development of common study information system, regional development especially of regional learning colleges which were part of earlier strategies, and provision of access to education for disabled persons through ICT means).

EU's programmes have played a great role in developing eLearning in Estonia – for example, the EU's Socrates Minerva and the appropriate programme of Estonia, ***Creating network-based Estonian E-university model for the small countries in the context of eLearning in Europe 2003*-2005**, which aims to create an *Estonian E-university*.[76] In general, eLearning activities are supported by the EU's ***eEurope 2005 Action Plan***, ***eLearning Programme***, ***Education and Training 2010*,** etc.. However, the effectiveness of these latter programmes remains to be investigated since they are only currently

76 See also http://www.e-uni.ee/Minerva/.

referred to in several strategies like *Principles of the Estonian Information Policy, Tiger University Programme* and *Learning Tiger*.[77]

Although several other political documents have stated eLearning (in terms of web-based learning) as a mean to solve overall problems and hence should have had positively affected eLearning developments, these priorities have often remained in words. This is particularly the problem in lifelong learning (see the list of policies affecting lifelong learning in ANNEX III).

II.2.2 Evaluation of possible international influence, especially of the European Union, on eLearning policies

The basic policy document in the field of IS in Estonia is *the Principles of the Estonian Information Policy 2004-2006*. This strategy was strongly influenced by the *eEurope+* and *eEurope 2005* policy documents. Its focus was primarily on the development of individual eServices, including the necessary infrastructure for it and the development of ICT sector. There is a growing understanding, both in the EU and in Estonia, that in order to gain success, mere use of technology is not be sufficient – the real impact is only achieved if implementation of modern technologies is accompanied by the reorganisation of processes and continuous upgrading of skills. These principles have been taken into account in the strategy *Estonian Information Society Development Plan* – a follow-up to the current *Principles of the Estonian Information Policy*. The new policy document does not only deal with the state information system, but also envisages activities for increasing the competitiveness of the ICT sector, widening the use of IT in the business sector, in education sector (including teaching the needed basic skills and widening the use of ICT-supported learning) and in the society at large, and for adapting to changes brought along by the introduction of new technologies (Information Technology in Public Administration of Estonia Yearbook, 2005).

The new strategy takes very directly into account the objectives and priorities of the EU information strategy *i2010*, and also of those, which were stated in the *eEurope* strategy documents. According to Karin Rits, head of *Information Society Division* of the *RISO*, the EU's strategies are, to a certain extent, adapted to the local situation (e.g., solutions like *X-Road*, available to all), and that the goals in the strategies have come from the local level. At the moment, at the eGovernment level a survey to detect bottlenecks and challenges is being conducted (Rits, RISO 2006).

In the field of education, the *Ministry of Education and Research* has not carried out any analyses to assess the EU's effect on the national eLearning strategies. Neither has the EU's effect on the Estonian legislation in the field been analysed. However, in the process of elaborating the respective strategies, local socio-economic reality and international practice have been arguably taken into account (Anton, 2006b). In the framework of the project *REDEL* (financed by EU's ESF) the political survey is under this field, which should be completed at the beginning of 2007 (Tammeoru, 2006b).

eEurope 2005 has had strong influence in promoting the usage of ICT in education – an example in the case of Estonia is the *Tiger University Strategy*. Other development plans in education (e.g., *Learning Tiger* and *eLearning Strategy of Estonian E-university*) seem to be developed according to local specifics and needs. Furthermore, this is supported by the fact that the activities towards eLearning on general education started already in 1997 with the *Tiger Leap programme*. Also, the universities' strategies for eLearning are derived from their own needs for the future. The influence of the *i2010* has been great at the level of lifelong learning. Here, the main objective of the *Lifelong Learning Strategy 2005-2008* is derived from *Education and Training 2010*: to increase the participation in lifelong learning amongst 25-64 year old participants by 10% in 2008 (see Kiviselg et al., 2006).

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[77] Estonia is also related to the programmes like *eTEN* and has applied to take part of the project *eCONTENT*. The coordinator of these programmes in Estonia is the *RISO* (*Ministry of Economic Affairs and Communications*) and the support center at the national level is *Archimedes Foundation* (Information Technology in Public Administration of Estonia Yearbook, 2005).

In sum, although EU's influence in developing policies on eLearning in particular and IS in general has been significant, it is not plausible to argue that Estonia has followed specific best practices. As Estonia has been actively developing policies in the eLearning area since mid-1990, it has been emphasising local specifics and needs rather than compliance with EU guidelines. Today, the *National Lisbon Strategy* is designed in large scale on national strategies, and not in the prescribed EU ways. However, international practices are followed in certain scope (*ECDL* mainly) in the framework of general ICT skills' training and of teacher training. In the case of the private sector, being part of international corporations has not influenced training either (Kahn, 2006; Interviews with Kuusemets and Väravas, 2006).

II.2.3 Implementation of eLearning policies

The other question is how national strategies in the area of eLearning have been implemented and what have been the main results. This is important because while there has been generally a consensus among all political parties on the goals stated above, linkages between political rhetoric and policies/action plans often remain non-existent.

The action plans (especially the ones for the year 2006) of the *Principles of the Estonian Information Policy 2004-2006* are very general from the standpoint of education, bringing out only a few fields to be developed. Furthermore, as the main priorities are stated by *RISO* (although in cooperation with the *Ministry of Education and Research*), which is under the jurisdiction of the *Ministry of Economic Affairs and Communications*, it has no real power to evaluate the implementation of the strategy.[78] Hence, the strategy's value (especially in the education sphere) is questionable.

The deepest and well-elaborated plans (also for teacher training) have been worked out at the general education level. However, a careful analysis of the respective action plans makes one realise that although legal issues have been among the top priorities in all action plans, a total solution for these have not yet been found.

The implementation of the *eLearning Strategy of the Estonian E-university* 2004-2007 in higher education has been positive, although the need for further development is obvious (web-based curriculum, the number of web-based courses, especially in the case of distance and in-service training, advanced curriculum for teacher training, and most of all the expected role of eLearning in higher education). Behind the positive developments is the fact that the main initiative – the *eLearning Strategy of the Estonian E-university* 2004-2007 – was born out of the universities and not at the national level. This means that behind the Strategy are universities themselves, and thus taking on the strong responsibility of implementation (Laanpere, 2006b). This approach is also logical due to the legal autonomy and independence of universities in Estonia. At the same time, given that the *Estonian E-university* consortium is composed only of biggest universities in Estonia, the Strategy is not applied to those universities or higher educational institutions outside the consortium (Laanpere, 2006b). Furthermore, it can be argued to what extent does the Strategy reflect the future plans of universities for eLearning – considering how rarely the representatives of universities meet in the framework of this consortium, and how big a role they can actually play (noting that the *Estonian E-university* has been under another organisation, the *eLearning Development Centre*, since spring of 2006).

In addition to the main strategy for higher education, eLearning development has been supported by the EU's structural funds, based on the *Estonian National Development Plan for the Implementation of EU Structural Funds – Single Programming Document 2004-2006*. As a result, largely the development in the area is depended on the availability of specific financial resources. This means that to date the developments in eLearning are mainly based on single projects.

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[78] eLearning goals in strategy are the result of cooperation between the *Ministry of Education and Research* and *RISO* – how IT could bring benefit in education through a synergy approach. *RISO*'s role was to take overall direction in IT (Interview with Rits, 2006).

Lifelong learning is in the poorest condition in the field of eLearning. The respective objectives for lifelong learning in the action plan of *Lifelong Learning Strategy* are quite few (the most important one related to the *E-VocationalSchool*). One of the main problems in the field is the lack of recognition of learning as essential part in everyday life in the whole society; and secondly, the lack of legal and organisational system for lifelong learning at the state level to support the implementation of the set priorities.

Another very serious problem is that the few existing national strategies and policies addressing eLearning (*Tiger Leap*, *Tiger University*, *ICT Policy Framework*, *and National Development Plan*) are practically disconnected to each other. Even the closest action plans that are administered by the same institutions (e.g., *Tiger University* and *eLearning Strategy of the Estonian E-university 2004-2007* under the *Estonian Information Technology Foundation*) seem not to have shared goals, priorities, etc. (Laanpere, 2006b). The role of the *Ministry of Education and Research*, which should be the central coordinating unit of e-education in Estonia, has become merely the allocation of money from the state budget to the *Tiger Leap Foundation*, to the *Estonian Information Technology Foundation*, and from the ESF funds to *INNOVE*. It has not fulfilled the other crucial tasks as envisioned (e.g., relating the strategies of ICT-education to the other strategic documents in the field of education and creating the legal environment required for achieving the plans' objectives (The Tiger Leap Plus Strategy, 2001-2005).

II.2.4 Major public and private projects and programmes in eLearning: their aims, financing and results

II.2.4.1 Projects to develop basic ICT skills

Two major projects in the past have been launched in order to enhance overall digital literacy skills across Estonia: (1) the development of *PIAP*s to promote access to computers and the Internet (a programme already discussed above); and (2) the *Look@World project* to mainly train people for ICT skills development.

The ***Look@World Internet training project*** was a project for 100 000 people to create training network, to provide free-of-charge basic computer and Internet training (see Text Box 13).

> **Text Box 13.** Two-day courses (8 hours altogether) both in rural and urban areas were provided through the training project. The course included teaching of computer (its different parts and usage, main principles in working with computer, and usage of WS World) and of Internet (especially the use of search engines and of eServices) (Look@World Foundation's Internet Training Project Report, 2004).

Since competence of using Internet in urban areas was already higher than in the rural areas, more training was provided in the latter. During 2002-2004, 102 697 people (i.e.,10% of Estonia's adult population and approximately 15% of adult population in rural areas) was trained in the framework of the project. Hundreds of employees from enterprises took part in the training to learn the use of ICT tools in everyday work (Look@World Foundation's Internet Training Project Report, 2004). Thus, the *Look@World project*'s experience was very important also on enterprises (Interview with Tammiste, 2006). The project was implemented on the basis of PPP of the *Look@Word Foundation*, and is one of the biggest training projects financed by the private sector. See also the concrete budget for project in Figure 4 in ANNEX III.

According to the Lifelong Learning Strategy 2005-2008, the follow-up project of Look@World will be conducted in 2007. The original plan suggests that the EU's ESF funds are to be used for offering computer training, setting 15 000 as a realistic number of people who could be trained at the duration of the project (European Commission, 2005a). The role defined for the private sector, and especially the *Look@World Foundation*, is to oversee the training in the field of computer security for all computer home users (Interview with Tammiste, 2006).

II.2.4.2 Projects/programmes at general educational level

At the general education level, the most important activities have been in the framework of *Tiger Leap* development plans. An overview of the project carried out in the earlier phase can be found in ANNEX III.

In 2004, the Tiger Leap Foundation started the technology-teaching project, which was designed to help modernise the subject ***Manual and Technology Training*** (*Töö- ja Tehnoloogiaõpetus*) in Estonian schools.[79] Twenty schools from all over Estonia were involved in the pilot project, and got the computer lead CNC profiler and design software (Overview of general education in Estonia in 2001-2005).

General education schools have participated in several projects financed by the *European Commission*. The most important projects are *CALIBRATE,* concentrating on enhancing the usage of electronic learning materials, *eMapps.com* investigating mobile-based eLearning possibilities, as well as *eTwinning project* enhancing the cooperation among European schools.

The project ***CALIBRATE*** was launched by *European Schoolnet* in Tallinn in 2005 for 30 months.[80] It is part of a new group of IST projects supported by the *European Commission*'s *6th Framework Programme*. This project brings together eight Ministries of Education, leading research institutions, validation experts, technology providers and SMEs to carry out multi-level project designed to support the collaborative use and exchange of learning objects/resources in school. In the Estonian context, the plan is to recreate the Estonian news and community portal *Koolielu*, which also contains a repository of digital learning resources, and to connect it to other repositories of the kind and to learning environments widespread in Europe.

In 2005, ***eMapps.com*** was launched as part of the *European Commission*'s *6th Framework Programme*. It was also a pilot project about using ***mobile phones in learning process in Estonia*** (two schools have been selected here – *Tallinn 32nd High School* and *Haapsalu Upper Secondary School*) (The Annual Report of the Tiger Leap Foundation 2005).

eTwinning is a framework for schools to collaborate on the Internet with partner schools in other European countries.[81] It promotes school collaboration in Europe through the use of ICT by providing support, tools and services to make it easy for schools to form short or long term partnerships in any subject area. As a result of their participation in the framework, the Estonian teams have gained positive acknowledgement for its projects (e.g., 'My Week').[82] A local blog for the project was also developed and carried out several trainings and information days. The programme is very popular among general education schools – by the end of 2006, around 200 schools joined the programme.

In addition to these, the development of digital learning materials for both general education and EU levels is outlined within the framework of the Leonardo da Vinci programme. Higher educational institutions, which would teach the teachers at upper secondary level to design digital learning materials, are involved in the projects (see Eesti Postimees, 31.10.2006).

II.2.4.3 Projects/programmes at higher and vocational education levels

At the higher education level, the *Tiger University* programmes are the most important programmes related to ICT issues. Several new projects are, however, taking over the role especially on eLearning matters.

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79 See also http://klient.ok.ee/tiigrihype/?op=body&id=14.

80 See also http://www.europeanschoolnet.org/ and http://www.htk.tlu.ee/htk/projektid.

81 See also http://www.etwinning.net/ww/en/pub/etwinning/index2006.htm, http://www.htk.tlu.ee/etwinning/news, http://sopruskoolid.blogspot.com/.

82 See also http://projectmyweek.blogspot.com/.

The ***Distance Learning Programme at the Institute of Finance and Accounting*** in the *University of Tartu*[83] is composed of 17 web-page courses,[84] from which each student can compose their own portfolio (see Text Box 14). These 17 courses commence four times every year (and end with an exam three times a year); the total number of courses was 60 (with 605 students) and 65 (with 569 students) in 2005 and in 2006, respectively (Liikane, 2006).

> **Text Box 14.** The Distance Learning Programme was launched by the *Estonian Banking Association* (*EBA*) in 1995 when the first nine courses were introduced. These courses were worked out within the framework of the PHARE programme in cooperation with *Banking Institutes in Portugal and Catalonia* and *Belgian Bankers Academy*. In 1996, the pilot group consisting of 30 students graduated**.** In 2002, a contract was signed about the acquisition of the Project by the *Institute of Finance and Accounting* of the University of Tartu. Since 1996 the number of students who have participated in the *Distance Learning Project* has exceeded 7 000.

ICT Cert is a project aiming at the development of joint curricula, courses and accreditation opportunities for telecommunications specialists in Finland and Estonia.[85] The purpose of the project is to develop a system with which ICT assemblers or those intending to be one may acquire the needed qualifications and certificates. New curriculum will be developed, based on the requirements of qualification in Estonia and Finland, with the needed study materials for the required training (qualification may be achieved also by passing the competence tests without any training). A training cooperation network will be created in which resources (teachers, equipment) may be shared between the participating institutes. Paths for student exchange and on-the-job training in the neighbouring country will also be opened. The project is financed from the ERDF and is implemented in the framework of the program *Southern Finland and Estonia INTERREG IIIA*. This is a project of *Tallinn University.*

iCamp**,** *the Educational Web for Higher Education in an Enlarged Europe*, is part of a new group of IST projects supported by the *European Commission*'s *6th Framework Programme*, in which Estonia is represented by the *Tallinn University*.[86] Its main objective is to create an open virtual learning environment for university students across Europe by connecting different open source learning systems and tools, and to provide interoperability amongst them. This new learning environment is a learner-centred space where students and educators will work collaboratively on assignments across disciplines and across countries with a special focus on the integration of students and universities. *iCamp* will offer students and educators both innovative and easy-to-use tools for collaboration and interaction as well as access to a variety of resources.

In addition, *Tallinn Unviersity* has been organising an international Erasmus Intensive Programme ***eLearning in Higher Education*** **2004-2006** in Viljandi and Haapsalu.

Of utmost importance at the vocational education level is the ***E-VocationalSchool*****'s project *eKEY*** (*e-VÕTI*),[87] which plans to create 640 digital learning objects; to develop courses for 615 weeks; to support the introduction of LMS *IVA* or course management system *Moodle* by consortium members; to train 2310 professors, teachers and tutors; to create a support system based on education technologists (more specifically to employ 33 education technologists in schools of the consortium); to create special portal for web-based courses and digital learning objects; and to conduct studies in the field of eLearning. The project duration is set between 01.07-2005 and 30.06.2008.

However, since the abovementioned projects have only started recently it is difficult to appraise the developments in the framework of the respective projects.

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83 See also http://www.finance.ut.ee.

84 Bank Functions, Balance Sheet Activities in the Financial Institutions, Financial Services, Bank Financial Statement Analysis, Value Based Financial Management, Bank Organisation, Monetary Policy & Euro, Credit Management I-II, Foreign Trade, Real Estate Markets & Business I-II, Marketing of Financial Services I-II, Financial Markets, Life Insurance, Pension Insurance, Insurance of Property Risks, Project Work and Real Estate Law. See also http://www.finance.ut.ee/index.php?eng/67/11/0/104.

85 See also http://www.htk.tlu.ee/ictcert.

86 See also http://www.icamp.eu/learnmore/project_objectives/index.html and http://www.htk.tlu.ee/icamp.

87 See also http://iva.e-uni.ee/e-voti.

II.2.4.4 Projects in teacher training

Overall, the emphasis at the general education level on teacher training projects has been much greater (thanks to *Tiger Leap Foundation*) than at higher and vocational education levels. However, several courses have been launched in the latter cases (especially by the *Estonian E-university,* universities and *E-VocationalSchool*). As a result, greater role has been given to projects carried out at general education level.

On general education, the *Tiger Leap Foundation* has offered courses for basic ICT skills and ICT application training for teachers (e.g., in Biology, Chemistry, Mathematics, Physics, Astronomy, Elementary Studies, History, Estonian, English and German) (The Tiger Leap Plus Strategy, 2001-2005). Altogether, 75% of teachers have been trained twice in ICT skills (Overview of general education in Estonia in 2001-2005; Mägi, 2006).

The ***Training Programme on Digital Didactics*** was launched in 2003 and ran for two years.[88] This was a product of the cooperation between *Tiger Leap Foundation* and *Tallinn Pedagogical University*. The programme included courses like *Computers in Digital Didactics of Elementary Education*, *Computers in Math Digital Didactics* and *Computers in Digital Didactics of English*. In 2005, 88 teachers completed the 40-hour training. The final works created in the framework of the course are available from the Estonian educational portal *Koolielu.*[89]

The next project of *Tiger Leap Foundation* is the follow-up project to the *Computer at School*[90] – ***DigiTiger*** (*DigiTiiger*).[91] According to this project, the Foundation is making contract to 23 Estonian Schools and will provide free in-service training for general school teachers during the succeeding three years. Until the year 2008, the plan is to train about 6 000 teachers (see Estonian Portal Koolielu, news 06.02.2006).

In 2005, the *Tiger Leap Foundation*, in cooperation with *BSC Koolitus*, also started to work out the special course for school principals – ***Digidirector*** (*DigiDirektor*).[92] The aim of the course will be to introduce the possibilities ICT provides for schools and the role of principals on this endeavour.

New courses and projects have been launched in order to support teachers in the field of eLearning (Text Box 15).

Text Box 15.

The Implementation of ICT Skills in Learning Process – Projektipaun (*IKT oskuste rakendamine õppeprotsessis*) (http://www.htk.tlu.ee/projektipaun) is a cooperation between *Microsoft* and *International Society for Technology in Education* (*ISTE*). The aim of the course is to provide teacher solutions and examples on how to effectively use technology in teaching their subjects and in integrating it to different subjects. In addition to ICT skills, the course gives information about project learning (*projektiõpe*). This is a 20-hour long course.

AnimaTiger (*AnimaTiiger*) (http://www.htk.tlu.ee/animatiiger) is an 8-hour course to introduce to the teachers how to make short movies and to use these methods on students to make classes more attractive (e.g., art and literature subjects). The course has also a follow-up advanced course. In addition, the project is supporting the purchase of respective technical means like cameras for schools. The project is a cooperation between the *Tiger Leap Foundation* and non-profit institutions like *Nukufilmi Lastestuudio* and *Movev Bus* (*Kinobuss*).

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88 See also http://www.tiigrihype.ee.

89 See also http://www.koolielu.ee.

90 The project was launched in 2001, and was a 40-hour long in-service training programme for teachers, prepared by *Intel Corporation* and adapted in 26 countries (Laanpere, 2003/2004). The course included the following topics: study material and creation of web pages, use of Internet resources as well as educational and standard software, the possibilities about e-mail and ICT use for administration of class work. Furthermore, the course was suitable for Estonian teachers as well as for school managers (European Commission, 2004).

91 See also http://www.htk.tlu.ee/digitiiger/. The 40-hour course will include 10 modules and during the course different learning environments like *Plone*, *IVA* for teachers and *VIKO* for students are used. The main aim is to introduce the new innovative learning methodology and means to teachers. The final work is to create own web-based course in LMS *VIKO*.

92 See also http://www.tiigrihype.ee/?op=body&id=18.

At the higher education level, the *Estonian E-university* and *E-VocationalSchool* have given great emphasis on training of teachers/trainers and especially of educational technologists. During the courses provided by the *Estonian E-university* teachers are taught the new possibilities in ICT, creating web-based learning materials and specific teaching methodology. The web-based courses provided are divided into three different levels: basic level has courses for 2 CPs, advanced for 6-8 CPs and expert level for 15-35 CPs. [93] The courses are mainly available in the web.

Some of the new projects are presented in Text Box 16.

Text Box 16.

OPAH – Teacher's Professional Development Supported by ePortfolio (http://www.htk.tlu.ee/opah) is designed to support a teacher's professional development through ePortfolio solutions and to develop the competences of lecturers and teachers in educational technology at all the three levels of teacher education. The activities of the whole project are divided into two groups. Group I – *Teacher's Professional Development group* has three subgroups: *an initial training group*, *occupational year group* and *continuing education group*. All these groups together create the idea and content of the digital portfolio. Group II – *Technical group* creates the implementation, technical and software infrastructure for ePortfolio. The project is financed by EU's ESF.

B-Learn – Assisting Teachers of Traditional Universities in Designing Blended Learning (http://www.ut.ee/blearn/) is planned to offer solutions on how to integrate traditional learning methods with methods offered by new technology. Primary target groups are the users of blended learning (teachers, students, instructional designers, educational technologists) mostly from higher education institutions, and from other types of institutions as well. Innovative usage of technologies and methods by teachers would result in better learning results, more flexibility for all but mainly part-time students, more satisfaction and improvement of orientation towards eLearning.

Notwithstanding the number of projects initiated to address the basic and advanced ICT skills, it has been claimed (also on higher education) that there is still much room for developing teachers' and professors' competence in ICT (see also Strategy of the Estonian eLearning Development Centre 2007-2012). Currently, 23.5% of teachers at primary, 24.0% at lower secondary, 29.0% upper secondary and 39.4% vocational education level do not have sufficient computer skills (Empirica and TNS Emor, 2006).

II.2.4.5 Specific programs to specific groups

In general, the *Ministry of Economic Affairs and Communications* and the *Ministry of Social Affairs* are responsible for assuring access to the Internet for disabled people, according to the principles of the WAI. This obligation is also stated in *Estonian Information Society Development Plan for 2013* (Estonian Information Society Development Plan for 2013).

The *Tiger Leap Foundation* supports access of pupils with special needs to general education by making ICT available for that purpose. In particular, the project ***ICT in the Education of Pupils with Special Needs***[94] provides support for centres and counselling for children with special needs, their parents, teachers, officials in education and for all other interested parties. The *Ministry of Social Affairs* provides for some ICT equipment. This is even more essential because many needed equipment are very costly for these targeted pupils. The *Estonian E-university* has created two web-based courses for students with disability, supporting their studies with 15 *Fujitsu Siemens Amilo Pro V2000* laptops and with six screen reader licences (*ekraanilugeja litsentsid*) (Tammeoru, 2006a).[95]

Since 2003, ICT trainings for persons with disability have been carried on within the framework of the project ***THINK***,[96] with financing coming from the *Tallinn University of Technology*. This project offers trainings on the usage of computer, and thereafter assuring graduates a job in the labour market. In 2004, there were 120 people who participated in the programme.

The ***Look@World project*** has been of utmost importance for people in rural areas.

93 See also http://www.e-uni.ee/index.php?main=101.
94 See also http://www.tiigrihype.ee/eng/erivajadused/mis.html.
95 See also http://www.e-uni.ee/index.php?main=160.
96 See also http://www.think.ee.

In sum, the number of projects focusing on the development of ICT skills or on the usage of ICT to support learning designed for the disabled and people living in remote areas are more than limited. Also, the overall assessment on activities in the field has been rather accidental because most of them are based on single project and hence with very specific goals. However, the general view on how eLearning should be promoted overall and on what role it has to play at different education levels and in lifelong learning and hence in teacher training is still missing. This generic view has not been developed in any specific strategies or through any laws.

II.3 The legal framework supporting eLearning

II.3.1 Laws and acts that have been adopted in the area of eLearning

In general, the legal basis in the area of eLearning is mainly restricted to some strategies and has no complete or specific legal basis which would ensure or hinder further development of the field. In fact, the term *eLearning* cannot be found in any legislative document in Estonia (Laanpere, 2006b).

