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INFORMATION AND COMMUNICATIONS TECHNOLOGY FACTORS FOR ADOPTION AND USEAGE DETERMINANTS IN LATVIAN COMPANIES

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INTRODUCTION

Understanding the interplay between innovation, technology and productivity growth is the foundation for projecting the future economic growth rate of a company, country, a region, or the world

(Gordon, 2004)

Over the last two decades, much of the developed world has been transformed by **Information and Communication Technologies (ICTs)**. For this dissertation, ICT is defined broadly to include hardware, software and network applications that are used to create, manage and disseminate the information needed to coordinate, monitor and evaluate the activities (internally and externally) of a firm. This definition is consistent with that used by the ICT International Benchmarking Study [65]. These technologies have made significant productivity gains possible [75;111] by enabling great changes in how processes are carried out, for example by reducing labour costs, by increasing proximity to customers and by standardizing products and brands [127]. This phenomenon however, has been most reported and researched in the large organizations of developed countries [19;152]. If the benefits available from ICT adoption are opportunities for productivity and effectiveness gains that are largely based on economies of scale benefits, these benefits would be much less observable in companies in developing economies, and accompanied by less evidence of real productivity gains [100;170;171;196]. This dissertation will investigate the factors leading to ICT adoption in firms in a developing economy and, using Latvia as an example, try to identify how those factors could be managed to increase adoption of ICT.

EU leaders have advocated for considerable investment in the use of ICT and created Community wide plans to facilitate introduction of ICT and ICT tools. The investments and plans have been meant to ensure the competitiveness of companies in the expanded EU, by assisting firms and individuals to acquire new skills and create robust and sustainable business models. These measures have especially targeted firms in new accession countries and less developed areas. Despite the ambitions of EU plans and planning, the possibility of achieving step gains, so called “leapfrogging”, or even basic productivity gains remains largely a debatable practical question. In Ireland, despite attracting companies with a high sophistication of ICT use, the general use of new ICTs failed to diffuse to local companies. Because diffusion is the result of firm independent adoption decisions (the focus of this dissertation), diffusion can be affected or influenced by affecting or influencing adoption decisions. This shows the importance/utility of viewing ICT diffusion in a full context, considering firms of all sizes and type [5].

The thesis will seek to identify patterns of adoption of ICTs based on the expected benefits and obstacles [91] for companies in a developing economy, and consider the significance and relevance of the factors more associated with smaller companies in emerging economies such as Latvia. The literature about ICT Diffusion was summarized by Forman and Goldfarb [64] and included description of the major areas of research about ICT adoption decisions. The current dissertation fits within a broad category of research of ICT adoption and organisation characteristics. This means that this dissertation does not address such things as firm size and industry specific characteristics and how they impact adoption decisions. This analysis stresses the importance of companies' management capacity to absorb and apply technological knowledge, while taking into consideration company size and innovation opportunities.

The diffusion of ICT is an important context for this thesis. Rogers defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system." [175, 5]. Adoption is the individual-level decision to use a new technology. Diffusion is the aggregation of a number of adoption decisions. Diffusion research is then concerned with finding patterns across a large number of adoption decisions within a company or group of companies or sectors of business. While diffusion is an important research area for studying what and how innovation is spread, this research is primarily concerned with the factors used in the individual decision – adoption. While there is real overlap between these two terms, it is important to emphasize that they are different concepts. The theoretical concepts involved in diffusion of innovation are treated more deeply in Chapter 3.

Information and communications technology (ICT) is a convenient term for a rapidly expanding range of equipment, applications services and basic technologies that process information. The elements of ICT fall into three principle categories: computers, telecommunications and multimedia data that form the technological basis for conducting all kinds of processes between humans and machines [107].

Because of its potential to become a widespread tool, potentially enabling companies in less developed countries to close the productivity gap with more developed countries, ICT diffusion has been amply studied since the 1990's. It has been studied from many points of view, including: as firm level decisions driving adoption, country development policies, capital expenditure and infrastructure build-up, technological leapfrogging[1], manufacturing impacts, utilization impacts, enablement of process transformation, and others reviewed below.

An extensive analysis of ICTs as a general purpose technology (GPT) has compared it to electricity as a fundamental enabling technology, based on its pervasiveness (spread to most sectors), technology improvement lowers the costs of its use and innovation spawning (make it easier to invent and produce new products or processes) [22;101]. It is yet unclear whether ICTs in countries like Latvia have met the theoretical criteria needed to consider them GPTs.

From the point of view of economic impact, empirical investigations have, by and large, used firm-level and sector-level data on the diffusion of a single technology in a single country [62]. These investigations provide solid evidence on the explicative power for firm level adoption of ICTs.

The evidence on the impact of market structure on adoption and diffusion is, on the other hand, inconclusive [18]. Some recent studies in the European Union have concluded that in the majority of cases, ICTs' application to process efficiency improvements in companies have shown a negative relationship to productivity improvement and employment. Applications aimed at creating new markets and growth on the contrary, show a positive effect

The main summary of diffusion research in fields other than economics is Rogers (1995) which compares the importance of information transmission in epidemic models of diffusion. Emphasizing communications and sociology, Rogers focuses on the role of communications networks in technology diffusion from the perspective of the firm (independent adoption decision). This limits the consideration of adoption to that of the perspective of the firm's corporate culture[2] and structure.

In summary, extensive ICT diffusion research has largely focused on firm and sector-level adoption studies given the importance it has as a General Purpose Technology. The

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[1] "Technology leapfrogging is a term used to describe the bypassing of technological stages that others (other countries) have gone through." ict regulation toolkit; http://www.ictregulationtoolkit.org/en/Section.1829.html. Accessed 09.12.2009.

[2] Desphandé and Webster, 1989, reviewed several studies and defined organizational (or corporate) culture as "the pattern of shared values and beliefs that help individuals understand organizational functioning and thus provide them with the norms for behavior in the organization." Corporate culture is an important predictor of organizational capabilities and outcomes such as customer orientation (Desphandé et al. 1993) and new product development (Moorman, 1995). Schneider and Rentsch, 1988, describe culture as "why things happen the way they do," and organizational climate as "what happens around here." Cultures can be determined by the values, assumptions and interpretations of organization members (Hales, 1998).

analysis