According to the ***Regulation of National Curriculum for Basic Schools and Upper Secondary Schools*** (*Põhikooli- ja Gümnaasiumiseadus*), *Informatics* or *Computer Studies* is not a compulsory course either in the basic or upper secondary education. The *Ministry of Education and Research* has not also approved the required textbooks. The national curriculum for basic and upper secondary schools of Estonia sees ICT mainly as a horizontal cross-curricular theme – the developing of communicative, technological, math and cultural skills are viewed through ICT.[97]

Every school has to find its own way to integrate ICT in different subjects in different grade levels, and guarantee the mastering of standardised **ICT competencies** by all **students by the end of compulsory 9-year of the basic school**, which have been enacted since 2002 (Laanpere, 2003/2004). See overview of these competencies in ANNEX III. This kind of approach may not be effective in the long run as it does not provide in the national system how to concretely enhance overall ICT skills and in what terms at different education levels.[98] In addition, according to the new draft of *Regulation of National Curriculum for Basic Schools and Upper Secondary Schools* the system is not changed.[99] This is illustrated by the fact that after successful deployment of the new national curriculum for basic and secondary schools in 1996, the following two national curriculum releases have failed (in 2002 the failure was partial, in 2006 complete) (Laanpere, 2006b).

At the same time, according to the ***Regulation of National Curriculum for Basic Schools and Upper Secondary Schools*****,** every basic and upper secondary school has the right to provide optional courses in their respective schools. Consequently, most of the schools provide *Informatics* courses for basic school after all, starting in some cases already from the first grade level (1-3 school years). On the other hand, this results in occupying the computer classes and means that other teachers are not able to use computers for their lessons even if they want to (Laanpere, 2003/2004).

The Terms and Order of the Correspondence of Textbooks and Wordbooks to the National Curriculum and Specification for Textbooks and Wordbooks and Other Educational Literature (*Õpikute, töövihikute ja tööraamatute riiklikule õppekavale vastavuse kinnitamise tingimused ja kord ning nõuded õpikutele, töövihikutele, tööraamatutele ja muule õppekirjandusele*) brings out the

[97] According to the Draft of Regulation of National Curriculum for Basic Schools and Upper Secondary Schools (30 September 2006) the stated horizontal cross-curricular themes are lifelong learning and career planning, environment and sustainability, civil society and entrepreneurship, national culture and cultural diversity, IS, technology and innovation, health and safety, values and morality.

[98] Today, for example in the curriculum of different science subjects (primary science, biology, chemistry, physics, earth science) the role of ICT is emphasised differently: mainly using interactive learning materials, searching information via Internet and using the possibilities of ICT are considered important. In primary science and biology, project-based learning and simulation-games are suggested (The University of Amsterdam, 2002).

[99] Draft of Regulation of National Curriculum for Basic Schools and Upper Secondary Schools (2 January 2006).

necessity to have educational references in textbooks for using ICT means (§3). Article 6 states that audio-, audiovisual and electronic materials are used in the learning process as additional learning materials. In sum, as the usage of ICT means is voluntary, much depends on single teachers and on school principals.

The Framework for Teacher Training (*Õpetaja Koolituse Raamnõuded*), the curriculum for teachers of general education offered by higher education institutions, sets out as one of the objectives the development of the skills of teachers in the field of ICT. The competence to use contemporary ICT (general ICT skills) is also one of the qualification requirements for teachers (§ 18). ICT qualification requirements for teachers have also been mandated since 2005 in the ***Professional Standard for Teachers*** (*Õpetaja Kutsestandard*) – according to which teachers should know how to use ICT hard- and soft-ware, including different learning environments; should have knowledge about teaching methodology using ICT; should be capable to create digital learning materials and web-based courses and critically evaluate the available digital learning materials; and should know the truths about Intellectual Property Rights (IPR) (including citation). However, in general, the legal basis for professional standards in Estonia today remains questionable.

A positive development about teachers‘ ICT qualification is that the *Tiger Leap Foundation* has been working on a promising framework for eLearning-related competencies for teachers. However, this framework has not been finalised, legitimised, or implemented (Laanpere, 2006b). The other question is at which legal level this framework should be stated.

In some cases, legal acts related to eLearning are adopted due to the ***Estonian National Development Plan for the Implementation of the EU Structural Funds 2004-2006***, which gives a concrete legal basis for the distribution of structural funds (see also section II.2.1).

There is a general requirement for the provision of ICT infrastructure in schools and training institutions, as well as in the public points for using computers – ***the Specification of Health Care for the Computer Studies and for the Public Use of Computers*** (*Tervisekaitsenõuded arvutiõppele ja arvuti avalikule kasutamisele*).

II.3.2 The legal framework for Intellectual Property Rights

Industrial Property matters are supervised by the *Ministry of Economic Affairs and Communications* and implemented by the *Estonian Patent Office*. The authorship rights are regulated by the ***Copyright Act*** (*Autoriõiguse seadus*) which has been in force since 1992. Copyright and related rights are in the hands of the *Ministry of Culture*. See overview about legal developments and collection of acts (including personal data protection) in the areas of intellectual property and ICT in ANNEX III.

According to *Copyright Act*, works of literature, art and science are protected by authorship rights. From the standpoint of eLearning, authorship rights are also protected in computer programmes, lectures and audiovisual works. However, besides *Copyright Act*, there are no special IPR laws for materials in digital form. The only restrictions are related to databases and computer programmes (Nemvalts, 2004). The rights come into being from the moment of starting the work with the creation.

In general, the author has personal (related mainly with name) and proprietary rights over creation. If the creation is the result of the assignment of work, then on the basis of employment contract the proprietary rights in certain limits are descending to the employer. In the case of web-based courses or materials, this means that the creation is related only to the author's name, but it belongs to the employer (e.g., to the university), who has the right to regulate usage of the creation (Nemvalts, 2004; Copyright Act).[100]

[100] See also http://sise.ttu.ee/?id=1605.

It is very much possible to consciously or unconsciously violate IPR by using materials or courses available in the web (eLearning Conference, 2006). However, according to some persons actively engaged in the field of ICT-education, these violations, especially in the case of eLearning are not considered very important (Interview with Toots and Laanpere, 2006).

Furthermore, the question about IPR in the case of eLearning in Estonia may be overestimated and be more a theoretical problem. The main issue here is related to the attitudes of school teachers and university staff who do not want to share their digital content with colleagues. At the same time, it is clear that Estonian (higher) E&T market is too small to create a business potential for learning objects written in the Estonian language. This is why the *Tiger Leap Foundation* and *Estonian Information Technology Foundation* have been promoting the use of open licencing of digital learning materials (especially, *Creative Commons Licences*) (Laanpere, 2006b). On the practical side, it has to be taken into account that usually web-based courses do not work by itself – it needs persons behind it to communicate to students (through forums), assess the students' work, etc. (Interviews with Väli and Kusmin, 2006). Maintenance of web-based courses in LMS must also be paid (e.g., in *WebCT*).

II.3.3 Main legal issues and constraints affecting the development of eLearning

According to the *Regulation of National Curriculum for Basic Schools and Upper Secondary Schools Informatics*, ICT is not a compulsory course either at the basic or upper secondary education level (for an in-depth discussion on this issue, see Text Box 17). Although pilot exams are carried out to assess basic ICT skills in the 9th grade (where participation is voluntary) and the results of the exams have been rather good, the question whether that kind of system of no system in the field of ICT skills is enough to introduce eLearning and take it as the base to build up IS. At the same time, without making a paradigmatic change in the curriculum of general education, the realisation of a progressive usage of ICT in the learning process remains elusive. Moreover, on the basis of the study findings about ICT usage for educational purposes in general education, it can be said that the current curriculum, built on classical pedagogy and a strong orientation towards assessed achievement, hinders innovation and multidisciplinary learning (Toots, Plakk and Idnurm, 2004: 18). This is not about using several new methods and tools for assessment, but more about using ICT means and materials as additional support in teaching the subject.

Text Box 17. **Concentration on ICT only as a horizontal theme in the development of curriculum is not enough:**

- Firstly, the current approach suggests that the different subjects are covered unequally with ICT – i.e., every subject plan should address, among others, the possibility of using ICT tools, as well as the availability of these tools. The other aspect is the inappropriateness of existing curriculum tradition in Estonia which is subject-centred and into which horizontal approach is imported from elsewhere. To date, horizontal themes remain backward in teaching – that is to say, they are not taught at all in large scale. Thus, whether or not students can benefit from different ICT means and digital learning materials depend on the teacher – the teacher's knowledge about availability of these materials and desire to use them in the class. For example, although there are 5 000 materials available in the Internet for general school teachers, there is no consensus how these materials should be used.
- Secondly, some claim that the importance should not be placed on how one achieves ICT skills, but on the result; hence, there is no essential need for *Informatics* to be a compulsory course in general education. However, are the ICT skills acquired through subject learning enough? How much basic skills are required? At what ICT skill level has students achieved after they have finished the various education levels? Although there are very skilled students, this kind of approach may not be beneficial for all students and may actually result in unequal skills. Today, it would be an exaggeration to suppose that everybody already has basic ICT skills.
- Finally, compulsory *Informatics* would solve the problem of resistance on the use of ICT tools in subjects among *Informatics* teachers. Through this, the teachers do not have to search the ways to influence the importance of their own subjects. This is more important because computer classes are usually the main places where ICT tools can be used.

In addition, the use of ICT in teaching subjects is strongly dependent on the school boards, on whose competence development matters of schools depend (Learning Tiger Action Plan 2006-2009; Basic Schools and Upper Secondary Schools Act). The tangible effect of the Foundation's activity in support of development of eLearning may be limited, especially if its activity is not supported by some kind of legal regulations.

The main issue is how to combine eLearning with national curriculum, and also of which kind should the general working order at schools be. First of all, it means that the technical environment must be in place in order to use ICT more in classes for both vocational and higher education which, in turn, are to be supported with relevant motivation system for teachers. This implies, above all, a good remuneration system for teachers who, on the one hand, spend their time preparing and using ICT in teaching, and, on the other, their compensation depends on the number of classes in a week. The question is even more important when one takes into account that eLearning is a relatively time-demanding task (eLearning Conference in Tallinn, 2006).[101] The compensation system and authorship rights issues (resistance of teachers to share their digital content) are quite serious constraints in the area of eLearning.

Further, developments in ICT usage in the learning process are hindered by the lack of a legal basis about ICT qualification requirements for principals as well as for teachers. The *Ministry of Education and Research* should have developed respective standards at both levels by the year 2001. Even though the *Framework for Teacher Training* has required the acquisition of general ICT skills as one of the competencies for graduation, and that ICT qualification standard has been established in the *Professional Standard for Teachers* of 2005 (albeit not legally binding), the real effects of these acts remain in question. This means that reference for ICT skills may not be taken seriously in assessment system for teachers, not to mention that there is no legal requirement for teachers to use ICT in teaching (State Audit Office, 2003). An important step to come out of this situation may be the establishment of a framework for eLearning related competencies for teachers. However, the question as to the improvement of the situation, if any, at vocational and higher education levels is another issue.

Due to the missing ICT qualification standard for principals, the main problem has been the lack of respective in-service training programmes. The standards are also necessary for universities and other training centres to plan the specific courses. Until 2005, school principals took part in in-service training designed for teachers. In 2005, two special courses for principals were conducted. However, the fact may not be relevant when one takes into account that since 1998 all school principals at the general education level have to pass the 160-hour training on school management which has always included an ICT component (Laanpere, 2006b). ICT-related in-service training is very important for principals, upon whom ICT implementation in everyday learning process depends and upon whose competencies development of schools/universities rely to a great deal (The Basic Schools and Upper Secondary Schools Act).

Developments in the area of ICT in education are, however, not supported enough by the central government. In the ***Strategy for State Budget 2007-2013*****,** eLearning is not considered as a priority. As such, no extra financial resources can be expected for this area in the next years.

In sum, it can be said that due to the missing legal basis or even missing vision about using ICT in the learning process, the state has taken no responsibility for the development of the field. This kind of situation is a bit mitigated by the availability of EU's structural funds, which, to this day, has mainly guaranteed financial resources for the field, but only for vocational and higher education. As pointed out above, a legal basis for ICT skills is incomplete – in particular, on the kinds of skills to be acquired concretely at different levels (except the skills for 9th grade students) and on how skills are to be guaranteed. National strategies or other directives hardly indicate the use of ICT tools in the learning process.

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[101] For example, in the *University Nord*, a special remuneration system for enhancing eLearning has been established since 2005 to motivate professors. According to the system, the design of web-based course has higher coefficient than traditional course. See also http://www.nord.ee/UserFiles/File/e-oppe_akava.pdf. In *Tallinn University of Technology* auditorial work is equal to work done in the framework of eLearning – hence, teachers have the opportunity to choose the teaching form suitable for them and not losing salary as a consequence (Interview with Kusmin, 2006).

II.4 Dedicated specific ICT infrastructures and applications

II.4.1 Description of the existing technical background for providing eLearning services

II. 4.1.1 ICT infrastructure in educational sphere and its usage in the learning process

Comparing data collected in 2000 with that of 2004, the survey *Tiger in Focus* shows that schools are the main place where students can use Internet (79% in 2000, and 88% in 2004). The exception here is in Northeast Estonia, where Internet use at schools is lesser than in other regions (i.e., 55% in 2000 and 73% in 2004).

At the general education level in 2006, there are no school without a single computer: on average, there are one computer per 16 students, one computer per 3 teachers, and one for principal of the school (Mägi, 2006). The best *computer ratio per students* is in Tallinn (over 20); the worst in Lääne County (a bit over 10). And the best *computer ratio per teacher* is in Järva County (4.5); the worst in Tallinn (a bit over 2). See also Table 9 and Figures 5, 6, 7 and 8 in ANNEX III. 96-97% of lower and upper secondary schools have broadband Internet access. The percentage of school Internet access is better in thinly populated (99.7%) than in densely populated areas (94.0%) (Empirica and TNS Emor, 2006). Võru County is in the best situation (with 99% broadband connection), and among those in the worse are Lääne County (84%), Tallinn and Ida-Viru County (87%).

Possibilities have been established in most schools to provide computer studies as voluntary course and develop students' ICT qualification at all levels, and subjects as horizontal theme in curriculum as well. Today, computer sciences are taught as a separate subject in more than 80% of the primary, lower secondary and vocational schools and in 95% of the upper secondary schools, according to the statements made by Estonian head teachers (Empirica and TNS Emor, 2006). As the financing of ICT infrastructure is in the hands of local governments, the real situation in the area of ICT infrastructure in Estonian general education schools varies, although it is clear that the overall situation can be evaluated positively. At the regional level, the situation should be positive, as there have been several projects by counties to better enhance Internet connection (Interview with Mägi, 2006). According to the study of the *European Commission*, in cooperation with *TNS Emor*, the availability of computers in schools for students and teachers is below EU average. There are only seven (7) computers for 100 students, whereas in EU25 the indicator is 11 (in Denmark even 27). Special computer classes are mainly equipped with computers – the share of computers for other classes is only 28%, compared with EU's 61% (Empirica and TNS Emor, 2006).

Table 9. The number of computers in general education used by students and teachers (2001-2006)

	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Number of schools	671	651	640	622	615
Number of students	213 774	206 837	199 411	190 879	180 967
Number of computers used by students	6 763	7 585	8 432	9 366	9 365
Number of computers used by teachers	2 404	2 707	3 356	4 406	6 279
Total number of computers in schools	10 596	12 076	14 158	16 581	18 570
Total number of Internet connections	542	574	594	640	…

*Note: *Data about the years 2001-2005 is based on national statistics; Data about 2006 is based on statistics from EEIS* Source: EEIS, 2006

On the use of ICT, the survey *Tiger in Focus* indicated a 15% growth in computer usage outside school over the period of four years (81% in 2000 and 96% in 2004), but the computer usage at school had slightly decreased during the same period (85% and 82%, respectively). This is largely due to an increase in home computers over said period. According to the survey, 74% of pupils used a PC at home. In the case of teachers, the situation had improved more compared with that of students. In 2004, 80% of teachers had a PC at home, while in 2000 the respective indicator was close to 40%.

Also, if in 2000 only 17.5% of teachers had Internet connection at home, in 2004 the number was 54%, of which 34% had permanent connection (Toots, Plakk and Idnurm, 2004: 26-27).
In vocational education on the year 2006, the number of students per one computer is about 11, and in higher education the respective share is 20. See also Table 10 below. Information is not available about basic equipment level for the teacher in classrooms in vocational and higher education. However, at vocational level, 81.6% of teachers agree that their school is well-equiped with computers (Empirica and TNS Emor, 2006).

Table 10. The number of computers in vocational and higher education (2001-2006)

	Number of students	Number of computers used by teachers	Number of computers used by students	Number of computers for common use	Number of computers for school administration	Total number of computers	Number of servers
Vocational education level							
01/02	36 629	575	2 540	280	582	3 915	120
02/03	35 295	666	2 731	266	711	4 543	140
03/04	35 577	794	2 817	312	795	4 682	139
04/05	37 181	959	2 950	355	842	5 204	146
05/06	32 631	1 106	3 065	405	No data	5 291	148
Higher education level							
02/03	56 272	3 046	2 664	No data	No data	7 931	162
03/04	58 265	2 730	2 873	No data	No data	9 023	189
04/05	60 212	3 077	3 278	No data	No data	10 155	198
05/06	64 937	3 771	3 223	810	No data	9 897	347

Source: EEIS, 2006

In general, almost all Estonian schools now use computers for teaching and have internet access. 95% use the internet via broadband connection. There is hardly any variation between school types since it is close to 100%, with the exception of vocational schools which remain at 87%. A high 87% of schools have a website, 70% offer e-mail to teachers but only 18% do so to students. Only 28% of Estonian schools using computers for teaching use them in classrooms, with the highest percentage being achieved in vocational schools (40%). ICT is mostly used as part of teaching in computer labs (91%) which seems to be the typical case in the new member states. Computers in the school library are also more widely used in vocational schools (57% as opposed to approximately one-third in all other school types). The lack of computers in their respective schools is considered by 53% of respondents to be the greatest barrier why teachers do not use computers in class (Empirica and TNS Emor, 2006).

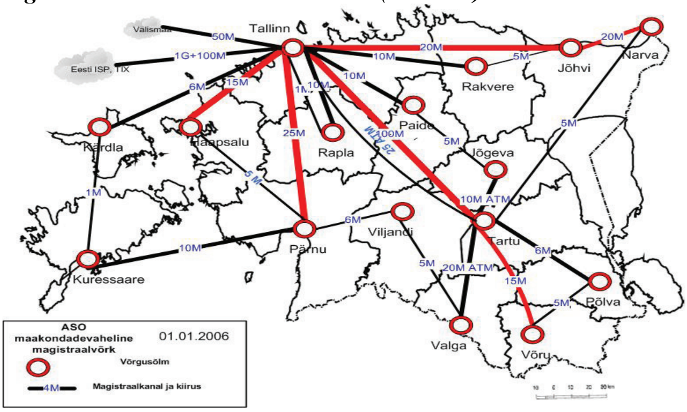
In sum, basic ICT infrastructure should be in place in the education sector. Although the *European Commission* survey presented above suggests some scope for further ICT infrastructure improvements in Estonian schools, the other important issue to be addressed has to do with the quality and even more the possibilities to use ICT in classes.

II.4.1.2 ICT infrastructure in public and private institutions

The development of the public sector ICT infrastructure started very early in Estonia and has been very successful. Most of the civil servants who need computers for their daily activities have them: already in 1995, 34.8% of the administrative staff of central apparatuses were equipped with computer workplaces, 89% of needs for computer workplaces were satisfied in 1998; and as of 2005 the corresponding figure is 97% (Information Technology in Public Administration of Estonia Yearbook, 2005; also, see Table 5 in ANNEX III). The backbone network (see Figure 9) has been built up due to several public projects – ***EEBone project*** (*Pea Tee*) in 1998, ***Village Road*** (*Küla Tee*) in 1999 (currently under *Village Road III*), and ***eCounty*** in 2001 (see ANNEX III). The projects have been administered mainly by the *Estonian Informatics Centre,* and by the *RISO*.

The backbone network **EEBone** connects all Estonian county centers and several nodes in Tallinn. PeaTee has Internet connection based on TPC/IP protocol and 16 Mbps bandwidth. The bandwidth of the backbone network between cities is 4-50 Mbps, connections to Estonian Internet Service Providers (ISPs) are 100 Mbps and 1000 Mbps, and traffic within Tallinn 100 Mbps up to 1000 Mbps (ICA Country Report, 2005).

Figure 9. Backbone network PeaTee (EEBone)



Source: https://www.aso.ee/et/files/ASO_2006_jaanuar_magkanalid_1.jpg

In the private sector, 80% of enterprises had at least one type of computer in 2005 (RISO, 2006). According to the survey of Factum and Ariko, 97% of enterprises have broadband and 3% dial-up Internet connection in 2006 (RISO, 2007). At the same time, broadband connectivity of enterprises is widespread but with a sharp division by size: in 2004, 93% of large enterprises (250+ employees) had broadband access, 78% of medium sized enterprises (50-249), but only 65% of small firms (European Commission, 2005b). As discussed in the *Introduction*, the overall broadband coverage in general is the result of active telecommunications enterprises.

II.4.2 Provision and description of major eLearning applications

Special LMSs such as *WebCT* and *IVA* have been used for creating web-based courses. The LMSs are used often for distributing materials, submitting homework and assessing results of the study. Several educational institutions, especially universities, are using study information systems in order to register students to the courses and for posting information about study results.

Tallinn University, especially by its *Center for Educational Technology*, develops the most common open-source LMSs and CMSs (see Text Box 18).

Text Box 18. *Open Source Software* (*OSS*) is usually developed on a voluntary basis and, as a rule, freely available according to the licensing principles of *Open Source Initiative* (*OSI*). As a major software user, the public sector has a key role in promoting OSS (IT in Public Administration of Estonia, Yearbook, 2004).

In 2004, the *Tiger Leap Foundation* initiated a project for distribution and promotion of freeware in schools aiming to be launched at county level. In the course of the project it was expected to release a *Linux* distribution that is suitable for schools to prepare training materials and to train teachers. Furthermore, since spring 2005 the *Tiger Leap Foundation* only supports projects that will be released under the *General Public License* for the code - and as for the content a *Creative Commons License* will be required. A number of Estonian educational open source software applications have been developed: LMS *IVA, VIKO,* CMS *KooliPlone*. Moreover, Estonia being a country with a small market, the government has funded the translation of *OpenOffice*'s spell-check programme in Estonian (Vuorikari and Sarnow, 2005).

1) ***IVA*** (*Interactive Virtual Academy*) is a web-based LMS developed in *Tallinn University* in 2002.[102] It is a modification of another open-source *Zope* product called *Fle3*. The structure and functionalities of *IVA* system advocate constructivist approaches to learning and teaching. For constructivists, learning is not merely transmission of objective knowledge - each learner constructs actively his/her own 'picture of the world', associating new meanings with previous experiences and communicating with others. With its one developer (Laanpere, M), *IVA* is mainly a developmental and research project – meaning, this is the software for very innovative professors. In other cases, it may not be as user-friendly as suggested (Interview with Laanpere, 2006). The development of *IVA* LMS in *Tallinn University* was partly supported by the *Ministry of Education and Research* of Estonia, *Tiger University Programme* of the *Estonian Information Technology Foundation*, *Estonian E-university* and *Hansabank*.

   Today, *IVA* is an official LMS of *Tallinn University*.[103] It has Estonian, Russian and English user interfaces and is currently used by more than 2 000 users (Vuorikari and Sarnow, 2005). *IVA* is also one of the three software systems used by *Estonian E-university*. The other two official learning/course management systems of the *Estonian E-university – WebCT* and *Moodle* – are the main competitors of *IVA* (Ruul, 2006). *Moodle* and *IVA* are the most preferred learning and course management systems also in vocational schools (Vocational schools reports in the framework of the *eKey* project for I half of 2006).[104]

   Most of the web-based courses in Estonia have been created in WebCT. For example, in 2006 from all 1 000 web-based courses, 795 were created in *WebCT* and the other 205 in *IVA*. In 2006, of the 18 000 students taking part in web-based courses, 14 750 are users of *WebCT* and 3 250 of *IVA*. For instance, in the *University of Tartu* in the academic year 2004/2005, *WebCT* was used by one-third of the University's 6 000 students.[105] Altogether, 825 user licences for *IVA* and *WebCT* have been issued (Ruul, 2006).

2) Open source LMS ***VIKO***[106] was developed during 2001-2003 taking into account the needs of the general educational schools. Schools do not have to set up their own server, *VIKO* is offered as a free service by *Tallinn University*.

Text Box 19. The *VIKO* environment enables teachers to distribute their learning materials and to make the information and timetable available in the web. In addition, there is a special support system for teachers containing general information about web-based learning and design of electronic educational materials. The environment also includes the forums for communication.

3) The Tiger Leap Foundation has supported the completion and further development of the environment. There was a plan to develop the next version of VIKO in September 2006 that would include the possibility of submitting students' homeworks to teachers through the environment. In 2006, there were over 50 schools using the VIKO learning environment, of which about half are active users of the environment (see Estonian Portal Koolielu, news for 02.03.2006).

4) New learning environment for the first classes ***KRIHVEL***[107] is at work in cooperation with *Tallinn University* and *Haapsalu College.*

   In the case of all the aforementioned LMSs, the communication elements (e.g., forums) are considered to be important parts of the eLearning approaches in the Estonian educational sector. However, ICT-supported learning in the country typically lacks interaction in the learning process

102 See also http://www.tlu.ee/?LangID=1&CatID=1614; also http://www.htk.tlu.ee/iva/.
103 *LearnLoop* is also an example of free software that has been used in *Tallinn University* (Interview with Toots, 2006).
104 See also http://portaal.e-uni.ee/e-voti/aru/seire/2006I.
105 See also http://www.ut.ee/orb.aw/class=file/action=preview/id=153202/e_oppe_strateegia_seletuskiri.pdf.
106 See also http://www.htk.tlu.ee/*VIKO*/.
107 See also http://trac.htk.tlu.ee/krihvel/.

between participants, and eLearning solutions are mainly different types of learning materials for self-study. The following are prescriptions on the use of LMSs in the Estonian educational system:

- Overall, the LMSs used in Estonia should be more interactive, including simulation games, case studies, assessment systems, etc.
- In addition to the provision of information, LMSs should also guarantee that students have an overview about their obligations. Currently, this is only the case in higher educational institutions where students, due to the use of LMSs, have information about their obligations for the semester since the first lecture. The same system should be used also in general education.
- LMSs should have a supporting role in education (e.g., having learning materials and scientific articles in the form of .pdf in the Internet).
- LMSs should be developed in a way that they can be used also as a guide for students – i.e., what materials should be learned, and in what order in the framework of one subject.
- LMSs should be used more to carry out seminars (e.g., using forums to discuss certain question raised by teachers and students).

5) ***KooliPlone***[108] is a Plone-based CMS for school websites also developed in *Tallinn University*. It was released in autumn 2005. The CMS *KooliPlone* is for schools for creating web pages. In addition, *KooliPlone* provides several modules to make the usage of the portal more attractive and useful. These modules are curriculum, timetable, developmental conversations and school's newspaper. By October 2005, there were 10 schools that created their web pages with *KooliPlone*.

6) ***Edutizer Academy*** is being developed by *Mindworks Industries Ltd* to meet the e-training needs of schools and universities. Today, the main clients of the system are from the public sector, and the leaders of financial, telecoms, automotive and real-estate sectors.[109] *Edutizer* was originally the result of *Hansabank's* proposal, but later on the usage rights were also provided to other firms.[110] The LMSs based on *Edutizer* are used for distributing materials and using the environment as the testing centre. Big firms using the system have been cooperative in financing further development of the system's functionality. The materials provided in the system and their interactivity depends on each firm, but the design and presentation of learning materials are usually bought in (Interviews with Tammiste, Kuusemets and Väravas, 2006).

7) Universities use ***study information systems***. However, as there are no commonly agreed data formats and database structures, these systems are not interactive to each other and hence do not support exchange of digital data (e.g., student information).

8) The existence of central databases for learning materials is limited.

   The *Language Immersion Center*, *Miksike* and *Koolielu* are important repositories at the general education level. The ***Language Immersion Center***[111] can be considered one of the best organised information-providing repositories for second language studies: reading, writing, speaking and listening comprehension. Access to its digital learning resources is also provided for a fee by a **repository of e-worksheets, *Miksike LIc*.**[112] *Miksike* gives more than 25 000 worksheets in HTML eWorksheets and offers a variety of collaborative learning services to facilitate learners in constructing their knowledge. *Miksike* works for regular schools and for lifelong learning communities. In schools, *Miksike* is mostly used by teachers to get new ideas and information, as well as to obtain different worksheets and material for tests (Toots, Plakk and Idnurm, 2004: 48).

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108 See also http://www.htk.tlu.ee/kooliplone.
109 See also http://www.mindworks.ee/about.html.
110 These inlcude *Elion*, *EMT*, *Sampo Bank*, *SEB Estonian Union Bank*, *Estonian Energy*.
111 See also http://www.kke.ee/index.php?lang=est.
112 See also http://www.miksike.ee.

The **Estonian news and community portal *Koolielu***[113] is important in providing eLearning materials. But while it offers **digital learning resources** to teachers and information to students, *Koolielu* does not offer possibilities for web-based learning. The Estonian Portal *Koolielu* provides about 5 500 learning subjects.

At the higher education level, there is a central database for web-based courses administered by *Estonian E-university*. The *Estonian eVocationalSchool* is developing a similar database for web-based learning materials and for web-based courses.

9) The amount and quality of equipment and number of rooms used for videoconferencing is claimed to be not sufficient. In fact, there is only one room meant for it in large universities (Interview with Kusmin and Toots, 2006).

See other specific applications in Text Box 20.

Text Box 20. The **APSTest** programme was created as a test environment in cooperation of *APSProg Llc* and *Tiger Leap Foundation* and with the support of the *University of Tartu* (http://www.ce.ut.ee/APSTest/apstesteng.html[)]. The purpose of the project was to create a system for everyday exercises and tests. The package consists of three programmes: *ApsTeach* (question and test construction), *ApsPup*il (answering) and *ApsAssist* (work with results). The students would only need *Apspupil* (less than 1 Mb). The use of *ApsTest* is free in all Estonian schools and universities.

eFormular (http://www.eformular.com/avaleht_eformular.php3?muudakeel=en) is a tool providing possibility for creating electronic forms (*eFormulars*) and conducting surveys via the Internet. It can be used by teachers to conduct test or quiz in an interesting and novel way or by students to collect data for project questioning different people.

In sum, the main technological means in basic information and technology communications infrastructure and especially of different eLearning environments should be in place; and that not only in the education sector, but also in the private sector.

II.5 Provision of eLearning services

II.5.1 Detailed description of the major services provided within eLearning

The share of online services in the field of education in Estonia is rather limited. The major services developed are closely related and influenced by the progress of eGovernment services with the main purpose to enhance administrative tasks in the sphere of education. These kinds of activities find the strongest support at the Ministerial level.

Table 11. Detailed description of major services provided within eLearning

1. Hosting services	
Institution	Service
EENet under *Ministry of Education and Research*	*EENet* provides schools at all educational levels and educational NGOs **hosting of services** on the basis of *IVA*, *Plone*, *Kooli-Plone* and *VIKO*. As the costs of this service are covered by the *Tiger Leap Foundation*, the schools can use it free of charge (Laanpere, 2006b). Permanent Internet connection is provided to numerous research institutions with transmission speed of 100 Mbps. The network extends to most counties in Estonia (EENet, 2006). In addition, development projects are being carried out in cooperation with universities and scientific institutes (IT in Public Administration of Estonia, Yearbook 2003).
In the beginning of 2005, the number of end-users of Estonian academic network was approximately 228 000 people.	

113 See also http://www.koolielu.ee.

2. Educational information systems[114]	
Ministry of Education and Research	**EEIS**[115] replaces several separate databases of educational information. In October 2005, cross-usage between *EEIS* and the Population Register became operational. The further purpose is to add to the information system the statistics module for information processing and to link the system to other central educational systems like *eSchool* and *KIS* (*Schools' Administrative Information System*). Until 2005, the implementation of the project was financed with EUR 243 000 (Overview of general education in Estonia in 2001-2005).
Belongs to ***Ministry of Education and Research*** and is administered by ***National Examination and Qualification Centre***	**SAIS**[116] is the service to help to submit admissions applications electronically through the Internet to higher education institutions since 2005. *SAIS* also helps to organize other procedures, including the exchange of information between the student and the school, the acceptance of a study place or its refusal. In addition, *SAIS* is connected to databases in other countries. The system was established within the framework of the *Tiger University Programme*, under the supervision of the *Estonian Information Technology Foundation* and with the assistance of the EU's Structural Funds with the total amount of about EUR 89 000.
Fifteen (15) Estonian higher education institutions have been using *SAIS*.	
-	**The X-Road** was launched three years ago. At the beginning, it was developed as an environment that would facilitate making queries to different public sector databases. By now, a number of standard tools have been developed for the creation of eServices capable of simultaneously using the data of different databases. All Estonian upper secondary schools' graduates can use the *Citizen's Portal* to view their national exam results. Also, a system has been designed as an operative additional opportunity to enable receiving express confirmation about exam results through e-mail and the short message service (SMS) sent via a cell phone.
In 2005, 31 000 students were tracking their exam results at the *Citizen Portal* (in which exam results are sent to them via SMS 10 000 times and via e-mail 3 300 times) (ICA Country Report, 2005).	
3. Services for general educational level	
Provided by ***Koolitööde Ltd*** and development supported by ***Look@World Foundation***	**eSchool**[117] is an Internet-based communication environment between school and home, a web-based gradebook service. It contains information about studies and allows parents and pupils to view their study-information – e.g., grades, missed classes, home assignments, over the Internet. It also improves parents' communication with teachers via forums. The system is in use since 2004. Today, there are applications to connect the *eSchool* service to mobile phones.
In 2006, there are 220 schools connected to *eSchool* service – i.e., usage by a third (120 000) of the general educational students.	
Tiger Leap Foundation	• provides financial support for procuring learning software • provides support for developing digital learning materials, simulations, and usage of ePortfolio • financial support for developing LMSs for general education • provides in-service teacher training.
Universities and general educational schools	Develop digital learning materials for general schools. For example, web-based learning projects in the natural sciences, in cooperation of *5DVision Llc* and *University of Tartu*.
Tallinn University	Provider of LMSs and CMSs, etc.
Technology School of Tallinn University of Technology	Provider of courses (including web-based courses) for the students of secondary and vocational schools.

114 *X-Road* targets upper secondary education. *SAIS* focuses on higher education. *EEIS* is important at all levels.

115 In 2004, the *Ministry of Education and Research* also launced similar system for research area – **Estonian Research Information System** (*ERIS*) (Information Technology in Public Administration of Estonia Yearbook, 2005).

116 See also http://www.sais.ee.

117 See also https://www.ekool.ee/tugi/abi.html.

During the school year 2006/2007 courses were provided in the field of natural sciences, environment, design and construction and product development. City camps are organized for students in the 7-9th grade during the holidays.	
Estonian Academy of Arts	This Academy is the provider of virtual children's textbook, **Virbits**.[118] The learning material is meant to develop reading and writing skills. The main target groups are pupils at preliminary education level.
Audentes	**E-Gymnasium** provides possibility to go through the whole school programme online at the level of upper secondary scool, with the restriction that the most important tests have to be done at the school.
Private sector	• develops digital learning materials • provides financial support for developing e-applications.
4. Services for vocational level	
Estonian E-VocationalSchool	• develops common infrastructure (*Estonian E-VocationalSchool*'s server where *IVA* and *Moodle* are centrally administered; it also provides common virtual portal for courses and for learning objects) • supports development of web-based courses, simulations, and curriculums • supports training (in-service training) of professors, teachers and tutors; great emphasis has been given on the training of educational technologists • supports cooperation at the level of higher professional education institutions and vocational education institutions.
5. Services for higher educational level	
Estonian E-university	• pays for joint license on *WebCT* • supports development of web-based courses and web-based curriculums[119] • is working out quality standards for web-based courses • provides in-service training at the three different levels – basic skills providing courses, advanced courses and courses for experts and tutors for professors, teachers and tutors • supports cooperation between universities.
Since 2005, the *Estonian E-university* and the *Estonian E-VocationalSchool* have been organizing the activity called **e-cafeteria-club** (*e-kohvik-klubi*). In 2006, the new electronic publication, **eLearning News Journal** (*E-õppe Uudiskiri*),[120] has been released (see ANNEX III).	
Universities	• main providers of web-based courses and web-based curriculums • providers of support courses in the sphere of eLearning, but also web-based courses related to the field of pedagogics (especially *Tallinn University*) • providers of web-conferences • developers of local open source LMSs (especially *Tallinn University*) • providers of initial teacher training • main R&D institutions (especially *Tallinn University*).
National Europass Centre	**EuroPass**[121] supports internatisation of education. It is a new way of helping to make the skills and qualifications clearly and easily understood in Europe (EU, EFTA/EEA and candidate countries). *EuroPass* consists of five documents: *Europass curriculum vitae (CV)*, *Europass Language Passport*, *Europass Certificate Supplement*, *Europass Diploma Supplement* and *Europass Mobility*.
Private sector	• provider of financial support (e.g., cooperation between *Jukotec Llc* and Estonian vocational institution system since 2000) • provider of educational software (e.g., Microsoft's programme MSDN Academic Alliance for educational institutions)

[118] See also http://lizard.artun.ee/~pir/virbits/.
[119] Awards have been given to web-based courses of high quality since 2004.
[120] See also http://portaal.e-uni.ee/uudiskiri.
[121] See also http://europass.cedefop.europa.eu/europass/home/hornav/Introduction/navigate.action?locale_id=1.

6. **Services for lifelong learning**	
Universities and Estonian E-university	• providers of web-based courses.
-	CV databases to provide information about training possibilities, job possibilities and career planning (including the e-school on making a career)[122]. The best examples here are information systems **Pathfinder, EURES, CV-Online**.
Financial support by ***Open Estonian Foundation***	Establishment of the **information system of Estonian public libraries**. For example, one aim of the county-based data communication project called *Village Road* (*Küla Tee*) was to provide data communication services for local governments through Internet connection of the libraries (Public Administration in Estonia, 2004).
By the end of 2003, most public libraries had permanent Internet connection.	
7. **Services at workplace**	
Private sector	• provider of LMSs specifically for private companies • ICT skills training.

The statistics below provides an overview of the outcome of the activities of the *Estonian E-university* and universities specific to web-based learning at higher education level where most of the activities in the field of eLearning have been focused.

During the period 2002-2006, the *Estonian E-university* has launched 980 web-based courses in a wide range of subjects.[123] Altogether, 18 000 people have taken part in web-based courses of *Estonian E-university* (see Table 12). In addition, 30 video lectures have been created, 9 thematic networks established, and the training of 18 educational technologists and 850 professors supported. Today, there are 10 regional eLearning centres (Tammeoru, 2006a). The *Estonian E-university* has also supported the development of three web-based curricula in English. These involve the curriculum of the *University of Tartu – Cognitive Science*, of *Tallinn University – Management of Information Technology,* and of *Estonian Information Technology College – IT Systems Administration* (Interview with Tammeoru, 2006).

Table 12. Increase in the number of web-based courses and students taking part at higher educational level (1999-2006)

Year	Number of web-based courses by the year	Number of students using web-based courses by the year
1999	14	100
2000	50	1 000
2001	100	2 000
2002	238	3 500
2003	350	6 500
2004	430	9 500
2005	750	12 000
2006	1 000	18 000

Source: Ruul, 2006

Several important points must be raised as regards web-based courses, web-based curriculum, and web-conferencing in universities.

(1) Web-based courses: The number of web-based courses in the *University of Tartu* was 335 in 2005 (The eLearning Strategy in University of Tartu) and in *Tallinn University of Technology* about 85, of which five were totally web-based (Tallinn University of Technology; Interview with Kusmin, 2006). There were 175 web-based courses provided by *Tallinn University* in 2006 in the IVA server (i.e., on

122 See also http://www.cv.ee/content/?id=480&gr=1.
123 See also http://www.e-uni.ee/uus/vaata.php.

the average, 28 users for every course) (Laanpere, 2006a). As for the private universities, the *Estonian Business School* has implemented web-based courses especially in *Management of Information and Communication Technology*, and the *Estonian Information Technology College* has used web-based courses in all specialisations (10% of subjects altogether). Some other private universities (e.g., *Concordia Audentes International University Estonia* and *University Nord*) have also provided web-based courses since 2004 (there were five web-based courses in the *University of Nord* in 2005).[124] The *Mainor Business School*, which is not a member of the *Estonian E-university* consortium, has also been using eLearning.

(2) *Web-based curriculums*: To this day, there are very few web-based curriculum. However, there is a trend towards this as shown in the initiatives taken by many larger universities. For example, the *Estonian Information Technology College* has developed a two-year curriculum in the web for IT specialists – the *IT Systems Administration* for distance learning.[125] In the *University of Tartu*, there is a totally web-based programme, with final exams taking place in classrooms (a programme provided by the *Institute of Finance and Accounting* in the *University of Tartu*).[126]

There is no MSc programme and PhD studies in Estonia focusing on eLearning design, provision, consultancy or technology (Laanpere, 2006b). With regard to an important area of doctoral studies related to eLearning, there are few fresh PhD theses defended by young Estonian researchers in Tartu, Tallinn and Turku Universities, and three more PhD students are studying abroad (with *Kristjan Jaak Scholarships* from the *Archimedes Foundation*) (Laanpere, 2006b). At the vocational level in general, much emphasis has been given to ICT specific curriculum to develop specialist education in the area of IT (Interview with Püüa, 2006).

(3) The practice is very different in the area of the *web-conferences*. One of the best examples is *Tallinn University* and its *Department of Government,* which has one or two *video lectures* in a week. This is because it has colleges outside the City of Tallinn, for example in Haapsalu, and it has cooperation agreement with the *University of Tampere* (Interview with Toots, 2006). In *University of Tartu*, 10 video lectures were created during 2005. *Video lectures* have also been created in *Tallinn University of Technology*.

The activities of the *Estonian E-university* and other Estonian universities, especially in the field of web-based courses, have had implications for lifelong learning. In 2005/2006, there were approximately 60 available web-based courses for lifelong learning at the *Estonian E-university*. In 2005, the *University of Tartu* provided 129 web-based courses with 3 035 participants in the framework of in-service training.[127] In 2006, there were two in-service training courses in *Tallinn University of Technology* (and, in addition, four courses for general education) (Interview with Kusmin, 2006); and 78 courses, available in the LMS *IVA*, in *Tallinn University* (Laanpere, 2006a).

II.5.2 Description of nature of eLearning services

In Estonia, the need to develop methodologies for utilising ICT in learning, educational software and learning materials is shown by the fact that eLearning applications are mainly used for administration purposes – for enrolment to a course or a school (40% of those using the Internet) and for communication with school and teachers (36%). At the same time, the participation rate in web-based courses and eTraining is 10.6% (see Table 13; for more concrete information see also Table 16 in ANNEX II).

[124] See also http://www.nord.ee/UserFiles/File/e-oppe_akava.pdf.
[125] See also http://www.itcollege.ee/kolledz/uudis.php?id=908.
[126] See also http://www.finance.ut.ee/index.php?eng/67/11/0/104.
[127] See also http://www.ut.ee/24224.

Table 13. Usage of Internet on educational purposes, % of those using the Internet (2005-2006)

EDUCATION	2005	2006
Enrolment to a course or a school	20%	40%
Communication with school/teachers	19%	36.1%
Submitting admission papers to university	7%	13.5%
Participating in web-based courses or training	7%	10.6%
Having one's results of finals sent as an SMS or to an e-mail	5%	9.7%
Registering for state examination	-	4.4%

Source: RISO, 2006

The ICT means at general educational level are mainly used in natural sciences – the software in these subjects is in place, the subject itself favours different approach and the teachers in these areas are usually younger (Interview with Toots, 2006). Specifically on basic and lower secondary education, ICT-supported learning is most common in the sciences and geography, and also in Estonian language in the 8th grade. Upper secondary students use computers more often in foreign languages and geography, but very rare in mathematics and Estonian language (Toots, Plakk and Idnurm, 2004: 13). In everyday studies, ICT is used mostly for searching information in the Internet (70%), writing reports (55%) and giving presentations (30%) (Learning Tiger Action Plan 2006-2009).

In 2003, of the 34 available learning software applications (including web-based) only a few were actively used by teachers in their subjects. Today, the number of respective materials has more than doubled.[128] The most well-known and with the largest usage are the digital learning materials related to natural sciences. Individual teachers usually design the digital learning materials provided at this level.

In vocational schools, steps have been made to design 15 web-based courses in cooperation with, and in the framework of, the *eKey* project. Most schools have the willingness to develop web-based courses and eLearning objects (Vocational schools reports in the framework of the eKey project for I half of the 2006).[129] This is shown in the number of applications in 2006 for design of web-based courses for the *E-VocationalSchool*: 241 applications from 32 vocational schools. The most popular fields are information technology (57 applications to design web-based courses), specific fields depending on specialisation (32), economics (32), general things (20), law (18), technical subjects (16), service (15), languages (13), accounting (11), physics and chemistry (11), rural economy and forestry (11), and art and handicrafts (5).[130] There were 57 applications altogether for developing the learning objects (The Report on implication of the eKey project for *INNOVE* in the first half of 2006).[131]

In higher education, there is no evidence that the design of web-based courses is dependent on the area, although the number of courses from 'soft areas' is generally higher than in science and technology subjects (Interview with Tammeoru, 2006).[132] The division of web-based courses according to respective areas in the Estonian E-university consortium is as follows: 20% of courses in the field of economics; 16% in social sciences and informatics; 11% in educational sciences and philology; 5% in biology, geography and mathematics. There are also courses in the areas like upper secondary school subjects, engineering, physics, chemistry, law, medicine, etc. The share of web-based courses in the *Estonian E-university* consortium among all courses was up to 14% and in the *Estonian e-VocationalSchool* up to 2% in 2006 (Strategy of the Estonian eLearning Development Centre 2007-2012). In total, the share of web-based courses in higher education institutions is believed to be about 30% (Ruul, 2006).[133] According to *eUser's Country Report for Estonia*, about 30-40% of

128 See also http://www.tiigrihype.ee/projekt/valmis_opi.php.
129 See also on http://portaal.e-uni.ee/e-voti/aru/seire/2006I.
130 See also http://portaal.e-uni.ee/uudiskiri/stat/voti.
131 See also http://portaal.e-uni.ee/e-voti/aru/seire/Seire_2006_I.xls.
132 On the contrary, in *Tallinn University of Technology*, for instance, the biggest share of courses having e-support belong to the *Mechanical and Informatics faculties*.
133 At the same time, experts in the field argue that this claim is not justified even for the *University of Tartu*, the biggest university in Estonia (Laanpere, 2006).

courses are believed to have some form of eLearning (Kalvet, 2005). eLearning is mostly used as a support to lectures, which entails use of some ICT equipment and making materials available on the web (Strategy of the Estonian eLearning Development Centre 2007-2012).

In most cases in 2002, web-based courses mainly contained materials in the form of *MS Word*, *MS Excel*, and *PowerPoint* presentations, but also included links to Internet-sources in respective fields. The Kristi-Jette Remi survey results showed around 50% usage of office software for design of web-based courses (Remi, 2002: 37). Today, web-based courses are based on *PowerPoint* and *video lectures*, including the materials, which are educational texts, exercises, different tasks and tests for practicing, forums for communication, and also possibilities for examination (Interview with Kusmin, 2006).

Web-conferences and video lectures seem to have the largest usage in the educational sector as compared to other sectors (e.g., private sector and other public institutions) (Remi, 2002: 69).

In lifelong learning, the share of eLearning is very limited. The same goes in the public sector. This is so even though some steps have already been taken at the Ministerial level (Interview with Laanpere, 2006). Traditional training, instead of self-learning, is preferred in which one has to get a couple of days off to go to training. This depends on the subject – web-based learning, for example, is not considered good for strategic management, or for simulations and learning how to negotiate. But if there is an environment where materials are put up it will be accepted (Interview with Rits, 2006).

In the private sector, eLearning applications for training and education of employees are quite often combined with traditional learning, with the main aim to deliver learning materials. The company intranet provides job aids and important supporting materials to the students such as the employee handbook, regulations, and quality standards (Remi, 2002: 31). eLearning applications are: employed in addition to the distribution of materials, information and guidelines for different activities (also, all kind of instructions) (Pikk, 2006); and used for evaluating employees' qualifications and doing test (Piin, 2004: 45-47; Interviews with Tammiste, Kuusemets and Väravas, 2006). The LMSs are used for in-service training for beginners, and also for continuous complementary training. Since back-office needs more specific training that cannot be provided for in LMSs because face-to-face interaction is considered here to be of utmost importance (Interviews with Kuusemets, Väravas and Tammiste, 2006).

The level of interactivity of learning materials is very different in the private sector. Perhaps, the best example is the telecom company *Elion*, which has given a lot of emphasis to make information interesting and easier to read (e.g., many pictures, schemes, very small textual part, system that is easy to navigate, etc.). It has been claimed that 5%-25% of overall in-service training has some form of web-based learning in private sector where the most preferred form is blended learning (Kahn, 2006; Põldsam, 2006).

In general, the use of ICT-based learning materials greatly depends on the schools' ICT infrastructure, internal organisation of work, the willingness and skills of teachers and employers to use new teaching forms and the support from school's directorate or TOP-level in enterprises for eLearning (Overview of general education in Estonia in 2001-2005). To date, the availability of different digital learning materials has been the most problematic issue. It can be said that the development of eLearning services in Estonia has been poor, especially when we consider SCORM, IEEE LOM, IMS CP/LIP/QTI compliant content, interoperable content authoring, storing and brokering services, ePortfolio services, web-based courses search and enrollment databases (Laanpere, 2006b).

II.5.2.1 The role of assessment and accreditation techniques in eLearning services

The ***ECDL*** system is the *de facto* standard for user training, as well as in general, vocational and in-service training. Although *Informatics* is not a compulsory course in general education, its inclusion as an elective course is under the *ECDL* system.

ECDL programme was initiated in Estonia by PHARE ISE. Later, the field has been organised by *AO Keskus*,[134] which works under *the Estonian Information Technology Society*. The *ECDL* programme started in Estonia in 1998. The tests may be taken in *ECDL* test centres over Estonia, there are altogether about 30 of those. Today, about 6 500 people have taken the *ECDL* test in Estonia.

It is said that *ECDL* has had the biggest share in enhancing ICT skills (Interview with Laanpere, 2006). The most widespread field of application of *ECDL* has been the occupational standards (*kutsestandardid*). The number of those is over 500. In these standards the bases for computer usage competences have been defined through modules of *ECDL* (Oruaas, 2006).

ECDL standards have been the base for *Informatics* courses in Tallinn and Tartu universities. Trainers have followed *ECDL* standards also in in-service training in the field of ICT (including respective teacher training (for example in the framework of *Tiger Leap Foundation*) and also in the case of courses provided by *Estonian E-university*.[135] In addition, the *Ministry of Education and Research* can take into account the ICT skills requirements for teachers as stated in the *Framework for Teacher Training* and in *Professional Standard for Teachers* while registration the curriculum of teacher training (State Audit Office, 2003).

Currently, the *Estonian E-university* is developing eLearning quality standards for higher education. These standards include: general instructions; how the web-based course should be built up and what sorts of information are to be included (e.g., information sheet for the course, manual for using *WebCT*, the objectives of the course and the syllabus, learning materials, references to the additional learning materials, communication means, tasks and the rule for assessment); and how the course should be carried out.[136]

II.5.2.2 The differences in terms of the services provided for the target groups

eLearning services in terms of digital learning materials and of eLearning applications provided in general education are more harmonized, as these are directed by the state with more or less concrete vision in the field, based on the strategies discussed above. The services for adult training depend more on private sector and autonomous universities, and hence these are quite diverse. In addition, services to children and young people have had much more attention in recent years and thus have also had policy support. This has led to greater variety of services for younger age groups.

The digital learning materials that have been developed for general education have been mainly seen as support materials for teachers (especially exercises), and for students as well to make learning easier. However, the current materials are very theme- and subject-oriented. The digital learning materials are mainly oriented on presenting the text in easier way, with further link possibilities and with pictures and practices. The materials are available for public and are free of charge.

At the higher education level, the main aim has been to enhance the information flow between students and teachers: that is, to enhance communication between these groups and to help teachers with ICT-supported material delivery. The web-based courses are mainly using *PowerPoint* and *video*. These solutions are available for students participating in specific courses and are often single university-centred. Students do not have to pay additional fee for web-based courses. Too, many web-based courses are provided for in vocational schools. Here, the cooperation between different schools is greater. However, the courses and certain learning objects for explaining concrete theme are mainly oriented on students. It can be said that the eLearning environments (especially study information systems, LMSs and course management systems) are used more actively at these two levels. On higher education, the movements toward web-based curriculum are the biggest ones.

[134] See also http://www.ao.ee/keskus.htm.
[135] See also http://www.e-uni.ee/e-oppija/2004/taiend.html.
[136] See more http://www.e-uni.ee/index.php?main=108.

The courses provided in the framework of lifelong learning are mainly available in the web page of the *Estonian E-university* and are not available without a charge. But there are also some courses available for informal learning and are free of charge. The difference of these courses lies especially on the topic of the courses, which are oriented on general daily issues (e.g., gardening, cooking, etc.). However, the content provided for these target groups has been very limited to this day.

II.5.2.3 The differences in terms of the services provided by public and private actors

The services provided by the public sector are considerably more harmonised than in the private sector. The *Tiger Leap Foundation* and consortiums at higher and vocational education levels provide some kind of supervision in the public sector in terms of training, counselling, and financing etc. On the other hand, private companies often develop in-house competences where attitude towards eLearning is very variable. Interactivity is generally lower in among the private sector than in the education sector.

The main difference between the education sector and the private sector is that the latter does not share the understanding that there should be forums and communication behind web-based courses besides just delivering materials (Interview with Laanpere, 2006).

II.5.2.4 The division of responsibilities in the provision of content between public and private actors

There are no clear divisions as far as content development is concerned. Here both autonomous universities and private sector actors have been left with more or less unregulated territory to develop eLearning content according to their specific needs. As discussed above, at other educational levels and in vocational education, there are no common guidelines or prescriptions as far as content is concerned. Neither is there a strategic or other policy document that divides such responsibilities. However, the *Estonian E-university* has initiated steps to standardise web-based courses.

Currently, the publishing of books and textbooks (especially for general education) has been in the hands of the private sector. A major reservation, however, on the part of the private sector to develop digital learning materials is the probable loss of profits for them (Interviews with Mägi and Anton, 2006a).

II.5.2.5 Language issues: availability of services in other languages

In developing digital learning materials, web-based courses and curriculums, the main attention is given to the Estonian language. In the case of higher education, and especially of the *Estonian E-university*, some courses are also provided in English (see the web page of Estonian E-university).[137] In higher education, the Russian web-based courses have not been developed.

Since Russian is the most common minority language in Estonia there is an intention to develop a Russian version of the local open source LMS *VIKO* for general schools (see Estonian portal Koolielu, news, 02.03.2006). Most of the resources are in Estonian and Russian in the e-worksheets repository *Miksike*. These trends are due to the fact that the Russian language is permitted as a medium of instruction in teaching general education.

Unlike many other European teachers, Estonian teachers do not seem to have problems in finding adequate web-based material. This is only criticised by 6% of Estonian teachers – as opposed to the EU25 average of 20%. Lack of content in national language is even less of an issue: less than 2% claim it to be an issue, as compared with the overall European level which is five times higher (Empirica and TNS Emor, 2006).

[137] See also http://www.e-uni.ee/uus/vaata.php.

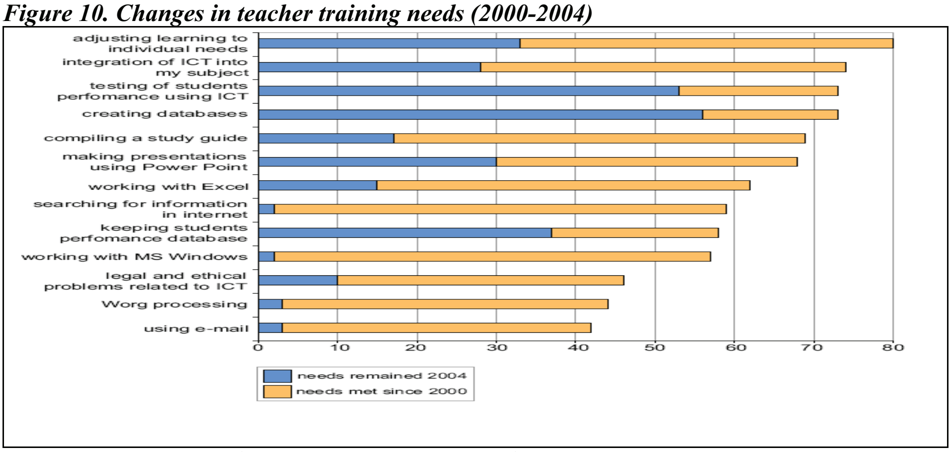
II.5.2.6 Training of the trainers and teachers: capacity of teachers in providing the necessary digital literacy teaching services

According to the *Tiger Leap Plus Strategy* 2001-2005, a teacher: should require ICT competences and methodological skills in initial training; should acquire systematic and good in-service training; should use respective competences in everyday work and have access to the information of sample exercises and different themes, and also have access to e-mails (Tiger Leap Plus Strategy 2001-2005).

The ICT national strategy *Tiger Leap* stated that all respective programmes for initial teacher education programmes should include courses on the use of ICT in education and educational technology. The expected total volume of such courses should be at least four (4) *ECTS* (Laanpere, 2003/2004).[138] See more about teacher training curriculum from the standpoint of ICT in ANNEX III. Even though the objectives of the teacher training are further developed in the *Learning Tiger* strategy (Learning Tiger Action Plan 2006-2009), the real situation has been negative due to the *Bologna-related reform* of university curriculum. Today, the introductory *Informatics* course is compulsory only for students who did not pass the ICT competency test, and eLearning topics form only one part of a general didactics course (4 CP in total, about 1 CP for eLearning environments) (Laanpere, 2006b).

On the other hand, teachers' in-service training needs (e.g., in general education) have become more sophisticated and specific because most teachers could master basic operations in *MS Windows*, find additional information for their subjects in the Internet and use e-mail (see Figure 10). However, the aspects of implementation of ICT for student performance assessment and data management have remained areas in acute need of in-service training (Toots, Plakk and Idnurm, 2004: 16).[139] Today, in-service training is mainly oriented towards ICT-supported learning methodology (including the use of different eLearning environments, especially those of LMSs and course management systems).

Figure 10. Changes in teacher training needs (2000-2004)



Note: % of teachers who said they cannot accomplish the listed task and would like training Source: Toots, Plakk and Idnurm, 2004: 17

The most important restrictions in enhancing ICT skills of teachers in vocational education have been the lack of time and low interest in eLearning (Vocational schools reports in the framework of the

[138] For example, due to the *Tiger Leap Programme* the teacher training curriculum at Tartu University and *Tallinn University* included a basic course in *Informatics*. Moreover, a number of specialities provided courses in subject didactics dealing with computer applications and/or courses on the basics of educational technologies. Specifically, teacher education curriculum in the universities of Tallinn and Tartu comprise the following ICT-related courses: a) *Introductory informatics* (2 CP course), b) *ICT in school* (2 CP course), c) PLUS some optional courses related to *subject didactics*, e.g., Computers in school mathematics (3 CP).

[139] The survey also found significant differences in the schooling patterns of urban and rural schools. Rural schools, which have fewer financial and human resources, rely mainly on the informal exchange of optimum practices among colleagues, and do not make great demands on professional teacher development.

eKey project for I half of the 2006). However, it is at this level of vocational education where the support of educational technologists has been strongest. Promotional work at this level has also been impressive – for instance, there had been nine information days all over Estonia during the year 2006 (The Report about implication the eKey project about the first half of the 2006 for INNOVE).

One of the objectives in higher education is to give more emphasis on in-service training (Tiger University Plus Programme 2005-2008). According to the survey ***Needs analysis of Estonian E-university*** in 2004,[140] 43% of teachers had not passed any ICT-related complementary training during the last three years at high education level; 22% of teachers had respective trainings for less than 10 hours; 17% for 21-40 hours and 15% for more than 40 hours (Laanpere, Läheb and Plakk, 2004: 15). Similar pattern has been observed with regard to pedagogical complementary training during the last three years: 48% of teachers had not undergone pedagogical complementary training at all; 19% had it less than 10 hours; 13% had it 21-40 hours and 17% had it more than 40 hours. Although more than half of teachers were satisfied both with the announcement and the arrangement of complementary training in their institution, only a few were satisfied with the content of training and with possibilities to implement gained new knowledge in practice. Least satisfying was the assortment of available complementary training. As regards support systems in the institution, more respondents were satisfied with IT support than with support to eLearning or pedagogy (Laanpere, Läheb and Plakk, 2004: 15).

In conclusion, much emphasis has been given on improving digital literacy skills of teachers (especially in general education) through in-service training. Nevertheless, there have been necessary changes in initial training (but as to whether these changes have been positive is another question). More attention must be drawn at in-service training at high education level. Furthermore, as the survey *Needs analysis of Estonian E-university* shows, ICT-supported learning is often used by teachers who have likewise studied through this method.

II.5.2.7 Price levels and affordability of eLearning solutions for the target groups

Most of the digital learning materials, which development is supported by *Tiger Leap Foundation*, are available in the Internet for free, and some are used in schools in the form of CDs (Overview of general education in Estonia in 2001-2005). The procurement of learning software is also supported by the Foundation. The schools are paying relatively small monthly fee for using *eSchool*. The commercial monthly fee for each school would be around EUR 200-250. Since hosting and initial costs were largely covered by companies and NGOs, schools are paying the monthly fee of EUR 50 (Look@World Foundation). The available LMSs and CMSs for general education are essentially open source.

At vocational and higher education levels, there are available local open source LMSs. The *Estonian E-university* pays for the *WebCT* licence. Financial restrictions seem to be the major barrier in acquiring special ICT equipment like those for videoconferencing.

Most courses provided inside universities are free. Courses (especially teacher in-service training) provided inside the *Estonian E-university* and *E-VocationalSchool* consortiums are often 50% cheaper than the usual. Basic skills courses are totally free for teachers the consortiums (see also Tammeoru, 2004). For vocational schools, which take part in the *eKey* project, the courses are 75% cheaper.

The prices of courses for in-service training are generally a bit lower than traditional courses (for

[140] There were four sections in the survey: 1) background information (including indicators of everyday use of computers, self-evaluation for IT skills); 2) readiness and willingness to use eLearning: experiences, competences (both pedagogical and technical), attitudes, pedagogical concepts of learning and teaching; 3) evaluation of existing eLearning support system and training possibilities; 4) eLearning policy (judging current situation, problems, needs). There were 195 respondents altogether from 6 partner institutions. Results in Estonian are available at the *Estonian E-university*'s home page at http://www.e-uni.ee.

many cases the cost of the CP is about EUR 38, and the amount of course varies from 1 to 4 CPs).[141] Some courses, however, have quite the same price level – e.g., some teacher training courses (also, see the web page of the *Estonian E-university*).[142] The more specific theme the course handles, the higher the price is; and here, the differences with web-based courses are considerably big (as much as it is possible to do that kind of comparison at all since web-based courses mainly handle quite simple and general themes).

In sum, the expenditures on eLearning have been limited both in the education sector and the private sector. The overall attitude in developing web-based courses at different educational levels has been their resource-demanding nature in terms of time and finance.

II.6 Specific issues and problems related to eLearning

This section presents the general problems in education system in Estonia with particular reference on financial issues that have significant impact on the development of eLearning in the country.

To date, state support is concentrated on concerns related to the overall goals in education other than questions like eLearning. In a situation in which financial concerns are the biggest problems, venturing into an additional financial responsibility in new risky areas such as eLearning does not seem to be promising.

- The financial priorities for general education are mainly investments in schools and teachers' wage.
- The main problems in higher education are about quality and resources. Since the support from the state budget is minor and universities are rather autonomous in Estonia, the competition for resources has been based mainly on quantity of students. This also means the lack of cooperation tradition between universities to focus more on reasonable use of finances and on quality. In addition, there is a serious lack of professors, especially in technical areas, because the wage is too low. However, this is also a question of having not enough new generation of teachers. The lack of teachers results in overburden of the existing ones.
- On the students' aspect, the state has no financial resources to give scholarships as competitive, or comparable, as working in the private sector. This reality, in turn, favours working in the private sector more than prioritising completion of education. A solution to mitigate the problem would be to have flexible universities actively using web-based learning. Further, in order to tackle the problem, there should be higher financial support from the state for students (i.e., bigger stipends, financial aid) in order to keep them in the education system while studying.

However, eLearning as such is not considered the solution here because the state is not yet willing to considerably change the current education system and it is not willing to invest more in education (especially in activities that are very much resource demanding such as eLearning which requires availability of much better ICT infrastructure/equipment and content). That eLearning is part of knowledge society, the objective so broadly declared in several national strategies, is not recognised yet. This means that there are not enough resources to integrate eLearning into overall education, to legal and institutional spheres. It must be mentioned that the current difficulties is mitigated by the availability of the EU structural funds. Moreover, the lack of attention given to eLearning issues is a question about state capability, and the lack of respective competence at the Ministerial level at this time. But what is important here is that the lack of financial resources is not only a question of the small state budget, but rather of unstable political environment. The goals today are very much dependent on prevailing political ideas. What is a real pity is that the educational system is over

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[141] EUR 30-45 per 1 CP is the usual price for training and at the undergraduate level in universities. See also, for example, *Tallinn University of Technology* (http://www.ttu.ee/?id=2153) and *Tallinn University* (http://www.tlu.ee/files/arts/2306/UusAP489c3bf37339d7c5c912fa76f1bc43d0.pdf).

[142] See also http://www.e-uni.ee/taiend/TLU.htm#TLU1.

politicised at all levels – especially at the local level where the selected principal must be neutral and does not belong to any political party.

II.7 Acceptance and usage of eLearning services

II.7.1 Users of eLearning: usage, perceptions and attitude

The usage of the ICT-supported learning can be considered to be in a quite early stage and used mainly if the teacher (but also educational institution) is full of enthusiasm enough to take advantage of ICT means.[143] The overall figure of computer-based learning participation in Estonia is 10.3 in 2005 (Eurostat, 2006; see here also Table 13 in ANNEX I).

At the basic and secondary educational level, both students' and teachers' ICT competence has increased significantly during 2000-2004 and therefore has increased computer usage in teaching subjects among students from 8% to 73% and among teachers from 32% to 61% (Toots, Plakk and Idnurm, 2004: 73). The students' competence was measured in the framework of the survey *Tiger in Focus*.[144] The results showed that the proportion of students with the lowest scores has dropped sharply and although boys' knowledge and skills are still higher, girls have made more notable progress.[145] Furthermore, 80% of students would like to use ICT in learning. On the other hand, the time that students spend learning with ICT has not increased (Toots, Plakk and Idnurm, 2004: 11-18).

The same survey (*Tiger in Focus*) asked teachers to estimate their competence.[146] The use of ICT in teaching had tripled between 2000 and 2004 (Toots, Plakk and Idnurm, 2004: 10). The share of teachers using a computer on a daily basis increased from 32% in 2000 to 46% in 2004. Only 2% of teachers did not use a computer (Toots, Plakk and Idnurm, 2004). Today, according to estimations, about 10-11% of trained teachers are using ICT means in their subjects even if learning activities had not been altered or developed (Interview with Mägi, 2006). Hence it cannot be said that there have been many instances of how resistance of teachers limits the prospects for development. One of the best examples is the web-based gradebook, *eSchool* service, in which the resistance was mainly based on the issue of fairness of electronic means which, in turn, resulted in double work for teachers (i.e., registering grades not only on paper but in the electronic system as well). In sum, only a few of the possibilities, which ICT can provide for learning and teaching, are currently used in schools. Rather, teachers see ICT-supported learning as a useful tool in enhancing student discipline and motivation (Toots, Plakk and Idnurm, 2004: 18, 11).

ICT is increasingly used in school management and administration. According to the principals' survey, ICT is extensively used for keeping student registers and storing subject syllabuses. Less common is the application of computers in activities, which demand closer cooperation between teachers and advanced skills in data processing and analysis (Toots, Plakk and Idnurm, 2004: 16).

At the higher education level, computers are mostly used by professors as a tool for text editing, tool for information retrieval from the Internet or as a tool for e-mail exchange. Usage frequency of web-based LMSs (*LearnLoop*, *WebCT*), data analysis (*SPSS*) and content management (*Postipoiss*) significantly differs from overall computer usage – 60% of teachers (117 people) are not using web-

[143] For example, it has been claimed that Tallinn is in the worse situation in the area of eLearning than other schools due to the lack of enough enthusiasm and wish to experiment. However, one of the reasons maybe the large size of schools.

[144] This was done in two ways. First, a test with multiple-choice answers was composed to measure actual knowledge and skills. And, second, a set of statements was included in the survey to measure self-perceived skills. Actual knowledge and skills were calculated by the total sum index and by three sub-domain indices.

[145] Overall, nation-wide academic placement tests in 2002 with participation of 45 schools and 740 students – and in 2005, 129 schools and 6 623 students – show that students' skills and knowledge is good, and over **90%** of students have required presumable ICT competence (Learning Tiger Action Plan 2006-2009).

[146] The statements were divided into two categories. The first category measured general skills in using ICT; and the second category measured the professional application of ICT in teaching the subject.

based LMS (Laanpere, Läheb and Plakk, 2004: 6). In regard to the skill in creating web page, 31% (the biggest group of respondents) indicated their skills as 'cannot at all'; 8 respondents indicated themselves as experts; and 34 people rated themselves as proficient. The result is that 24% of teachers do not use eLearning tools at all; 49% are using some web-based tools; and 25% are using several eLearning tools. Very few have indicated that they do all their teaching in web-based form (Laanpere, Läheb and Plakk, 2004: 10; see also Text Box 21).

Text Box 21. Personal experiences in different learning management areas can be summarized by usage frequency as follows:

- Feedback to students by e-mail (47% regularly and 34% seldom)
- Uploading learning materials (39% and 17%)
- Creating a course web-page (17% and 13%)
- Using a web-based LMS (WebCT, LearnLoop etc.) (11% and 7%)
- Participating in a web-based course as a student (3%; and do not have any experience 69%)
- Combining face-to-face courses with eLearning (11%; and do not have any experience 71%)
- Conduct an entirely web-based course (3% and 3%; do not have any experience – 90%)

Overall, the share of teachers in Estonia who used computers in their classes last year at all educational levels (except in special computer classes) was 60%, compared with EU's 74%. The respective figure is lower for example in Latvia (35%), but is considerably higher in Finland (85%) and in Denmark (95%). A very high 87% of teachers use prefabricated pedagogical material from existing online sources, and 65% use materials available in the schools' network and databases. Offline learning materials such as CD-ROMs are used by 72% (Empirica and TNS Emor, 2006).

The demand for the use of eLearning tools is growing – and is the biggest – among students.[147] Today, from a total of 42 000 students in all member universities of *Estonian E-university* consortium, over 40% of students (18 000) are taking part in web-based courses.[148] Among Internet users, 5.9% of individuals are using it for formalised educational activities (see also Table 14). The highest is the usage of computer-based learning participation in the age group between 25 and 34 years – the figure is 15 (Eurostat, 2005). However, the demand is mainly for usage of LMSs in order to have better access to information related to learning and concrete subjects. Furthermore, because of the developing ICT society and other eServices, the demand in this sector is believed to grow very fast in the coming years (eLearning Conference in Tallinn, 2006). This can also be observed from the increasing number of students at the higher education level.

Table 14. Percentage of individuals having used the Internet in relation to training and educational purposes (2005)

Percentage of individuals	Estonia	EU25
Percentage of individuals who used Internet in the last 3 months for formalised educational activities (school, university, etc.)	5.9	8.5
Percentage of individuals who used Internet in the last 3 months for other educational courses related specifically to employment opportunities	3.1	6.8
Percentage of individuals who used Internet in the last 3 months for post educational courses	2.3	5.4

Source: Eurostat, 2006

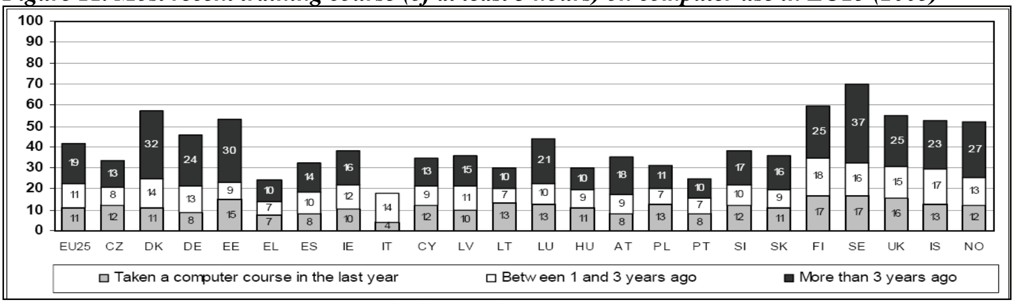
Although a legislative framework and measures were introduced to promote learning both in the workplace and outside (especially *Lifelong Learning Strategy*), it may be said that more effort is required from different parties to create a proper learning society and learning organisations. First of all, there is need for time for the idea of lifelong learning to take root. The demand for ICT-supported learning is smallest in lifelong learning. According to *Eurostat*, 5.9% of people aged 25-64 participated in E&T. In 2005, only 2.3% of individuals used the Internet for educational purpose; and

147 In 2001-2003, 88% of students were ready for web-based learning, but as the figures show, the web-based learning itself was then in the starting phase (Sule, 2003).

148 It should be taken into account that one student can enrol in several web-based courses, and hence the statistical figures may be higher than the real case (Interview with Laanpere, 2006).

2.4% of the inactive population, 5.8% of the unemployed, and 13% of the employed were into computer-based learning (Eurostat, 2005). However, as there is no demand, there is also no supply – the web-based courses provided for adult training are very limited both in scope of content and in numbers. The intensity of ICT skills' training at present is considerably low, although the respective figure is still high compared with other EU25 (see Figure 11).

Figure 11. Most recent training course (of at least 3 hours) on computer use in EU25 (2005)



Note: As a percentage of the total number of individuals aged 16 to 74 Source: Statistics in Focus, Eurostat, 17/2006

It is difficult to measure how much people learn from 'googling'. According to a *TNS Metrix* survey, the most frequently visited websites are the search engine *Neti* and the news portal *Delfi*. Also popular are online newspapers – *Postimees*, *Sloleht* (*Sõnumileht*), *EPL* (*Eesti Päevaleht*), as well as portals for different operations in the field of real estate (*City24*, *KV*) and cars (TNS Emor, 2006; also, see Table 1 and Table 2 in ANNEX III).

In the private sector, eLearning applications are used extensively by large enterprises for training and supporting learning of their staff.[149] Banks and telecom companies use web-based learning for training their staff (Massy, 2004). In addition, the highest percentage for using eLearning applications exists in the areas of electricity, gas and water supply (37%) and of real estate, renting and business activities (36%) (Eurostat, 2006; there were no statistics about the financial sector). In 2006, 33.5% of enterprises used Internet for training purpose (SOE, 2007); and 30% of enterprises used eLearning applications for training and education of employees (Eurostat, 2007). The same indicators for EU25 and EU15 are 20% and 19%, respectively. In 2005, the percentage for Estonia was 24 - the difference with EU average was not so remarkable (Eurostat, 2007). Assessing enterprises on the basis of size, 56% of large enterprises, as compared with 30% of SMEs, used eLearning applications for training employees in 2006. In other words, bigger companies have recognised and adopted eLearning faster than SMEs (see Table 17 in ANNEX II; Tables 17 and 18 in ANNEX I).

While larger employers can develop their own personnel, SMEs often lack the resources and it is more difficult for them to find a substitute for employees participating in training (Kiviselg et al., 2006). However, eLearning solutions are considered useful where the number of employees is great enough, which is mainly the case in large companies (Interview with Väravas, 2006). SMEs prefer traditional training in order to facilitate organisational culture and communication with each other. On the other hand, the feedback for eLearning in large companies are neutral, rather than euphoric, since it has become a natural part of everyday work (Interview with Tammiste, 2006).

Overall, users think 'access' as one of the main benefits of eLearning. Most of the employers think e-access reduces the time spent away from the job; and secondly, they are convinced that self-paced learning enables learners to take the most of the training programme and content (Remi, 2002: 31). Large companies regard cost efficiency as a benefit from eServices (Interview with Väravas, 2006). In general, the benefits of eServices are believed to be saving of time (86%) and of money (46%), and the availability of more qualified information (35%) in faster way (74%) (see Oviir in *Eesti Postimees*,

[149] For example *Hansabank*, *SEB Estonian Union Bank*, *Elion*, *EMT*, *Eesti Energia* (see *Eprojekt*, at http://www.eprojekt.ee/).

19.10.2006). The main reasons raised for not using web-based training include the possibilities not to use the computer, the lack of knowledge about the opportunities of eLearning, the lack of trainings in certain speciality and the satisfaction in traditional training (Piin, 2004: 42).

There are different ways to measure satisfaction in web-based learning. The main form used is the employee feedback, but corporations and government offices also pay attention to the bottom line results. The simple tracking number of learners is very often used (Piin, 2004: 49). This means that there is no special evaluation for the quality of courses offered by universities that use eLearning approaches. The training management units and the board, which plays a very important role in the education sector, mainly make decisions (Piin, 2004: 51).

II.8 Impacts of eLearning developments

To date, eLearning has been developed in the framework of different projects – in particular, *Tiger Leap* programmes on general education, *Tiger University* and *Estonian E-university* on higher education, and *E-VocationalSchool* on vocational education. Arguably, the deepest impact eLearning has had can be found at the general education level, where the next strategy for developing eLearning (*Learning Tiger*) also considers putting in place the necessary legal bases for new trends in education. The developments in the eLearning area on general education are mainly based on networks of teachers – one of the greatest net benefits from eLearning. The other main net benefit in the area in Estonia comes from the unified consortium of universities, the *Estonian E-university* on higher education. The same is the case for *E-VocationalSchool*. Although public universities in Estonia are autonomous, the role of the *Estonian E-university* has been very important – i.e., a supportive role to enable universities to reach their respective strategic goals. Here, the *University of Tartu* and the *Tallinn University of Technology* have elaborated their own strategic plans in which especially web-based learning plays a crucial role. However, it may not be plausible to argue that eLearning has greatly, if at all, ushered in reforms in the higher education sector. The same can be said about vocational education and adult training.

This is likewise the case in general education. Important is here the finding of the survey *Tiger in Focus* which shows that although 80% of students would like to use ICT in learning, the time that students spend learning with ICT has not increased (Toots, Plakk and Idnurm, 2004: 11-18). At the same time, one of the main motives in purchasing a computer is educational reason (23%); and people with high education are the ones most willing to buy a computer (35.1%), as well as families with two or three children (42.7%) (Vare, 2005; Content Village, 2005).

On all these educational levels, a positive development has been the effects of eLearning on the availability of information and on making communication easier between students and educational institutions.

eLearning has effected the overall spread of ICT. eLearning programmes, especially at the general education level, have been of utmost importance from the standpoint of developing ICT infrastructure.

Tiger University programmes have supported the provision of ICT infrastructure in higher education. For the larger society (especially for rural areas), the Look@World project was certainly important in spreading ICT infrastructure. What is important is that these programs have not only created physical infrastructure for eLearning, they have also generated public interest in eLearning. Noteworthy is the leading role played by the private sector in many of the initiatives, especially in the provision of finance. However, eLearning has not affected much the ICT industry and training industry. Many leaps forward have been made in teacher training; but, the management of ICT tools in teaching activities, especially the training of didactical skills, needs further improvement.

Furthermore, the use of ICT-supported learning and of eLearning applications has certainly deepened the country's IS. However, it is clear that various public (e-tax office) and private services (online banking) have had much greater impact. In addition, it can be argued that Estonia has not been able to capitalise from eLearning developments in lowering digital divide. In fact, even though there are no in-depth studies, it can be argued similarly to the case of e-elections that favour young, relatively well-to-do urban age groups; not to mention that advances in eLearning in Estonia mainly help the young people in the larger cities of Tallinn and Tartu.

Moreover, eLearning has had only limited effect on growth and competitiveness, as well as on achieving the *Lisbon* targets. On the one hand, Estonia's growth and competitiveness have been clearly driven by other factors (outsourcing, foreign direct investments, etc.). On the other hand, lack of general eLearning strategy has led to different outcomes in different sectors: while formal education projects have been successful, there is clear lack of eLearning measures for older and poorer age groups.

Summary of Chapter II

To date, eLearning activities have been strongly affected by developments in the area of eServices in Estonia. As a result, several projects have been taken up in cooperation between the public and private sectors to support educational institutions mainly with the provision of ICT infrastructure. In addition, several steps have been made to develop eLearning content due to the initiatives of public sector's foundations. Yet a concrete system for eLearning in the public strategies, as well as a clear legal base, is missing – this seems to be the main barrier to the further development of the area.

Contemporary eLearning policy has been mainly successful in creating infrastructure at the general school level, including some eLearning services like web-based grade-book *eSchool*, LMSs and CMSs like VIKO and KooliPlone, web-based learning materials and learning object repositories like *Miksike* and *Koolielu*. At vocational and higher education levels, these policies have supported the development of web-based courses, materials and curriculums, as well as the creation and use of LMSs (such as IVA, WebCT and Moodle). However, these mechanisms have not affected the usage of ICT as expected. Neither has the time students spend learning with ICT increased, nor has the usage of ICT means by teachers in learning process been comparable to those in EU25. At the higher education level, ICT in education is mainly used for administrative purposes, e.g., for enrolment to a course or a school and for communication with school and teachers. Teachers in higher education mainly use ICT as a tool for text editing, information retrieval from the Internet, or e-mail exchange. In addition, the current policy has failed to address the issues about high digital divide and e-exclusion. In other words, there has been lack of attention on older, lower-educated, poorer and Russian-speaking population groups. This means that students and employees are the ones who have mainly gained from the benefits ICT has to offer for educational purposes.

In the private sector, only 30% of Estonian enterprises have benefited from ICT means in cutting expenses, increasing turnover and introducing new products and services. And only larger enterprises (especially banks and telecom companies) have thus far gained from eLearning.

III: ASSESSMENT OF THE STATE AND DEVELOPMENT OF E-LEARNING

This chapter aims to integrate the various data collected and analysed in the previous chapters. It identifies the major factors, both drivers and barriers that influence the development of eLearning services in Estonia. It does so in three inter-related steps: (1) an account of the current state and trend in the development of eLearning, (2) a presentation of the major factors affecting the evolution of eLearning, and (3) an analysis of barriers to, and drivers of, the development of eLearning.

III.1 Current main achievements and shortcomings

Based on certain indicators established through an analysis of the data and information presented in the previous chapters, this chapter gives a summary of the current state and trend of eLearning developments in the country.

<u>General characteristics of eLearning in Estonia</u>:

Achievement:

- In cooperation with some of the leading actors in the private sector (ICT companies, banks, telecoms), the Estonian public sector has been very successful in implementing projects that have greatly improved the ICT infrastructure at schools and in regionally remote areas as well. In particular, these developments include: (1) the realisation of different *Tiger programmes* to provide schools and universities with computers and Internet connections; and (2) the implementation of projects such as *Look@World* to contribute to the development of people's basic ICT skills.

Shortcomings:

- However, a single policy document that combines all the aspects of eLearning has been missing from the very beginning. Both in policy formulation and organisation (i.e., in the design and implementation of policies), Estonia has relied upon non-profit organisations, schools and universities, and local initiatives, rather than upon a central policy coordination and formulation from the government. This, in turn, has led to the creation of various foundations and consortiums that implement policies independently, yet technically under government supervision. In effect, the government has not played a central role in developing eLearning.
- In Estonia, the idea of eLearning is very much related and closely associated to web-based courses and also to digital learning materials delivery at different levels of education (although lesser degree at the level of general education), in lifelong learning and in the private sector. Such misconception regards eLearning in Estonia as a self-study and not as a collaborative learning process with other learners.
- eLearning is seen as a goal by itself rather than a mean to build up the knowledge-based society.

<u>eLearning in general, vocational and higher education</u>

Achievements:

- Various NGOs have emerged with the common orientation to support the development of eLearning in Estonia, namely: [a] *Tiger Leap Foundation* (focusing on general education); [b] the *Estonian E-university* consortium (focusing on higher education), which was established through the initiative of universities; and [c] *E-VocationalSchool* (focusing on vocational schools).

- Several development plans to promote ICT infrastructure, as well as the role of ICT in everyday learning process, have been made for both the general and higher levels of education. The different *Tiger* programmes for general and higher education have been a key to the developments from the very beginning. Some universities have likewise set their own goals in the field of eLearning.
- Contemporary eLearning policy has been most successful in creating infrastructure at the general school level (especially as regards the ratio of computers per students, teachers or principals, and the availability of broadband connection in all schools). The main services provided within eLearning at general educational level include web-based grade-book *eSchool* service, web-based learning materials and different educational portals. In addition, there are some programmes created making it possible to acquire upper secondary education through the Internet. At the levels of vocational and higher education, the most important support services within eLearning are the ones provided by the special consortiums. Main attention is given to web-based courses and materials on these levels. Availability of materials in the web supporting on-campus courses has been improving.
- Due to the initiatives of universities, especially by *Tallinn University*, locally open source LMS like *IVA*, *VIKO*, and CMS *KooliPlone* have been developed. All of these LMSs are widely used in Estonia; yet *WebCT*, also supported by the *Estonian E-university*, is the most popular.
- Interest towards eLearning has been high since 2000 for both the general and higher education levels. Today, over 90% of students at the general education level have necessary ICT competence. The highest interest towards eLearning is at the higher education level, where almost a third of university students belonging to the *Estonian E-university* consortium claim to have participated in web-based courses. However, it must be noted that the statistics refers to participation in available web-based courses (based on logfile), not in the share of web-based courses compared to on-campus courses.

Shortcomings:

- At the general education level, a legal framework to incorporate ICT in the learning process is incomplete. Moreover, the curriculum remains classical and traditional – not enough emphasis is given on the use of ICT in the learning process (e.g., ICT is dealt with in the national curriculum as a horizontal theme), let alone web-based learning materials. ICT qualification standards for students and teachers need to be further developed and should have stronger legal base. The respective standards for principals are to be worked out. In addition, ICT-related in-service training for teachers has been voluntary at the moment. In sum, although the strongest emphasis has been given precisely to general education level, much of the stated goals are not yet achieved. In fact, although 90% of students require ICT competence from schools, the time students spend learning with ICT has not increased.
- At the higher education level the stress has so far been on-campus education, and not on distance learning, in the provision of web-based courses and curricula. This is also shown also in the low number of web-based curriculum. In addition, there are not enough curriculums in higher education that contain courses for ICT skills, and especially for respective didactical skill necessary for using ICT-based teaching. Moreover, there is no curriculum concentrating on teaching eLearning specialists: there is no MSc programme focusing on eLearning design, provision, consultancy, and technology – not to mention PhD studies.
- The development of eLearning is not supported by a special remuneration system or by other favourable conditions for teachers who use ICT in their teaching. However, it has been claimed that, for instance, much of the digital learning materials today are not created because of financial reasons, but more so because of the overload of teachers and hence the lack of time.
- The design of web-based courses is hindered by threats related to authorship rights, although IPR in Estonia is considered to be up-to-date. The use of open licencing of digital learning materials (especially *Creative Commons Licences*) has been promoted by the *Tiger Leap*

Foundation and the *Estonian Information Technology Foundation*. However, it has not yet found the support needed at the Ministerial level. Cooperation between teachers has been stronger here at general education level than at other levels.

- Today, since the role of ICT in education is not specified in the programmes of the public sector there are also no concrete schemes supporting the development of eLearning in general. Interestingly, the *Tiger Leap Foundation* has managed to include secure private financing because of its formal status of being an autonomous entity from the *Ministry of Education and Research* – otherwise, the private sector would not have been interested in financing as it would have meant a direct support for the public sector.
- In fact, the main initiatives of the *Ministry of Education and Research* – the central government unit that is supposed to be responsible for the development of eLearning activities and services – have only been related to the establishment of several information systems in education, like *EEIS* and *SAIS*, which can be considered more particularly as by-products of eGovernment services than as educational ones. One of the results is that ICT in the area of education is mainly used for administrative purposes – i.e., for enrolment to a course or a school and for communication with school and teachers.
- At the same time, there is a lack of interoperability between content authoring, storing and brokering services. ePortfolio services, web-based courses, search and enrollment databases are likewise lacking. The study information systems of universities are not interoperable with each other. Connection to existing databases or other information systems via *X-road* has also been only hypothesised. In addition, the lack of compliant content illustrates the poor development of eLearning services – not to mention that companies and institutions (e.g., Estonian TV, radio, publishers), which are main content owners, are not involved in eLearning development projects (Laanpere, 2006b). However, there is a serious lack of digital learning materials in general.
- A critical shortcoming is that at different levels of education eLearning is not incorporated in the overall education reform or strategic plans. Hence, it is not seen as a mean to provide solutions to current problems; but as a goal by itself. More specifically, even though teachers see ICT-supported learning as a useful tool in enhancing student discipline and motivation, it is not mentioned in existing strategies that the use of ICT could improve the current situation in which many students are dropping out of school or are repeating a school year. Further, the use of ICT in vocational education is a plausible option that could improve its current negative reputation.
- Further, the latest survey suggests that, although computer and Internet penetration in Estonia is comparable to the EU average, the existing ICT infrastructure in classes other than special computer classes is considerably lower than the EU average. A contradiction here is the fact that 70% of financial resources in general education level should have been directed to maintaining and improving the schools' ICT infrastructure. On higher education, the greatest problems are related to the lack of special technical equipment (e.g., for videoconferencing).

eLearning in the private sector

Achievements:

- The will to modernise the training system has been recognised earlier in the private sector than in the educational system (the first LMS *Edutizer* was initiated by one of the largest banks in Estonia – *Hansabank*).
- In general, about 30% of Estonian enterprises take advantage of eLearning applications for training and education purposes.
- There are also some training and software enterprises in the market whose activities include the provision of eLearning services (i.e., providing general ICT skills training, creating of virtual learning objects and digital learning materials, supporting purchase of new modern technologies for schools and further development of eLearning environments [especially those

in Estonian, and those of local open source LMSs], and creating web-based test environment for controlling ICT skills of the teachers and students).

Shortcomings:

- Private sector efforts in eLearning (other than via publicly led Foundations mentioned above) are clearly concentrated among larger companies, especially in the banking and telecoms sectors.
- Due to small local market (in terms of physical number of companies, geographical distance and real wage), it is doubtful that Estonia will see a dramatic rise in the development of the eLearning content in local private sector in the near future. It seems simply cheaper to have traditional training at the company level, and as there are not many similar companies, it is not feasible to develop Estonian-language eLearning programmes and content.
- Private sector cooperation with the public sector remains limited in developing eLearning content or special environments for different levels of education. One of the reasons behind this is that there has been a tendency to develop LMSs, CMSs, etc. locally as open source – in which a main exception is the financial support provided to *eSchool* service on general education.
- Furthermore, as publishing of textbooks is under the monopoly of private firms, the latter would rather fight for traditional than digital learning materials to guarantee for themselves at least some kind of profit. Hence, further developments in the area of eLearning depend much on actions related to a broader project of changing the system.
- To this day, the cooperation between public and private sector has been limited in the field of R&D. Meaning that, the claims of knowledge-based society is not backed up with universities and enterprises neglected competition. The private sector's role has been limited in financing certain projects.

<u>eLearning in lifelong learning and eLearning services for the unemployed</u>

Achievements:

- The main achievements of eLearning in the areas of lifelong learning and services for the unemployed on these levels are: a number of general ICT skills training, some web-based courses available from the *Estonian E-university* portal free of charge, opportunities to use the Internet at public libraries, and the availability of several online job-search systems.

Shortcomings:

- While the demand for self-study courses is very low, the services provided in the framework of lifelong learning and for the unemployed are modest. Web-based training for the unemployed is not in use. And although the *Lifelong Learning Strategy* recommends that participation in lifelong learning must be considerably increased in Estonia, advances provided by web-based learning are not yet seen in this field.
- To date, the emphasis in the case of unemployed people is on teaching the basic ICT skills in a traditional way.
- The idea of regional learning colleges is yet to be implemented.
- In addition, there are no legal mechanisms in place to legitimise knowledge and skills (e.g., accreditation of prior learning experience, including professional skills), both of which are acquired outside formal education.
- In the case of 'googling' or searching in the Internet, search engines and online databases are most often used to search for information related to real estate and cars, and rarely for educational purposes.
- There are not enough policy initiatives in the areas of eLearning that could prove most vital for Estonia's sustainable growth and competitiveness except for one-time projects that, for

example, address digital divide and training of older, poorer and Russian-speaking population groups. Such a policy of no policy is potentially deepening digital divide and e-exclusion.
- The possibilities of web-based learning in these unemployed target groups are also hindered by variations in ICT infrastructure, as well as the availability and affordability of the Internet in rural areas.

III.2 Factors behind the existing developments

The major factors affecting the evolution of eLearning are summarised in the following structure:

- Economic factors: macroeconomic and microeconomic environment

The Estonian economy is characterised by a continuous growth in GDP, which has been one of the highest in the EU in the last years. Rapid economic growth, with its direct impact (e.g., increases in tax revenues to cover public ICT-investments) and indirect impact (e.g., increases in living standards and thus more widespread home ICT-infrastructure) have had certainly positive implications for the development of the Estonian IS and for the emergence and acceptance of eServices. However, Estonia has been falling behind in terms of productivity and has not been able to take full advantage of ICT. For example, only bigger companies have maximised their activity through the use of ICT in-service training activities; but for SMEs it has been limited.

Nevertheless, both the private and public sectors have been developing a variety of eServices (e.g., banks' extensive promotion of Internet banking services, and the Citizenship and Migration Board's issuance and promotion of the use of electronic IDs). Successful developments of eServices in other areas have been the main stimuli to the provision of eLearning services.

Provision of eLearning services has also been supported by the Estonian ICT market, which is dominated by telecommunications network services. Estonia has highly developed telephone communications and networks, and is known for its provision of alternative data communications options (e.g., wireless Internet). In fact, Estonia has one of the highest broadband penetration rates not only among the NMSs, but also both in the EU15 and the world. The geographical proximity of highly developed ICT countries (Finland, Sweden, etc.) to Estonia, as well as the good neighbourly relations among these countries, further contributes to the country's development.

Yet, compared to the public and private sectors the share of computers and Internet access in the households is considerably smaller. Access to the Internet in the rural areas needs to be developed. Although the state has made several steps to provide ICT infrastructure in all counties and is seen to continue its activity, the biggest problem about everyday usage of the Internet is still not solved. This is partly due to the contrasts in availability of different services provided online. Considering the fact that average incomes in rural areas is below state's overall average, the current situation is even worse. Since the state has declared that it will not subsidise Internet connection, it should therefore give more emphasis on designing free digital services (e.g., through *Citizen Portal*) that are attractive to every citizen in Estonia. The need for sufficient ICT equipment and quality of Internet connection is not only a problem in rural schools, but also of schools in the city of Tallinn.

Nonetheless, costs of broadband connection in Estonia are generally one of the lowest in the EU.

- Policy factor: policies at national, regional and local levels

Attempts to build up an IS as well as a knowledge-based economy in Estonia have been present since the late 1990s. ICT has always been regarded as one key priority to ensure Estonia's economic growth and to build a strong society – an idea which is also adopted in the *Lisbon Strategy*.

Although Estonia has been the frontrunner in eServices, it is claimed that the current ICT policy is not sufficient to assure sustainable results. This is mainly because of the lack of vision about how the Estonian economy could benefit from ICT and which role Estonia may generally play in the area of ICT at the international scale. These ideas are related to the implementation of the strategy *Knowledge-based Estonia*, in which ICT is regarded as one of the key areas. However, concrete programmes and measures to fulfil this goal have still not seen the light. In addition, there is a lack of vision on how ICT can create added value in non-economic sectors like education, and hence support the building of sufficient bases for future innovations. The main reason behind the shortages is the fact that the state is not a leader in enhancing ICT as it should be. This is also the reason quite many initiatives in ICT have arisen in the private sector (e.g., the last initiative about computer safety).[150] At the same time, the state has played a great role in enhancing ICT in Estonia in the early 2000s, when there were *Informatics Council* and *Informatics Fund* – i.e., focused financial resources.

There exists no coherent strategy for eLearning. At present, eLearning is promoted through the different individual strategies in the E&T systems. The main ICT priorities (including eLearning) are set by *RISO* (allegedly in cooperation with the *Ministry of Education and Research*). As long as *RISO* belongs to a particular Ministry – i.e., the *Ministry of Economic Affairs and Communications* – it cannot enact actions for other Ministries, meaning that the implementation of the overall priorities of ICT-education as stated by RISO cannot be assured. Furthermore, the different NGOs (*Tiger Leap Foundation* and *Estonian Information Technology Foundation*), rather than the *Ministry of Education and Research* itself, play the greatest role in the implementation of eLearning initiatives.

Firstly, this kind of rather fragmented public sector's provision of eLearning reflects the absence of consensus, and hence priorities, about the role of eLearning in the Estonian educational system, and about how the available ICT applications, environments and content should be incorporated into the study process. One of the results is misconception of the term 'eLearning', resulting in some negative stereotyping about it – for instance, some support traditional learning because it maintains the so-called 'human touch'.

Secondly, it may be asked: does this kind of a decentralised system guarantee developments in the area?[151] Do these foundations have enough power to go further in their actions?[152] Apparently, the activities of the Foundations remain limited, especially if there is no support from the *Ministry of Education and Research*, and hence no connection created between new ICT-supported and current traditional learning processes. This then evokes two other significant questions. First, how strongly are the activities of these Foundations connected to each other?[153] And, second, how are the activities of these Foundations and their consortiums take into account the opinions of educational institutions, the level that needs the support in the development of eLearning. This kind of fragmented system has resulted in lack of cooperation between different institutions dealing with eLearning development

[150] The main solution is seen in the ID-card, which over a million people already have. Another solution is seen in mobile phone SIM-cards. The theme will become more public during the first semester of the next year. The problem is triggered by the fact that the current authentication systems are created in 1993/1994 and now is the time for updating.

[151] These Foundations can be considered as centralised only from the point of view of their respective orientations to specific educational level, namely, *Tiger Leap Foundation* on general education and *Estonian Information Technology Foundation* on vocational and higher education.

[152] For example, educational literature for general educational school is absolutely in the hands of the private sector and hence market-based. This, in turn, means that *Tiger Leap Foundation* initiatives can only be project-based.

[153] Positive examples here include the cooperation between the *Tiger Leap Foundation* and the *Ministry of Education and Research* to put in order ICT skills qualification for teachers and students; and the *eLearning Development Center* in order to provide connection between *Estonian E-university* and *E-VocationalSchool*.

(*Tiger Leap Foundation* and *Estonian Information Technology Foundation*, companies and universities, secondary and vocational schools) (Laanpere, 2006b).

The development of eLearning in educational institutions is strongly dependent on the TOP-level (principals, rectors, directors of departments etc.). Yet, some claim that the ICT knowledge and skills of said level is not sufficient to plan the actions to be taken in the area of eLearning. The result is uneven possibilities for students in different schools and at different educational levels. In addition, current policies to build the IS have failed to address the specific concerns about the older, poorer and Russian-speaking population groups. As indicated in the previous sections describing the positive state of the ICT sector and eServices in Estonia, ICT-related progress in the area of eLearning in the country has been rather demand-driven – i.e., dictated by the actors active in the field and by the private sector – than policy-led.

In general, although the main activities in the field of eLearning have been directed to the provision of ICT infrastructure, more attention are increasingly given to the design and distribution of web-based learning materials. This is particularly so in the universities; and the main reason behind this is demographic: in the coming years there will be less high school graduates entering universities and thus the latter see eLearning as an opportunity to reach international as well as additional local students.

A special positive factor to enhance eLearning has been the joint steps and cooperation projects of the government and private companies in creating mechanisms for the use of the ICT infrastructure. An impressive example is the *Look@World Internet Training Project*, a PPP initiative to increase the number of Internet users and popularise eServices. However, whether the motives behind the project were to train the future clients of services (especially in the banking sector), or to solely contribute to the development of ICT in Estonia, remains a question. The cooperation between public and private sector in other areas has remained limited.

- Legal factor: regulation at national and EU levels, the relevant regulatory elements

From the perspective of the overall ICT sector, it is undoubtedly important that a functional regulatory institution was in place especially at the time when the Estonian telecommunications market has become completely open to competition and that the service has been offered by a variety of companies since 1 January 2001. While enactment of legislations that could promote the overall development of ICT is certainly positive for Estonia, there is currently no specific eLearning law or any other necessary regulations in Estonia. The *eEurope 2005 Action Plan* has been influential to the overall development of IS and several eServices in Estonia. However, the degree of international pressure for Estonia in the area of eLearning needs further elaboration.

The lack of a legal basis behind the initiatives can be considered a relevant issue. Due to this, several basic questions and significant issues are not mandated by the state and hence remain voluntary – questions and issues such as standards, qualifications, training, infrastructure, and content.

One crucial aspect hindering eLearning development is the inadequacy of existing ICT qualification standards for students, teachers and principals. *ECDL* has been the *de facto* main standard for user training, as well as for general, vocational, higher and in-service training. However, the requirement for ICT skills competence has no concrete legal basis until now so that it could be integrated into the national curriculum for basic and upper secondary schools (except that it is a skill requirement for the 9th grade). ICT is currently a horizontal theme – not a compulsory subject – in the general education curriculum. The problem about ICT skills competence is especially important at the general education level, where students are prepared for the higher levels and where subsequent developments and progress of students strongly depend.

In addition, the learning process has remained much more oriented on general learning than on students and their personality. The national subject programmes are too much oriented on classical pedagogy, which makes it difficult to use constructive methodology like group-work and different projects for solving specific tasks. The large number of students in classes and the strict timetable are favouring this trend. Also, many teachers are afraid of using ICT in their subjects because they think they do not have enough time to go through the entire subject programme which academic placement tests and national examinations demand and control. This is supported by the lack of available ICT infrastructure to be used in classes, requiring extra time for organising to have some of them in class. Indeed, the use of ICT needs further estimation as to what and in what ways it is (to be) taught in class.

At the higher education level, the content of curriculum is not under the jurisdiction of the *Ministry of Education and Research*. Universities enjoy a rather big autonomy. Thus, much depend on their respective strategies for the future. And as a result, this makes central state regulation in the field difficult. However, through strategic plans, regulations have been and can be done. For example, the state has tried to support through the *Tiger Development Plans* the provision of ICT infrastructure for universities, as well as training of teaching staff in the field of ICT and development ICT-related curriculum. Special educational institutions have also been established like the *IT-College* to providing ICT education. But from the perspective of eLearning, these developments are not enough particularly because the training of special eLearning experts is not emphasised at the higher education level.

Other important issues are the modernisation of teacher training and the system of remuneration. Currently, the wages of teachers are computed on the basis of the number of classes and courses they teach. This means that, for example, if digital learning materials are created at home and not in the framework of the project, it is not appreciated. The result is that the use of ICT-based learning greatly depends on the willingness of teachers to use new forms of teaching. Apparently, teachers have no particular motivation and time to use ICT in the learning process – not to mention, to prepare web-based learning materials on their own – for a variety of reasons, among others: [a] the usage of ICT in the learning process is not mandated by the state; [b] the usage of ICT tools demand extra time for teachers who are known to have very stringent time framework in line with the national programme; and [c] the amount of digital learning materials available is small. It is all the more difficult because today's teacher learning programmes do not foresee special didactical skills to prepare the web-based learning materials on their own, although in some universities the goal has been taken. This is supported by a survey result among Estonian higher educational institutions indicating that ICT-supported learning methodology is used in learning by the teachers who have had themselves used eLearning in their own studies. ICT is also increasingly used school management and administration. To date, the *Tiger Leap Foundation* has mainly carried on the ICT in-service training of teachers at the general education level. But still, due to a self-financing character and to limited financial and human resources, professional teacher development is not of importance in rural schools where, some claim, that teacher training chiefly relies on informal exchange of optimum practices among colleagues.

The *Estonian E-university* has mainly provided in-service training of teachers at vocational and higher education levels. Importantly, it is at these levels where teacher training is even more dependent on individual school, resulting in a wide variation of teachers' ICT qualifications at both levels. In addition, according to a survey on higher education, lecturers use computers mostly as tools for text editing, information retrieval from the Internet, or e-mail exchange.

The missing legal basis for eLearning means that, above all, there is no clear legal basis for financing eLearning initiatives. The main shortcoming of this is the orientation towards one-time projects. Too, the central government's *Strategy for State Budget 2007-2010* does not give enough support to ICT in education. However, the EU has been important in the initiative to provide financial resources for eLearning activities. It has supported the participation of Estonian schools in several programmes it has financed. Yet, it may be the case as well that the availability of EU's structural funds has to a certain extent hampered the country's drive to build its own eLearning local system and support, and contributed to Estonia's focus on a project-based approach to eLearning.

- Ethical factor

The main issue about ethics is related to authorship rights. It is not so much about fear of others abusing digital learning materials and web-based courses, but about the attitudes of school teachers and university staff who do not want to share their digital content with colleagues, and hence not letting collegues to comment on and develop their materials. Currently, there is an overall lack of knowledge about the possibilities to protect authorship rights.

- Technological factors

Compared to other former Soviet Republics, Estonia was in a rather advantageous position for a number of reasons: [a] there were some ICT-manufacturing industries existing in Estonia, [b] almost every former state-owned organisation had its computing centre in Estonia, and [c] a good level of ICT-education provided by the *Tallinn University of Technology* and the *University of Tartu*. Also important is the existence of well-educated human resource in the field of ICT capable of working out local learning (content) management systems. However, there is a lack of ICT specialist in the market at this time, especially those who have appropriate university education. In fact, the relative share of graduates in the spheres of science, mathematics and computing, as well as in the engineering, manufacturing and construction sectors in Estonia falls short if compared with the countries which are successful in the ICT field (especially Finland and Ireland). The number of doctoral graduates is very low. Nonetheless, a recent positive initiative, which shows state support in ICT education, is the opening of a web page that introduces the possibilities to acquire ICT education and to work in this field as well. Yet, there are no specific educational programmes concentrating on eLearning issues – more specifically on eLearning design, provision, consultancy and technology.

Another technological factor contributing positively to the developments is the advanced fixed (including broadband) and mobile telecommunications infrastructure created by Finnish-Swedish owned *Eesti Telekom Ltd.* Although several programmes have aimed to provide ICT infrastructure for schools, there is no overview about the real situation in every single school, especially as the availability of ICT tools and infrastructure depends much on the school. For example, a usual case is that bigger universities are in a better situation than smaller higher educational institutions, resulting in inequality from school to school in terms of the provision of different eLearning applications.

Furthermore, poorer ICT infrastructure in rural areas has hindered lifelong learning possibilities in the area of eLearning – the latter being especially the case of having computer and Internet access at home. A development in this endeavour however is the establishment of *PIAP*s, *WIFI* areas and the 'internetisation' of public libraries.

The existence and availability of environments conducive to eLearning is a very important factor in the development of eLearning as well. While several eLearning environments, LMSs, CMSs, study information systems, content repositories are available and being developed locally in Estonia, the problem is that the LMSs in Estonian educational and training institutions are not interoperable with study information systems or with content repositories and *EEIS*. This seems to be the overall problem in Estonia because there are not enough horizontal solutions developed between government agencies, central and local authorities, or either beyond the public and private sectors.

The other question is how well current ICT activities are responding to the actual needs of the private or public sectors. It has been claimed that to the state has not understood to this day that it should be the provider of (convenient) services. This is also the question on the non-use of the current available bases for developing eServices – i.e., *X-Road* and *Citizen Portal* – as much as they provide possibilities. Rather, the trend has been developing IT applications on their own. The trend has carried over to eLearning applications, coming from the practice that public and private activity are not integrated enough, as the public sector is afraid of commercial and the private sector of the too regulated market. Moreover, the private sector is holding itself back because of EU's overregulation. The result is either the IT sector sells what is asked (read: improving the product than the system behind), or the private sector develops systems which are not working in reality.

The essential factor in enhancing the development of eLearning is the need to develop software and content in the Estonian language. An important recent initiative in the area of software is the digitalisation of the Estonian cultural heritage, which is also being related to LMSs. But as indicated above, not all the means to support the provision of richer online content has been utilised. The use of already existing traditional educational content is especially underutilised despite its significance under conditions in which the scale and scope of eLearning content currently available is really limited and in which there are not enough capabilities (theoretical, practical, financial, etc.) for content design.

Although Estonians are not generally afraid of problems related to safety and security of using eServices, these problems are in the private sector agenda. The private sector is still working out solutions on these problems, as well as exploring ways to use internal LMSs outside the workplace.

- Socio-cultural factors (including skills and adaptability, knowledge of the employees)

The general image of ICT usage is very positive in the Estonian society and the share of Internet users is rapidly increasing over the years. Positive attitude towards IS has been generated in the media. In fact, Estonia has lower levels of concerns about data security and privacy/confidentiality, and this includes perception among non-users of the Internet.

The high level of formal education among the adult population of Estonia compared to the EU member states is certainly an important factor influencing the demand for eLearning. According to *SIBIS*, low levels of formal education appear to be the most significant reason why people cannot participate in the IS. The share of Estonian population with tertiary education is also one of the highest among EU member states. This is essential because the practice in Estonia shows that those involved in overall educational system are those who use eLearning applications. This is likewise reflected in the big digital divide between educated and low educated persons, as well as in the digital divide between young and old people. A plausible reason for the digital divide between the young and the old people is the fact that there is not enough information in the web for older people and craftsmen. This, therefore, contributes to the older people's dissociation from the Internet. The English language is also one of the problems in using computers or the Internet.

In relation to the use of ICT-supported learning and of eLearning applications in different levels of education, a most important consideration is the attitude of school principals and university heads upon which the culture of schools and universities begin. The same is the case in facilitating teachers' participation in ICT E&T by organisational measures (e.g., how to solve the absence of teacher during in-service training, how to motivate teachers to educate themselves, how to motivate teachers to use ICT). This, in turn, means that acknowledgement of ICT is very important at this level. However, this TOP-level is currently considered to be one of the main bottlenecks for the future. The reason is not mainly about ICT skills, but more so about the lack of knowledge on how to change – that is to say, it is not only about the decisions whether to use ICT tools in schools, but about change in the overall vision of work in schools.

Another very important factor is the attitude of teachers and professors towards using ICT tools in class especially in the framework of formal education. There have been many instances of how resistance from teachers limit the prospects for development. One of the best examples is the web-based gradebook, *eSchool* service. In addition to the absence of a legal background for eLearning and ICT skills, the resistance comes more from teachers of the older generation. Apparently, the overall attitude towards eLearning tends to be related to teacher's age.

The attitude of students seems to be the most positive among the three user groups. However, distinctions must be made. At the general education level, the main problem to be addressed is the lack of content, and even more the lack of information about existing content. At the higher education level, the main problem seems to be the wrong conception about eLearning – i.e., students are afraid of decreasing quality of education due to eLearning (overestimation of eLearning as a distance learning form), and hence see eLearning mainly playing a supportive role.

In spite of Estonia's high level of formal education, participation in lifelong learning and in company-provided training has been below EU average. In addition, Estonia has one of the highest shares of older workers in the labour market in the EU. One of the main reasons here may be the fact that to date lifelong learning is not appreciated in Estonia both by the population and the state. The state, as a matter of fact, gives modest financial support for lifelong learning.

In the case of private sector, eLearning is much dependent on organisational culture and the size of the organisation. For instance, it is believed that the use of self-study courses is effective if the number of employees is more than 1 000 because with this number the efficiency in terms of time, instant feedback, and lower costs could be guaranteed.

It must be noted however that eLearning in the private sector seems to be currently characterised by their limited efforts to take full advantage of ICT. An exception here is the importance put on eLearning by bigger companies, especially in the fields of finance and telecommunications, which have become successful in doing ICT-related business. Yet, having ICT skills is not seen as a crucial qualification for work in Estonia, and also a high number of people with higher education do not have ICT skills. As a result, the need for ICT skills training is still in the agenda.

In general, the main reasons for not using web-based training include the possibilities not to use the computer, the lack of knowledge about the opportunities of eLearning, the lack of trainings in certain speciality, and the satisfaction of current traditional training.

- Regional specificities and regional factors

A negative characteristic of the regional development in Estonia is its unbalanced and uneven character. In particular, development is highly concentrated in larger cities (especially in the capital city of Tallinn, and in Tartu and Pärnu as well). This has, in recent years, resulted in internal migration in which people from the smaller towns move to the bigger towns, which are the main centres providing tertiary education and where educational level of labour force is highest. In addition, while eLearning and the general development of IS are concentrated in cities, there are no specific eLearning programmes that are seriously needed targeting rural, poorer and Russian-speaking populations.

Since the development of ICT infrastructure is under the responsibility of uneven local governments, the differences may be quite big. Although, differences at the regional level are relatively low, they exist. This means that the eLearning development strategies required may vary from region to region.

- Demography

Much of the pressure to provide and use web-based learning has been generated from the problem of decreasing population. This particular problem has forced universities and vocational schools to use eLearning facilities in order to bring in more students locally as well as internationally.

Specific to the lifelong learning aspect, it is important to note the high percent of elderly people in the total population – that is to say, the changing situation in the labour market in favour of older people and the need to modernise their skills in the framework of the ICT 'techno-economic paradigm' (for the concept of 'techno-economic paradigm', see Perez, 2002). And specific to the demographical aspect, it is important to note the Russian-speaking minority, who are the main and rather large minority in Estonia. There are no specific eLearning policies targeting the Russian-speaking minority, not even in the sense of further integration or adult training. In this endeavour, utilising the *Language Immersion Center* – the information providing repository for second language studies, which can be considered one of the best repositories – would be of beneficial contribution.

III.3 Drivers and barriers for future eLearning in Estonia

Based on the major factors determined above, this study gives a Drivers/Barriers analysis of eLearning developments.

The following are drivers of eLearning development in Estonia:

- Continuous economic growth is important for creating the needed basis for public ICT-investments. Its consequence leading to higher living standard supports more widespread home ICT-infrastructure.
- There is strong political will to build an IS as well as knowledge-based economy. This is supported by legislations promoting overall ICT development.
- Due to a highly developed ICT infrastructure (refers to high computer and Internet penetration rates) together with the successful development of eServices (e.g., Internet banking, submission of tax declarations through the Internet, e-voting, etc.) there is a general wish to take advantage of ICT in as many fields as possible, including in E&T. This is supported by state strategies in order to build a knowledge society. In addition, this is also supported by the high level of formal education among the adult population, which means that the target group in the field of educational would not be the small ones.
- There is a generally very positive image of eServices among the Estonian population (e.g., massive use of e-tax office and electronic banking) and thus willingness to try 'something new'.
- Broadband costs are relatively low in Estonia compared to other EU member states.
- In addition, there has been active cooperation between public and private sectors in the development of ICT infrastructure and general ICT skills as well. This kind of positive experience provides favourable basis for possible future initiatives, especially if these, at least in the beginning, might seem to be too ambitious or costly to be taken up only by one side, - e.g., only by private or public sector.
- Special Foundations and Consortiums under the Government have been the main drivers especially in the field of eLearning. The specific task of these has been the promotion and provision of support in the field of eLearning. Today, the initiatives and programmes taken up by these organisations provide the main basis for future developments in the area, especially taking into account that there are no signs for the increase of the Ministerial role in the area.
- In practical life, developments in eLearning are born out of the need to develop software and content in the Estonian language, as well as the need to create different eLearning applications.
- In universities and vocational education institutions, the main driver is 'competitive pressure': there are less and less potential students due to demographic trends and thus higher and vocational education institutions try to capture as much students as possible. This has also led to increased efforts in eLearning (especially in the field of web-based learning where there are several courses being worked out and the developing trend towards web-based curriculum) as well as to internationalisation (i.e., attracting foreign students and professors). Internationalisation through web-based learning is supported by trends to develop English web-based curriculum.
- There is also a need to increase participation in lifelong learning and in company-provided training. In the first case this means the fulfilment of EU regulations, and overall it means more efforts to be done to take advantage of ICT tools in everyday life.
- There is need to pursue balanced regional development in ways that are not too concentrated in larger cities so as not to promote peoples migration away from rural areas. ICT has an important role to play in this objective and it also brings services (especially online services) closer to citizens.

- There is need to cope with digital divide and promote training of older, poorer and Russian-speaking population groups through e-inclusion. This is all the more important because there is not much eServices today that target these groups.
- A very important financial driver in the field of eLearning has been and still is the availability of EU structural funds and programmes upon which the developments specifically at the vocational and higher education levels largely rely. Although the *Ministry of Education and Research* has been behind the priorities for EU's ESF Measure 1.1, it is actually *INNOVE* that has had greater influence in supporting eLearning developments because it is this entity that selects the appropriate projects.

The following are barriers to the development of eLearning in Estonia:

- Lack of efforts to take advantage of ICT in the Estonian economy. This is related to the problem that eLearning is not seen as a means to take advantage in building a knowledge-based society. Knowledge, however, is one of the most important factors in terms of innovations and economic development.
- Lack of access to ICT infrastructure and availability of different services provided online. This is mainly the problem about regional differences in computer and the Internet penetration in households and in educational institutions as well. In the case of educational institutions there is a general lack of technical environment such as programmes and additional IT equipment (e.g., cameras, etc.) which are necessary for giving daily classes, recording lectures, providing WIFI in classrooms, making computers available in classrooms, etc.
- Lack of policy and administrative coordination both in design and evaluation of policies in the field of eLearning: there is no clear national strategy/development plan/policy document (single or significant part in others) for eLearning as a tool in building the knowledge-based society. The problem is that eLearning issues today have been supported by several single development plans (each for different educational levels), which have not been interconnected to each other. This mainly refers to the limited role of the *Ministry of Education and Research* and other related ministries (e.g., the *Ministry of Communication and Research*). Thus, in devising new strategic goals and plans, the public sector follows either the initiative shown by respective partners (e.g., universities, private companies), or policies at the EU level. Moreover, the implementation of these goals has not been assessed in the framework of the earlier strategies, and it is highly probable that such assessment will not be done in the near future. And even if such assessment is done under current organisational structure, it would not have any real impact. As long as *RISO* belongs to a particular Ministry – i.e., the *Ministry of Economic Affairs and Communications* – it cannot enact actions for other Ministries.
- Political consensus about the use of ICT in subjects has been missing. That kind of policy of no policy, however, may become the main obstacle in the field of eLearning in the future – the development in the area of education cannot depend only on the new means available, but should consider deeply how to, and which means actually, support the quality of education. The result is that the main emphasis has been given on the first instance to ICT infrastructure and then to eLearning as a web-based learning. There is also the lack of comprehensive approach to the development of ICT in education – in particular, lack of consensus for the role of ICT at different educational levels.
- These problems are also related to the lack of political will to use ICT to solve general problems in the educational system and also lack of political will to modernise curriculum (e.g., existing orientation towards classical pedagogy).
- Lack of clear legal bases for eLearning and ICT for all educational levels (especially at general education level). In the case of *Informatics* as a horizontal theme in general education curriculum, it may be argued whether or not this kind of approach is providing sufficient and equal bases for further developments in the next levels. The legal gaps are also described by the lack of ICT qualification standards for predefined skills for students, teachers and principals. In addition, eLearning developments are not backed up with financial and technical support for teacher training. To date, ICT-related in-service training for teachers has been

based on the principle of voluntary participation. At the same time, future changes in teachers‘ competences must address the pressing need for more teachers in schools and in universities. However, the insufficiency of teacher competences may result in unequal study conditions for students in different schools and at different educational levels. Also, there is lack of MSc (not to mention, PhD) programmes in Estonia that focus on eLearning.

- The lack of a legal basis means that there is no clear financial basis and financial plan to develop eLearning. Whatever has been achieved thus far is due to several one-time projects vis-à-vis long-term programmes. It can therefore be said that eLearning has been based on enthusiasm and money, rather than on students’ needs. In addition, current developments in the field of eLearning have relied too much on the EU structural funds. However, the financial system under the EU structural funds has been rather bureaucratic, not to mention its prioritisation of less, if at all, risky projects. At the same time, the availability of EU structural funds has, to a certain extent, hampered the country’s drive to build its own eLearning local system and support and contributed to Estonia’s focus on a project-based approach rather than on services in the area. This kind of approach may not be sufficient in the long run if Estonia wishes to go along with the developments in the fields of ICT and education. On the other hand, the *Tiger Leap Foundation* has been relying too much on state support, in addition to its funding priorities for project-based activities.
- Lack of cooperation between different institutions dealing with eLearning development (both at national and local levels). The highest problems here are at the level of universities. There is also low cooperation between teachers and educational technologists.
- Lack of horizontal ICT solutions developed between government agencies, central and local authorities, and between public and private sector. Every agency uses its own ICT solutions that are not interoperable to others. This is also a serious problem in educational institutions where different LMSs, study information systems, content repositories, and *EEIS* are currently not interoperable to each other.
- Furthermore, there is lack of common requirements within individual organisations on how to take advantage of currently available eLearning applications. The usage of available eLearning applications (e.g., usage of LMSs in educational institutions) has been accidental and varies very much in the framework of one institution.
- Solutions are yet to be found with regard to safety and security challenges of LMSs, especially those used by private sector.
- eLearning developments are not supported by specific contents needed in respective levels of education. In addition, there is lack of efforts done to digitalise and re-use existing content, as well as lack of cooperation among concerned actors. However, the limited scale and scope of digital content is not providing enough basis for further developments in the field of eLearning, especially in the case of self-study.
- At the same time, the small size of local market, to a large extent, discourages larger eLearning software and content developments in the private sector.
- There is also lack of policy initiatives targeted towards lowering digital divide, especially among the elderly, rural poor, and Russian-speaking minority.
- R&D has been and still is undersupported in the field of eLearning. Cooperation in R&D is non-existent, although the private sector has provided financial support for some public initiatives.

IV: ANALYSIS OF THE POSSIBLE POLICY OPTIONS

The purpose of this chapter is to find out the most important policy issues and options available for Estonia to foster the development of eLearning services. This chapter outlines the most important policy issues that need to be addressed. It then tries to establish a more proactive framework through which major breakthroughs in the areas of eLearning may occur pending the implementation of the proposed policy measures. These policy alternatives will allow the determination of a possible effect of proactive, forward-looking government policies on the evolution of eLearning applications in Estonia.

The findings and issues of this chapter are based on the results of the first part of the country study comprising the first three chapters as well as on the findings of the interviews carried out with the major stakeholders in the field.

IV.1 The most important policy objectives in Estonia

Although Estonia is known, at least in the EU, as a well-developed '*e-country*' in terms of available ICT infrastructure and e-services, current developments have not had enough spill-over effect to the other closely related areas, especially in the educational sector. What is important here is the acknowledgment that in building up IS, the new skills – technical, intellectual and social – are as essential for living, working and participating actively in the society (The *e*Learning Action Plan, 2001).

Within the framework of a knowledge-based economy, in which great emphasis (at least political) has been given by Estonia since the beginning of the 21st century, the education sector has to play an important role – i.e., that the **education sector must reorient itself and take advantage of technological developments and it must provide inputs for future innovations and technological breakthroughs**. This is supported by the innovation theory of Carlota Perez (2002): that research and educational policies must be oriented towards the logic of the techno-economic paradigm so as to enjoy the benefits of its unfolding potentials (also, see Kattel and Kalvet, 2006). Broadly speaking, the idea is positively related to evolutionary (Schumpeterian) economic theory, emphasizing the role of the state in the creation of (new) knowledge as the basis for economic development (see Reinert, 1999). Hence, **there is a great need for the inclusion of eLearning in E&T system not as a goal for itself, but both as a *goal* aiming at improving the quality and variety of learning methodologies applied in the institutions and as a *mean* for building and supporting the knowledge society**.

One way schools – and indeed the society as a whole – can take advantage of ICT and, at the same time, support the creation of new knowledge is through ICT-supported learning (see also Hakkarainen et al., 2006). This suggests the broader need for change from traditional educational methods to one that is oriented towards the current E&T system.

General, vocational and higher education

One of the important factors upon which the development of eLearning is claimed to be strongly dependent (especially by the representatives of the special Foundations and Consortiums in the eLearning area) is the need for consensus on the kind of skills and knowledge required for students. Should the stress be on those which can be easily measured by exams and by state exams as it is currently done? Or, should the orientation be on those skills which are essential in everyday life – such as skills for searching information, cooperation, analysing, assessing, generating ideas, time planning, ability to finish things, etc. The latter would be especially essential in the society, which evaluates the ability to learn more than pure knowledge of facts. The other question is whether the changing of existing educational methodology is a policy option today, taking into account the situation where

Estonian society, educators and parliament have not reached consensus on the goals, structure and content of the new national curriculum for primary and secondary schools during the last five years.
In the next 10 years, **policy makers, teachers**, **students** and **parents** have to be informed more about ICT means and ICT-supported learning methodology. One of the main aims must be the **elimination of prejudices toward eLearning and hence the rediscovery of its real definition: that eLearning is not only about self-study or distance learning**. This is even more important especially at this time when pedagogical and mind restrictions are claimed to be higher in the area of eLearning than in technological ones. Here, the *eLearning Conferences* must be considered a top priority. Importantly, **policy makers** are the first ones who should be informed more profoundly about the possibilities ICT can provide, including educational matters. Participants' attitude towards eLearning in practice is very important. This is because the participants themselves are the direct concerns of eLearning, namely, local level – **TOP-level** in educational institutions, **teachers** and **students**. Hence, more information activities should be also focused at the TOP-level in educational institutions (school principals, heads of faculties, directors of institutes, etc.), the level which makes decisions and distributes financial resources.

The measures for students depend on different educational levels. At the general education level, the role of teachers in giving information and guiding students on the use of different available ICT tools is very important both in the learning process and in the reorientation of current learning approaches. At the higher education level, since many students are afraid of eLearning due to misinterpretation of the term, more information drives for and among students should be carried out about the eLearning theme. This would include the distribution of informative materials, something, which universities can do independently given proper motivation and interest. To date at the national level, the respective orientation has however been mainly towards teachers (e.g., annual *eLearning conferences*).

Workplace training

The main factor in enhancing the development of eLearning is the **organisational agreement** that eLearning is to be considered as important as, or complementary to, traditional learning and that it is a priority. Other decisions are dependent on this agreement, considering the emphasis of web-based learning materials, LMSs, CMSs, course management systems, and so on. The practical value is that employees can use working time for learning because it is already the case in traditional learning. Here, the attitude towards eLearning at the TOP-level is also of utmost importance.

Life-long learning and informal learning

From the policy options above, it can be concluded that **life-long learning and informal learning is strongly dependent on academic education** and the orientation taken on learning process at this level – that is to say, both depend much on whether the academic learning is oriented on acquisition of facts or on ability to learn on its own. Moreover, the promotion of the idea of lifelong learning needs further and more focused attention, and should not be oriented only on potential learners. This means that the public sector should work out a concrete system for providing services in the framework of lifelong learning. As such it is about increasing the role of the state in active measures for unemployed persons (like training) rather than in passive ones (like aid).

In addition, it is very important to **promote knowledge about ICT society** (e.g., its meaning, reflections in media, public debates, etc.). And it is even more important to **enhance the knowledge about different eServices**. In the latter case, the paper-based information materials (brochures) would be an effective channel to exploit since Internet users are already most likely familiar with eServices. The promotion work should be carried out as close to citizens as possible.

IV.2 Suggested policy measures

In general, what should be done in the area of eLearning concerns the consensus about its role in the education system and the society as a whole. In practice, this is about explicitly stating the goals in certain policy strategy or as part of other strategies on building up the knowledge society. A favourable environment conducive to the realisation of the set goals should be in place. This would then include questions about financial resources, ICT infrastructure, quality insurance system for digital learning materials, involvement of current actors in the field of education and culture in digitizing content, establishing centralised brokerage systems with digital right management support as well as measures against piracy, and supporting further the training system of teachers. In broader terms, emphasis on promoting the idea of lifelong learning and eServices is needed.

IV.2.1 Policy measures on legal and regulatory issues

<u>General, vocational and higher education</u>

- There is a need for the development of an **overall eLearning strategy or a comprehensive learning strategy in which eLearning would be part of it**. Or, there is need for the inclusion of eLearning in state development plan and other significant strategy/policy documents. This kind of strategy should give an overall view of the current situation upon which concrete goals and vision for the whole education sector could be possibly set up. In doing so, ICT development at different educational levels would be interconnected. This strategy would be important to ensure some kind of stability in the area and to make possible that educational institutions plan more their activities. However, what is very important about the strategy is that eLearning should be brought out not **only as a goal by itself, but as a mean for implementing education reforms and building up the knowledge society**.

    - In general, the need for eLearning strategy or as a part of other strategies is essential to get enough **political**, **financial** and **legal support** for the area, especially when taking into account the current situation where eLearning 'has not been the mainstream', and especially not among politicians.

    - Extra strength should be given to coordination between different educational institutions and between different organisations involved in the areas of education and ICT. Accordingly, the **need for a special autonomous entity for coordinating ICT concerns in all areas** (general education, vocational and higher education, lifelong learning and private sector) must be seriously considered. It is important that this entity enjoys substantial political power.

    - The other possibility, and may even be more realistic and easier to implement, would be to synchronise the policies of different fields related to ICT at the **round table** for representatives in the fields of education (the *Ministry of Education and Research* and those organisations deeply engaged in eLearning issues like *Tiger Leap Foundation* and *Estonian Information Technology Foundation,* and *eLearning Development Center* and the *Estonian Information Technology Society*), of ICT development (*RISO*), as well as entities responsible for innovation and R&D (*TAN*) and respective representatives from the private sector (*ITL*) and Look@World Foundation.

    - The higher education institutions and vocational schools should **have their own eLearning strategies**. This is even more important in the case of higher education because the universities are rather autonomous and are not very eager to cooperate with each other. The support here by *Estonian E-university* and *E-VocationalSchool* is of utmost importance.

- In addition, the *Ministry of Education and Research* should **work out the overall framework for ICT qualifications** and **digital competencies, in addition to professional qualifications,**

that should be included in basic, secondary and post-secondary curricula. The main mistake done at present is that ICT education is divided into several small pieces and it is believed that if each fulfils its piece, it is what is expected. Also, the role of teachers and students in creating necessary connections between different educational levels are overestimated. This suggests that necessary ICT skills should be stated for different educational levels (general, vocational, and higher education and its different levels). Likewise, the progress in acquiring ICT skills should be stated so that this would not overlap at different educational levels.

- A particular important question is **the role of ICT in basic educational curriculum**. Should it be only the horizontal theme as it is now (and stated very generally), or should its clarification be deeper? The happy medium would be the position that *Informatics* is a compulsory subject at least for one year at general education level to guarantee equal skills for students, especially taking into account the preparation for higher education. This is also important for guaranteeing that all students in bigger and smaller schools have equal opportunities. The argument that computer teaching for everyone in traditional way is too expensive should not be acceptable at the state level. Furthermore, there should be regulations in place to guarantee that all students in the country have equal opportunities to take advantage of these new means.

- Since the development of schools is greatly dependent on the TOP-level and in order to make the most of the ICT means, the main policy measure for TOP-level should not only be ICT, but also the change management in-service training. This is important in order to guarantee that the TOP-level is able to connect successfully current and new learning tools and processes. Cooperation between school principals and teachers is also very essential.

- Teachers' competence to use innovative measures in their classes has been the biggest bottleneck in promoting the use of ICT in the learning process. Therefore, much more attention should be paid to developing curriculum to enhance teachers' competence and also to in-service training. This is supported by the fact that if teachers have not used eLearning in their learning, they do not know about that and will not use it in their own classes. To achieve the overall development in the field it is essential that there are established ICT qualification requirements for teachers, which are agreed in more binding ways than it is to date.

  - Teachers' educational curriculum should be looked at and be up-dated in accordance with the evolving ICT world. This is even more important taking into account the decrease of ICT-related courses in teacher's curricula due to the Bologna-process.

  - ICT competences for teachers should be established in a more legally binding way than it is done currently – for example, a decree of the Ministry of Education for teacher's evaluation (*de jure* approach). The difference on current regulatory bases for ICT competences (i.e., *The Framework for Teacher Training, Professional Standard for Teachers*) would be in the actual bases to control and demand the acquisition of ICT competences.

  - The other important aspect is teachers' in-service training where much emphasis has already been given. According to the developments, **ICT-related in-service training should, in some proportion, be at least compulsory** (*de jure* approach).

  - The regulation of teachers' ICT competences through in-service training should be developed in accordance to the consensus on the standard for ICT competence for teachers (*de facto* approach). In a structure where there is absence of a legal regulation for teachers' ICT competences, the latter can be promoted through shared standardised in-service training.

  - Also, the *Ministry of Education and Research* should issue an order to universities to practise in-service training for teachers, especially based on subjects not only on ICT.

Here, the market basis mechanism is not working. The teachers' in-service training is especially important for elderly teachers to guarantee that they are able cope with the challenges of the changing learning process and environment.

- **English language skills** of teachers should be given much more emphasis.

- In the case of teachers, it is also important to create a **motivation system** for them in order to enhance the usage of ICT and other up-to-date learning approaches in their work. This means, above all, flexibility in the educational system – teachers can choose which kind of learning methodology they would approve and their choice is not punished by the remuneration system. To date, it is too much to suppose that teachers improve their classes and use ICT means just for their own will to become better.

  - Firstly, the state should guarantee a **decent average wage** for teachers/professors comparable with the average wage in the private sector.
  - Schools and universities can pay **additional salaries or bonuses for dealing with eLearning matters**. More specifically, the change in the frameworks of remuneration system would mean that the salaries of professors should not be calculated only on the basis of work done in class, but also on the work done in other ways (e.g., the time spent using ICT means, creating new materials). And it is even more important to take into account course novelty and innovativeness, while compensating for its development. The emphasis here should be in improving the education, and the rewards system should target quality improvements in it with, possibly, ICT-supported approaches. eLearning should not be promoted only for eLearning.
  - However, while it is claimed that wage is a motivator to certain aspect, the motivation system should not be based only on wage. Other favourable conditions should be supported. For example, teachers should have the **position in society, which is appreciated** and should gain **recognition in the institution** for developing **new and high quality approaches for teaching** (meaning, that there are technical, up-to-date tools available in schools).

- At the moment, the quality of digital learning materials is variable and so the problem is related to large amounts of these materials and to the question of how to evaluate them. The same is true with web-based courses, and more with web-based curriculum in the future. Hence, **quality standards** should be worked out at the Estonian level and at the EU level in order **to guarantee the quality of digital learning materials and of web-based courses and curriculum**.

  - For example, all digital learning materials used by educational institutions should have the **quality mark**. There can also be other sources for respective materials, but here the user would take the risk on its own. The current framework, for instance, of the learning object repositories like *Miksike* and *Koolielu* is made post-ante or ex-ante **quality control**, **respectively**, for materials being put up.

  - Further, much emphasis should be given to quality standards at the higher education level. A positive development here is that the *Estonian E-university* is already working out specific standards. Also, in the development of courses more attention should be given to the details that are important for the people with disabilities (e.g., study videos with subtitles).

  - **The EU should develop common quality standards** that take into account the high possibility of web-based courses and curriculum to become international.

- The other question which arises from standards, especially from those worked out by EU like the *EuroPass* standards (facilitating internationalisation in the areas of learning and working), is how much of these standards are taken into account in developing particular standards internally or how much of these are integrated into the local system.

- In addition, more emphasis should be given on teaching the new generation of teachers. And at the local level in educational institutions, the solution here is not to be found in engaging entrepreneurs in teaching (especially in higher education) because they lack pedagogical background and are very much private sector-oriented.

Lifelong learning and informal learning

- A **political agreement** is needed between public and private (but also non-governmental) sectors **about the distribution of responsibilities on lifelong learning**. This means that there should be a real organisation and legal basis in place in order to achieve the goals set out in several strategies related to lifelong learning. A solution for this challenge could be the establishment of a **special department for lifelong learning or an NGO in/under the regulations of the *Ministry of Education and Research***.

- Also, there is a need for the implementation of a delivery system – **regional learning colleges** (developed on the basis of vocational schools and higher educational institutions), which have been one of the top priorities in strategies and ESF measures related to lifelong learning. These centres (equipped with up-to-date technical means, including possibilities to carry out video lectures, and likewise providing consultancy services) are especially important for those who live away from towns, but would like to acquire higher education, improve one's professional skills or would like to learn something new.
- The other important aspect in lifelong learning is to work out **standards for accreditation of prior learning experience** – i.e., standards for information that cannot be documented, but can be presented by doing the special activity for which qualification is needed (for example, video record of cooking). There should also be a consensus on the bases for working out these standards. The idea is more realistic because the systems and standards for this kind of new learner information packages have already worked out (see, for example, *IMS Lip Editor,* worked out by *IMS Global Learning Consortium, Inc.*).[154] Ministerial action is urgently needed for legitimising this kind of opportunities.

IV.2.2 Policy measures on fiscal and financial issues

General, vocational and higher education

This report has frequently stated the need for a legal basis for eLearning activities. The main reason for this is the need for a **legal basis for financing.** Today, the role of ICT in education is not specified, and neither is it supported financially.

- To date, the *Tiger Leap Foundation* has relied too much on state support and hence measures should be taken in order to enhance the endeavours of the Foundation to also use resources other than those coming from the state (i.e., for the Foundation **to also take advantage of the opportunities offered by the EU's structural funds**).

- On the other hand, eLearning developments in higher and vocational education have been relying too much on EU's structural funds. There is a need for concrete financial funds and programmes developed by the *Ministry of Education and Research*. The availability of **EU's structural funds should be taken as additional financial resources**, not as the only means to depend on.

[154] See more, at http://www.imsglobal.org/.

- In the educational sector, one problem is related to financing of the development of the Estonian LMSs. Since the *Ministry* is only interested in IT application which will make easier their work in monitoring the area under their responsibility, it has not contributed to local LMSs or other e-applications, which can be used by schools in their everyday life. This also means that less attention is given to the needs of students in the development of particular systems.

- It should be considered whether it is justified to support the use of just one LMS more actively at the state level. On the one hand, the usage of the LMS, which is accepted in the whole country, would make it easier to connect this LMS with other state's initiatives in the field and would guarantee some kind of unity in the educational system, especially when we are speaking about vocational and higher education. On the other hand, this kind of approach may result in lock-in effect in which the system is not developed further as it should be and would create the conditions hindering the possibilities to change the selected way in the future. There are three possible ways to be chosen: (1) the state financial support for having the country licensed for ***WebCT*** (must be a newer version of *WebCT* than it is today); (2) support further the developmental work of local open source LMS ***IVA***, in respect to the changes with *WebCT* due to *Blackboard* arising as the new market leader; and (3) the orientation taken on freeware (in addition to *IVA* and ***Moodle***). The use of *Moodle* is also supported by its flexibility – the changes can be done in the system specific to what is needed in particular cases. In all cases, the most important factor is that if one particular way is selected, the state should support changes to use the same system in all vocational and higher education schools in Estonia in order to support interconnectivity of educational system and guarantee unity.

- The state should also finance developmental work in order to guarantee **interoperability** between LMSs and study information systems. The next opportunity would also be to engage digital library in the system.

▪ The role of ***INNOVE*** comes in the agenda in relation to the distribution of financial resources under ESF measure 1.1.

  - Very important is the **financial support for activities based on programmes rather than single projects**. This mainly means that the state buys what is offered, and not what is necessary. The programme-based approach suggests that the development is more organisation-centred, or better service for users, and hence can support the current role of the Foundations in the area. Moreover, programme-based financing enables the setting up of more long-term goals for the area. Some steps toward changing the current system have already emerged.

▪ There is a need to develop **financial schemes based not only on public, but also private financial resources**.

  - This kind of approach should especially support higher, workplace and lifelong learning. In the case of higher education, this would mean private funds and expertise knowledge as well to be available to participate in the R&D programmes of universities. In the workplace and lifelong learning, this would mean the provision of training programmes by universities, which, in turn, is financed by the private sector.

  - In order to support interconnections in R&D between public and private sector one possibility could be the development of **common eLearning environments** (e.g., LMSs). In this case, both counterparts would be interested in further developing these environments and would be providing finances for the purpose. The result would be better learning environments for both sectors and for Estonia as a whole. The availability of LMS, partly supported by the state, would enhance the usage of LMS also in other enterprises than in finance and telecommunications sector, especially in SMEs, for whom the usage of that kind of systems is not affordable, but also attractive enough, at the moment.

Lifelong learning

- Financing in the framework of **lifelong learning** should be flexible. Today, the orientation has been on the working society. There is a serious need to investigate the biggest problems on which to concentrate. In the framework of lifelong learning, several solutions are proposed:

  - To make lifelong learning system rather **based on contract**s, every employer should provide additional resources. This kind of system has two aspects. First, the state is not willing to pay off the in-service training of employees from private sector. And second, in-service training financed by employers often serves a certain purpose.

  - **A schooling fund for lifelong learning**, including state finances for developing flexible solutions and different web-based courses, should be established. This requires a legal basis for lifelong learning. In order to implement this fund, a **survey** should be conducted to have a basis of the courses which the state must finance as top priority.

  - **A special fund** in order to enhance the ICT-supported learning should be developed for special groups – like for the people with no basic and secondary education, the older generation, the socially excluded, etc.

Informal learning

- Financing in the framework of **informal learning** cannot be a direct one. Here, the role of the state should be more oriented on providing enough eLearning applications and content on the web (content here is understood as educational materials developed for courses).

IV.2.3 Policy measures on infrastructure and technology

ICT infrastructural matters are not the main issues to be addressed today, although there are some regional differences the problems also occur in the new living, residential areas near Tallinn. At the same time, the **reserve for usage of ICT means** is a valid one – that is, all the technological possibilities are not yet explored. Furthermore, there is no consensus about the best way to use them. This is not mainly a question of ideas, but of costs and resources as well.

General, vocational and higher education

- It has been supposed several times that the quality of teachers' environments should be developed (e.g., the idea that **every teacher should have her own laptop, and every student's schoolbag should contain a laptop instead of books)**. This policy measure has been brought out also in the *Programme of the Coalition for 2007-2011* in which the Coalition will give each teacher a laptop computer and launch a programme aimed at granting each student the basic school technical access to computers and the Internet at home and at school. In general, the support from the state is still needed to build up a **sufficient basis for ICT infrastructure**, with more concentration on **special technical equipment.** For example, taking into account the possibilities of ICT in general education, a stronger need for smart boards will soon arise. In higher education, the equipments for videoconferencing are to be supported.

- Also, there are too much '**handicrafts**' in the area of technological equipment at schools today, being put up and down before and after every lecture. This is usually the case because there are not enough ICT means available so that all classrooms would be continuously equipped and the set-up of this equipment in classrooms seems to be a concern for safety. The system of the equipment should thus be made more automatic.

- In order to enhance developments in eLearning at the general education level in the regions, all general schools should have **equal starting point in the perspective of using LMSs and e-applications in education**. For example, all schools should be included in the network of *eSchool* service. Too, the use of different learning and CMSs (at least those developed in Estonia like *VIKO* and *KooliPlone*) should be actively promoted in schools.

- In higher as well as in vocational education levels, a **common LMSs** should be used in order to guarantee interoperability with other systems (e.g., to study information systems) and between different educational institutions as well. And if it is not possible to guarantee interoperability at the national level, at least **interoperability of LMSs and study information systems should be in place in individual schools**.

- It is very important at the local level that the usage of LMS inside one institution should be made **compulsory**. For example, information about all the courses provided by the institution would be available in the LMS.

- There is a need to **initiate a special state-financed interdisciplinary research programme dedicated to R&D on the next generation eLearning and knowledge management solutions** and involving innovative companies and researchers from different fields such as computer science, information science, educational science, cognitive science, media studies, psychology, (computer) linguistics, etc.

- At the local level, every school can promote its development in the area of ICT by hiring **IT specialist** responsible for hardware. There may also be a person who has general knowledge about learning and CMSs, eLearning services, ePortfolio, eLearning repositories, etc.

- The efforts of universities to provide **access to special databases** (e.g., EBSCO) for students are particularly important at the higher education level.

<u>Workplace training</u>

- To date, **digital learning materials in the private sector** are not interactive enough and mainly consist of guidance documents. However, interactivity is a very important aspect for enterprises themselves in the case of digital learning materials. Increasing emphasis on interactivity must therefore be given. At the same time, there are only a couple of advertising companies that are capable of design from Word document interactive web-based learning material. Companies have not also succeeded in hiring the needed special consultants for eLearning by themselves. The problem seems to be related to the overall limited emphasis on design in companies. This is why the ***Enterprise of Estonia*** **should provide state supported programme focusing on design in Estonian enterprises**.

<u>Lifelong learning, informal learning</u>

- In order to support lifelong learning, the **state-financed programme to equip adult learning centres with ICT** should be developed and implemented.

- The idea of **regional centres** should be finally implemented. The **technical basis of general educational schools (especially in rural areas) could be exploited** by using the rooms for adult training in the evening.

- In the framework of lifelong learning and informal learning, the **internalisation of libraries** and **establishing PIAPs** are important. State support for creating ICT infrastructure, including **WIFI areas**, in the countryside is here likewise important.

IV.2.4 Policy measures on content

General, vocational and higher education

The lack of good learning materials, not to mention their expensiveness, is an essential reason ICT usage in education is limited. The quantity of web-based learning materials is said to be greatly dependent on the number of users – the more users the more useful it is to work out ICT-based solution. However, what needs further attention in the promotion of ICT-based learning approaches is the notion that the only important content is not the existing reading/listening materials, but the web discussions and collaborations and the knowledge created with peer learners. Good eLearning can be implemented without much existing written materials.

- State programme should be in place **to translate and adjust eLearning content** developed, for instance, in the EU **to Estonian and to Estonian conditions**. The real work could be done even at the local level by teachers, whose efforts would be covered financially. This requires that a **quality assurance system** is in place in Estonia. However, the emphasis on translation only is not wise from a long-term perspective. This is mainly due to financial reasons (it is very expensive), and to fast-changing character of content today.

- The state should financially **support the digitalisation of cultural heritage**, including TV and radio broadcasts.

- In addition, a state-supported **open digital content programme** must be initiated, one which is oriented to the re-use of most of the content that have been written or recorded in the Estonian language and that would guarantee free access to them in the longer perspective. Here, common digitalisation and distribution is of the essence.

- The other question is a more general one – the state should be able to **guarantee authorship rights for digital content** and software to schools, universities, companies, and private persons. This means that the commercial publishers should have a secure market for selling their digital content to schools, universities, companies, and private persons (e.g., centralised brokerage systems with DRM support, measures against piracy).

- Further emphasis should be drawn on the tools enhancing collaboration between teachers and students or between students in the promotion of the use of LMSs. This kind of informative work could most probably be done effectively by the *Tiger Leap Foundation* and *eLearning Development Center*.

General education

- For the general education, a **framework on the use of ICT means and eLearning content in different subjects** should be in place. The framework should set the basis for themes and subjects that eLearning content needs to supplement. A positive trend here can be seen in the existing programmes from the *Tiger Leap Foundation*. Yet, the crucial **involvement of the representatives of the *Ministry of Education and Research*** is missing.

- Another important aspect is that **competition** should be created on the needed digital learning materials. Some steps toward this have already been made. To date, too much attention is given to the producer and not to the user: the state has financed the development of digital learning materials for which project applications have been made and not for those that are actually needed.

Vocational education

- For vocational education, more emphasis should be made on **practical skills** in teaching ICT. This means training IT specialists who could orient in real life and are able to solve software problems in accordance with real, and not only to IT, world. Here, **involvement of schools in private sector projects** would be of utmost importance. The private sector would not only provide stipends, but provide relevant expert knowledge as well.

- In developing digital learning materials, **cooperation between vocational schools** should be supported by **the state.** This is specifically important because it is too expensive to develop eLearning content with high quality separately in every vocational school. This kind of approach has already been taken in the framework of the *Estonian E-VocationalSchool*.

- The development of eLearning content should also **include the private sector and its interest**, especially to provide relevant web-based courses and content for professional and workplace training.

Higher education

- It has been claimed that since eLearning is very much resource demanding it will, with high probability, remain in the area of the real enthusiasts or in one or two universities (especially if one talks about eLearning in distance education). Thus, a possibility is to support only **a couple of universities in Estonia that are making their name based on web-based learning**.

- However, a more realistic programme is that *Estonian E-university* should **further facilitate the cooperation between Estonian universities**. But the question is how much it has done so far, especially in the case in which future decisions are rather made internally in *E-university* than born out of negotiations between member universities. Therefore, there should be concrete **state-financed programme to facilitate cooperation between Estonian universities in developing web-based courses/curriculum and joint-degree programmes**. Unfortunately, the existing organisational system has not supported this idea, and the reliance of projects on EU's structural funds has mainly resulted in single web-based courses. In addition, the project-based approach does not support long-term planning.

    - In order to assure the quality of higher education, the cooperation between universities should be facilitated through working out the **web-based joint-degree programmes**, especially in areas like business administration and public administration, **which are very popular among students** and which are offered in many different public and private universities.

    - Further, **English web-based courses and curriculum should be developed**. Since Estonian courses are not very commercial it is possible to make money with English courses (while allowing international participants). English web-based courses/curriculum could also be used for creating first impression of Estonian higher education and for enhancing income from foreign students to the country. The target market here should not only be the old European countries, but even more the East and Central European countries as well. The cooperation between different local universities would certainly give better results.

- Further internetisation should be supported in order to **do cooperation with foreign universities** and to be involved in different projects (e.g., in Erasmus-Mundus projects creating cooperation in web-based joint-degree programmes).

- Broader cooperation should also be facilitated **within different universities**.

    - **Web-based learning** should be first developed **in the framework of some general courses compulsory to very large number of students**. This means the assurance of quality and efficiency. There is also no need to pay for the same course for different professors in different faculties in the same university. However, it should be noted that web-based courses contain a lot of online tutoring and the teachers' workload in the framework of the course does not disappear completely.

    - eLearning should provide **wider opportunities for students** – i.e., if a student misses a lecture, s/he has the opportunity to follow the lecture using other means (e.g., audio or visual recording of the lectures).

- In higher education, there should be **support for web-based learning** not only in formal education as in the current case, but more so **in distance training**. Furthermore, in the latter case the trend should be towards developing web-based curriculum to enhance learning besides working and in rural areas.
- There should be some kind of **organisation in place to organise the provision of web-based courses**, especially given an international target group. This mainly means that someone would organise a decent group of students for every web-based course and assure the availability of a professor for the course to give feedback to students.

<u>Workplace training</u>

- Since eLearning applications in enterprises are currently seen mainly as a mean to deliver learning materials, with little recognition on the **importance of collaboration and interaction through the web**, extra attention must be drawn on this aspect. As a starting point, the design of LMSs can be undertaken, in which the importance of forums should not be underestimated.

<u>Lifelong learning and informal learning</u>

- In order to enhance developments in lifelong learning and informal learning, the eLearning content and services must be attractive enough and at reasonable costs.
- There is need for provision of **free digital services** (e.g., through *Citizen Portal)* to every person in Estonia. For example,
    - ePortfolio hosting service with *EuroPass*, blog and competency management tool; and
    - online competency testing and accreditation services (starting from *ECDL* and digital literacy, Estonian language, foreign languages, etc.).
- In the framework of lifelong learning, the emphasis should be given on **single courses**. There should also be a **common repository for available web-based courses and materials** provided by the public and private sectors in Estonia as well in the EU. However, neither is there demand nor supply at this time, and hence the scope of the courses is limited. In the case of content, **cooperation between educational institutions** (especially universities and vocational educational institutions) and **private sector** should be facilitated.
- In addition, there is a need **for training in ICT skills** particularly because ICT skills are below average. For example, one aim is to find out solutions how to continue the ***Look@World project* in adult training** to provide basic ICT skills. The ICT skills training are very important also for **trainers active in adult education**.
- Computer usage experience is generally in positive relation to eLearning usage. Since computer usage skills mainly come from using computers at home, rather than in schools, it is questionable whether the existing system could enhance eLearning among risk target groups with their worse than the average financial situation.
    - **eLearning may save students at general educational level from dropping-out or repeating the class** – unstable and secure students prefer computer to build personal learning conditions and interest towards learning. This means, firstly, that computers should be accessible to students after classes. And secondly, since concrete eLearning solutions for problematic students are too expensive to develop at the school level, it is at this is area and level where the *Tiger Leap Foundation* should take the responsibility and contribute to the creation of these special learning materials.
    - In the case of **unemployed people,** the main problems are deeper – i.e., psychological and

motivational. It is also questionable whether they have opportunities to use computers and Internet. If the problem comes from changing the job, then it is more difficult to provide courses to retrain people only online because it needs very specific content and it is currently believed that not all themes and subjects can be taught through the Internet (e.g., accounting) (see Chapter II.5.2).

- At present, educational opportunities for persons with disability to enter higher education are limited. Hence, policy makers must create mechanisms to mitigate this problem, if not solve it entirely through ICT-based learning.

IV.2.5 Policy measures on learning methodology

General, vocational and higher education

In the case of teachers, it is said that the bigger problem is related more to the lack of methodology than to the ability to use ICT.

- First, the Foundation responsible for eLearning along with the *Ministry of Education and Research* **should put more strength on promoting different learning methodologies, which are available among teachers** and then bring out systematically what eLearning is about. This is important not only in using ICT in general in more active ways, but also in the exploration of new teaching approaches needed.
- At the same time, the *Ministry of Education and Research* should put more strength on working out and continuously updating learning methodologies in line with current economic development, especially ICT developments.
- In addition to training as discussed above, a very important aspect is the development of **support system for teachers**, which would give direct guidelines on how to incorporate ICT into the subject and on how to concretely design web-based learning. The support for teachers should remain and be developed further. After all, teacher education cannot cover all the specific knowledge in ICT. A teacher is still the specialist in her own area. In particular, this means the need for assistants who are competent in technical as well as pedagogical matters and who are expected to give insights on how to implement the ideas of teachers through ICT tools.
- Emphasis should also be given on the **educational specific knowledge**.
- There is need for **training education technologists** at the level of formal education.
  - And there is also a need for **special MSc and PhD programmes**, which would concentrate specifically on **eLearning matters** – design, provision, consultancy or technology.

Workplace training

- Designing web-based learning approach (including creation of digital learning materials) is also a problem in the private sector. Currently, there are no trainings provided in the area (as has been shown above), and the *Estonian E-university* is claimed to be much centred on higher and vocational education levels. There is a real need for **practical advice for the private sector** in the area of eLearning.
  - Therefore, mechanisms have to be developed on how private sector could benefit from *Estonian E-university* and *Estonian E-VocationalSchool services*.
  - Private sector consultants should be trained in cooperation with the public sector (e.g., Foundations) in, for instance, special in-service training courses.
  - The role of the state here could be to facilitate a programme that focuses on how to benefit from ICT means. In doing so, the state supports the cooperation between enterprises and hence their initiatives to search the solutions together.

- Further, ICT education and specialists' education should be promoted. This means increasing the number of places financed by the state as well as the quality of education in order to promote education in different target areas and groups. The practice should be organised in ways that take into account the system in private sector (e.g., their need for IT specialists or practitioners during summer).

Lifelong learning and informal learning

- Teaching technologies and concrete methodology for adult education should be worked out.

Summary of Chapter IV

eLearning must not be considered merely as a self-study and distance learning, or as goal by itself; but as a mean to exploit the windows of opportunities the ICT paradigm offers. This means that the state should support the education sector to take full advantage of ICT tools, and thereby supporting innovation in education and the building up of the knowledge-based society and the IS. However, in the area of eLearning, serious threats should also be taken into account. For example, if life is too much ICT-centred the trends in some areas (such as E&T) may rather be the opposite.

In general, all these proposed policy options above require the existence of an overall political consensus on the role of eLearning in education.

A very important aspect in working out the framework for eLearning development in Estonia is that there is not one solution available for different problems (i.e., in developing policy options distinctions must be done between different educational levels, including lifelong learning and workplace training). In addition, it should be taken into account that eLearning without any face-to-face meetings is, and will be, a small niche service, a poor substitute to on-campus courses (Laanpere, 2006b).

V: MAJOR R&D CHALLENGES FOR E-LEARNING

The purpose of this final chapter is to identify the most important technical and non-technical R&D challenges in the future specific to eLearning so as to address the local and global needs identified in Chapter III. In doing so, the chapter also assesses particular areas for policy action, institutional change, human skills reforms, education development, and finance that could immensely contribute to the resolution of the challenges facing the development of eLearning in Estonia at this time and in the future. These factors will be used to prepare the Synthesis Report to find out the major common trends characteristic of the NMSs.

V.1 Studies needed in support of eLearning development

First, on the basis of the 'Policy Paper' of the *European ODL Liaison Committee* in the 2004 *Distance Learning and eLearning in European Policy and Practice: The Vision and the Reality*, the question arises: how much and in what way eLearning developments have been driven by different policies and strategies? According to the paper, national developments in most EU countries in the area of eLearning were not very substantial up to the year 2000 and that nevertheless strong policy initiatives. More than four years later the situation appeared very differently – although eLearning was down in policy discourse, it was up in practice – the eLearning market was showing a growth rate of 30% per year (European ODL Liaison Committee, 2004).

The situation in Estonia seems to follow the same path as described above, yet with the distinction that the development of eLearning in the country has only reached the stagnation phase characterised by disappointment in policies and hence with low growth. This is especially expressed in the adoption of the *E-memorandum* in Estonia in September 2006, which is directed to the students and teachers (not to policy makers). According to the developments in other EU countries, the question that arises is: **why policy initiatives have not supported enough the developments in the area of eLearning; and on the contrary, what have been those measures which have supported the area in a positive way**?

These questions are also important for Estonia, especially when the current fragmented organisational as well as fragmented strategies developed in support of eLearning are taken into account. However, **it is yet to be proved that this kind of organisational set-up and strategies actually prohibit the success of the area**. Further, as in the Estonian case the strategies in the field have been too much influenced by the changing political ideas, and hence not conducive for setting long-term goals and do not guarantee a stable financial system. A related question then is: '**How much does the availability of financial resources matter in the area**'?

However, ICT-supported learning should not be an objective in itself, but should be recognized as **indispensable in bringing about socio-economic changes**. This, in turn, sets out the question: **how and in what ways can the ICT be best exploited** in economic and non-economic spheres? Further, which **institution should take the responsibility of developing eLearning in Estonia** that would guarantee an integrated vision for developing digital competences in the education sector as well as in the society at large?

The other aspect here is how much and in what ways **EU strategies, policies and programmes have influenced eLearning developments in member states**. In Estonia, analyses of these respective areas of enquiry are still missing. This issue is both crucial and essential for Estonia because developments, especially on higher and vocational education levels, have largely been dependent on the availability of EU's structural funds.

V.2 R&D challenges set by ICT and by the knowledge society

1. Educational challenges and changes in learning approaches

ICT-supported educational change sets further future challenges for policy makers, educators, researchers, technology developers and teachers on how to prepare learners to engage in innovation and knowledge creation, activities which are becoming commonplace and most important sources of new material and intellectual wealth. Firstly, **the challenge is to explore and support the usage of new learning approaches, which are in line with current ICT developments**, and consider deeply the mechanisms that actually support the quality of education. In terms of the educational practices, a challenge for the knowledge society is that students, teachers, professionals, designers, and researchers take part not only in knowledge acquisition or social participation processes, but also in **knowledge creation focusing on shared objects of activity – the so-called 'social constructivist eLearning'** (Hakkarainen et al., 2006). More importantly, these are questions about the most effective and mostly used teaching technologies and methodology. If solutions to these questions had been tried and tested, they might usher in best practice principles that can be useful at the EU level, and to the development of respective knowledge-based societies and innovation systems.

At the local and global levels, the challenge for eLearning in terms of **social software** (**community based learning** – blogs, Wikis, etc.), rather than merely developing LMSs and repositories, must be addressed in order to engage learners in innovation and knowledge creation. However, since this is more likely a challenge for teachers on how to use the available tools, this requires further incentives for future teacher training programmes. This question is especially important for Estonia because the emphasis given on web-based interaction and collaboration has always been limited. The greatest challenge here is working out ways to address this shortcoming in the private sector, where this issue is a critical concern.

Another important challenge is to legalise the **accreditation of prior learning experience**. The idea is even more realistic since some systems and standards for this kind of new learner information packages have already been implemented (see, for example, *IMS Lip Editor* which was carried on by *IMS Global Learning Consortium, Inc*.). This question, together with the overall ICT competence issue, is especially important for Estonia to seriously consider the form and the formal level standards that could actually support new learning approaches and developments in lifelong learning the most.

Other important questions that need to be considered in employing new learning approaches are as follows:

- Firstly, in order to take most of the ICT-supported education it requires **surveys to be available to assess ICT skills** of students and teachers at all educational levels, including trainers and people not involved in formal education – lifelong learning, workplace learning, etc. In the latter case, another question then arises: how much can lifelong learning and informal learning benefit from the new approaches given the dependency on the values appreciated at the formal education level (meaning, also the capability to adopt the value of lifelong learning itself)?

- Secondly, it requires assessment of the **availability of ICT infrastructure** to enable re-orientation of education. In addition, before working out and supporting the usage of new learning approaches, a research needs to be implemented to assess whether the **possibilities to use eLearning are the same in terms of different subjects,** and if not, how they differ.

- Whether the new approach for learning **will change the role of school** (i.e., towards treating educational institutions more as the providers of services) is a related question, which may arise. In addition, the question as to 'what would be the effect of transforming schools into service providers and marketing organisations on education as a whole' needs further investigation. Interestingly, the negative effects of this trend of transforming schools into marketing organisations, a trend, which is already strongly present in Estonian schools, have been clearly demonstrated in some educational research in Estonia (Laanpere, 2006b).

2. **Technological developments and challenges posed by their application**

- One of the challenges in the area of eLearning is the **need to create interoperability** of eLearning systems and tools. Today, LMSs in Estonian educational and training institutions are not interoperable with study information systems or with content repositories and EEIS. As the selection of those eLearning systems, which are used by different educational institutions of the same level, especially in higher education, varies greatly, the challenge for interoperability is even greater.

- In general, one of the challenges is the need to develop horizontal applications (i.e., the need for measures supporting cooperation, especially at the ministerial level). To date, there is lack of a united view in providing services for citizens; and every entity tries to solve the problems in a self-indulgent way – i.e., IT solutions are entity centred and are oriented toward solving very specific problems. **The challenge here should be on more user-friendly and citizen-oriented services**. The other problem is that to date the new solutions developed have been based on solving complaints. This means that at the state level there is a great challenge to develop **a system to guarantee the systematic development and provision of IT-based services**.
- In order to overcome the technological challenges, cooperation between public and private sector in the field of R&D is very important. However, the role of the private sector has so far been limited to financing certain projects. A **scheme that would support synergy between these two sectors needs to be worked out**. This can be considered as a wider challenge and hence prevailing at the global level.

3. **Financing issues and challenges (business models) concerning the funding of eLearning**

- What business models should be used for producing eLearning content? Firstly, the solutions best for commercialising **the produce of digital learning materials** need to be explored. Secondly, both the public and private sectors must work together in implementing eLearning applications, notwithstanding which sector initiated a particular application, so that they could do business and enlarge their market in a way that is acceptable to users. For example, a practical question would be a financial system for sending SMS for exam results. This problem is manifested in the current situation where the private sector resists to finance open source LMSs, CMSs, etc.

- One of the greatest challenges related to digital learning materials is the resistance among **book and textbook publishers** due to the threat of losing their current market despite the *Ministry of Education and Research's* strong support to them. A solution to this problem would not only rely on changing the current orientation of publishers from traditional learning materials towards more innovative ones – not to mention, that such a change in orientation may not guarantee profitability for publishers. The challenge is **to study how this could be made profitable in Estonia**. Secondly, the emphasis should be on **how to re-use existing learning materials and what should be the necessary schemes and mechanisms to support it**.

- In addition, there is a need to establish a system, which would enhance the developments related to e-books. More broadly, this is a question of **how to support the web-based business** in the area so vulnerable in the terms of making profits (parallels can be drawn here with the audio area). In other words, this is a question of how to protect the content provided against piracy and at the same time guarantee the management of authorships rights.

- How can **exchange of web-based courses between different schools and participation in web-based courses provided by other schools at general and upper secondary education levels –** taking into account that the financial scheme for these levels is based on **capitation fee –** be supported? Broadly speaking, this is a question about how to legitimise and finance the eLearning networks.

- eLearning should support mobility of students **to take courses nationally from other universities and in foreign universities**. However, the required financial scheme for this needs to be figured out.

4. IPR issues in the area of eLearning

- In the case of eLearning, much more emphasis must be given to the issue of authorship rights related to digital learning materials including flexibility of these rights in order to allow other persons to use the materials and at the same time to recognise and complement them (e.g., ***Creative Common Licence***). Firstly, this means that when the state buys a digital learning material it should be made public – i.e., available to everyone freely and open for making ads. However, this approach is not yet adopted by the Estonian society. Secondly, the state must guarantee the usage of *Creative Common Licence*, even in the context in which a private company produces a particular digital learning material.
- The other challenge for the state, but also for the larger EU level, is the technical support required to guarantee **authorship rights for digital content and software** – meaning, measures to be worked out and be in effect to fight piracy (digital rights management).

5. Security aspects of eLearning applications

- Security problems seem to be the biggest challenge in the private sector. Although they have developed their own LMSs, there is still very much paper-based training. This is mainly a result of the restriction of **access to LMS and to the databases from home**. What is mainly feared is technical safety (i.e., viruses); yet, this is above all a question about data security of the companies – fear of the volatility of inner databases, data about clients, etc.

Summary of Chapter V

Two main R&D challenges for eLearning in Estonia can be identified. Firstly, there is a need to implement mechanisms that will positively support its development. These are measures and institutions that concern organisational set-up, policies and strategies, and financial support for the area. And secondly, the question on how to support the usage of new learning approaches in line with current ICT developments in formal education and in lifelong learning needs to be addressed. These issues include technological developments and the challenges posed by their application, financing schemes required in the use of eLearning, and solutions for current IPR and security problems.

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List of interviewees

Interview with Anton, J. Adviser of Information Technology, *Ministry of Education and Research*, on the 19th of September 2006.

Interview with Aru, H. Adviser of Education and Labour Market, *Ministry of Education and* Research, on the 18th of September 2006.

Interview with Kusmin, M. Educational Technologist, *Tallinn University of Technology*, on the 15th of September 2006.

Interview with Kuusemets, V. Head of Training, *Hansabank,* on the 25th of September 2006.

Interview with Laanpere, M. Head of the Center for Educational Technology, *Tallinn University*, on the 19th of September 2006

Interview with Mägi, E. Head of the *Tiger Leap Foundation*, on the 5th of September 2006.

Interview with Rits, K. Head of Information Society Division, *State Information Systems Department (RISO)*, on the 15th of September 2006.

Interview with Palm, J. Member of the Board, Education and Social Affairs, *Student Council of the Tallinn University of Technology*, on the 9th of October 2006.

Interview with Püüa, M. Head of the *State Information Systems Department (RISO)*, on the 15th of September, 2006.

Interview with Tammeoru, E. Head of the *Estonian E-university*, on the 8th of September 2006.

Interview with Tammiste, T. Director of IT, *EMT AS*, on the 19th September 2006.

Interview with Targama, K. Head of the European Structural Funds Unit, *INNOVE*, on the 21st of September 2006.

Interview with Toots, A. Associate Professor in the Department of Government, *Tallinn University*, on the 18th of September 2006.

Interview with Tüür, M. Member of the *Federation of Estonian Student Unions*, on the 30th October 2006.

Interview with Väli, I. Educational Technologist, *IT College*, on the 7th of September 2006.

Interview with Väravas, M. Developer of IT systems, *Hansabank*, on the 25th of September 2006.

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EUR 23367 EN/4 – Joint Research Centre – Institute for Prospective Technological Studies
Title: The Development of eServices in an Enlarged EU: eLearning in Estonia
Authors: Margit Suurna and Rainer Kattel
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Abstract

In 2005, IPTS launched a project which aimed to assess the developments in eGoverment, eHealth and eLearning in the 10 New Member States at national, and at cross-country level. At that time, the 10 New Member States were Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovenia and Slovakia. A report for each country was produced, describing its educational system and the role played by eLearning within both the formal education system and other aspects of lifelong learning. Each report then analyzes, on the basis of desk research and expert interviews, the major achievements, shortcomings, drivers and barriers in the development of eLearning in one of the countries in question. This analysis provides the basis for the identification and discussion of national policy options to address the major challenges and to suggest R&D issues relevant to the needs of each country – in this case, Estonia.

In addition to national monographs, the project has delivered a synthesis report, which offers an integrated view of the developments of eLearning in the New Member States. Furthermore, a prospective report looking across and beyond the development of the eGoverment, eHealth and eLearning areas has been developed to summarize policy challenges and options for the development of eServices and the Information Society towards the goals of Lisbon and i2010.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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3. Education

2005 – 2007	Tallinn University of Technology, Faculty of Humanities, *Master of Arts in Social Sciences (Technology Governance) (cum laude)*
2000 – 2004	Tallinn University of Technology, Faculty of Humanities, *Bachelor of Arts in Social Sciences (cum laude)* (equivalent to a Bologna Master's Degree)

4. Language skills

Estonian	native language
English	average
Russian	basic skills
German	basic skills

5. Special courses

Summer 2010	Intensive Summer Course on Security in Small States, University of Iceland, Centre on Small State Studies, Iceland, 21 June – 3 July
Summer 2008	Globelics Academy Ph.D.-School on National Systems of Innovation and

	Economic Development, University of Tampere, Finland, 2 – 13 June
Summer 2007	The First Graz Schumpeter Summer School on Evolutionary Economics 25 Years After the Seminal Contribution of Nelson and Winter: Problems and Perspectives, University of Graz, Austria, 15 – 22 July
Spring Term 2007	KTH Royal Institute of Technology, Sweden, participation in the courses of the Master's Programme in Industrial Economics and Management (Erasmus Exchange Student)

6. Professional employment

2008 –	Tallinn University of Technology, Faculty of Social Sciences, Department of Public Administration, Chair of Innovation Policy and Technology Governance, Research Fellow
2007 – 2008	Tallinn University of Technology, Faculty of Social Sciences, Department of Public Administration, Chair of Innovation Policy and Technology Governance, Extraordinary Research Fellow
2004 – 2007	Tallinn University of Technology, Faculty of Humanities, Institute of Humanities and Social Sciences, Specialist/Assistant

7. Scientific projects (participation as a researcher)

2009 – 2010	Business Models of Intellectual Property Based Firms. Open Innovation Based Business Models and their Applicability in Estonia

2009	Estonian Biotech Programme: Feasibility Study for an Estonian Biotechnology Programme
2007	Cluster Development in the Baltic Metropolises
2006 – 2007	Next Steps in Developing Information Society Services in the New Member States: The case of eLearning

8. Defended theses

Thesis: "The Impact of the European Union Accession on the Role of the Riigikogu in the Decision-Making Process" *(Bachelor of Arts in Social Sciences)*

Thesis: "The Influence of Quangos on National Innovation Systems – Case Studies of the Estonian Genome Project and the e-Learning Initiatives" *(Master of Arts in Social Sciences)*

9. Honours and awards

2004	Special award of the State Chancellery of the Republic of Estonia for the graduation work "The Impact of the European Union Accession on the Role of the Riigikogu in the Decision-Making Process"

10. Main areas of scientific work

Innovation policy, (national) systems of innovation, information and communication technology (in particular the respective educational matters) and biotechnology (all with an emphasis on the EU's New Member States)

11. Publications

Suurna, Margit. 2011. "The Developments in the Business Models of Biotechnology in the Central and Eastern European Countries: The Example of Estonia." *Journal of Commercial Biotechnology* 17 (1), 84-108.

Kattel, Rainer, Erik S. Reinert and Margit Suurna. 2011. "Industrial Restructuring and Innovation Policy in Central and Eastern Europe since 1990." In Mario Cimoli, Giovanni Dosi, Annalisa Primi (eds). *Learning, Knowledge and Innovation Policy: Policy Challenges for the 21st Century*. Oxford: Oxford University Press, xxx-xxx [forthcoming].

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Kattel, Rainer and Margit Suurna. 2008. "The Rise and Fall of the Estonian Genome Project." *Studies in Ethics, Law and Technology* 2 (2), Article 4, 1-22.

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Kattel, Rainer, Tarmo Kalvet, Erkki Karo and Margit Suurna. 2007. *The Current State of Clusters in Estonia and the Possible Role for Local Government Initiatives: the Cases of ICT, Electronics, Health Care and Biotechnology in Tallinn*. Report for Baltic Metropoles: BaltMet Inno, Tallinn University of Technology.

Lember, Veiko, Tarmo Kalvet, Rainer Kattel, Caetano Penna and Margit Suurna. 2007. *Public Procurement for Innovation in Baltic Metropolises*. Report for Baltic Metropoles: BaltMet Inno, Tallinn University of Technology.

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3. Hariduskäik

2005 – 2007	Tallinna Tehnikaülikool, Humanitaarteaduskond, *sotsiaalteaduse magistrikraad (tehnoloogia juhtimine) (cum laude)*
2000 – 2004	Tallinna Tehnikaülikool, Humanitaarteaduskond, *sotsiaalteaduste bakalaureuse kraad* (*cum laude)*

4. Keelteoskus

eesti keel	emakeel
inglise keel	kesktase
vene keel	algtase
saksa keel	algtase

5. Muu hariduskäik

suvi 2010	Suvekool teemal "Väikeriikide julgeolek", Islandi Ülikool, väikeriikide keskus, Island, 21. juuni – 3. juuli
suvi 2008	Doktorikool teemal "Rahvuslikud innovatsioonisüsteemid ja majandusareng", *Globelics Academy*, Tampere Ülikool, Soome, 2. – 13. juuni

suvi 2007	Esimene Schumpeteri-nimeline suvekool Graz´s teemal "Evolutsiooniline majandusteooria 25 aastat pärast Nelsoni ja Winteri põhjapanevat valdkondlikku panust: probleemid ja tuleviku perspektiivid", Grazi Ülikool, Austria, 15. – 22. juuli
kevadsemester 2007	*KTH Royal Institute of Technology*, Rootsi, osalemine magistriõppe programmis *Master's Program in Industrial Economics and Management* (Erasmus vahetusüliõpilane)

6. Teenistuskäik

2008 –	Tallinna Tehnikaülikool, Sotsiaalteaduskond, Avaliku halduse instituut, Innovatsioonipoliitika ja tehnoloogia valitsemise õppetool, teadur
2007 – 2008	Tallinna Tehnikaülikool, Sotsiaalteaduskond, Avaliku halduse instituut, Innovatsioonipoliitika ja tehnoloogia valitsemise õppetool, erakorraline teadur
2004 – 2007	Tallinna Tehnikaülikool, Humanitaarteaduskond, Humanitaar- ja sotsiaalteaduste instituut, spetsialist/assistent

7. Teadustegevus (osalemine teadusprojektides)

2009 – 2010	Innovaatiliste ettevõtete intellektuaalomandil põhinevad ärimudelid. Avatud innovatsioonil põhinevad ärimudelid ja nende rakendusvõimalused Eestis
2009	Eesti Biotehnoloogia programmi eeluuring

2007	Klastriarendus Balti mere regiooni suurlinnades
2006 – 2007	Infoühiskonna teenuste arendamine uutes liikmesriikides e-õppe valdkonna näitel

8. Kaitstud lõputööd

"Euroopa Liiduga liitumise mõju Eesti Vabariigi Riigikogu rollile otsustusprotsessis" *(sotsiaalteaduste bakalaureuse kraad)*

"The Influence of Quangos on National Innovation Systems – Case Studies of the Estonian Genome Project and the e-Learning Initiatives" *(sotsiaalteaduse magistrikraad)*

9. Tunnustused

2004	Eripreemia Riigikantselei poolt väljakuulutatud avaliku halduse alaste üliõpilastööde konkursil bakalaureusetöö eest "Euroopa Liiduga liitumise mõju Eesti Vabariigi Riigikogu rollile otsustusprotsessis"

10. Teadustöö põhisuunad

Innovatsioonipoliitika; (rahvuslikud) innovatsioonisüsteemid; informatsiooni- ja kommunikatsioonitehnoloogia (eelkõige hariduses); biotehnoloogia (kõik rõhuasetusega Euroopa Liidu uutele liikmesriikidele)

11. Publikatsioonid

Suurna, Margit. 2011. "The Developments in the Business Models of Biotechnology in the Central and Eastern European Countries: The Example of Estonia." *Journal of Commercial Biotechnology* 17 (1), 84-108.

Kattel, Rainer, Erik S. Reinert and Margit Suurna. 2011. "Industrial Restructuring and Innovation Policy in Central and Eastern Europe since 1990." In Mario Cimoli, Giovanni Dosi, Annalisa Primi (eds). *Learning, Knowledge and Innovation Policy: Policy Challenges for the 21st Century.* Oxford: Oxford University Press, xxx-xxx [forthcoming].

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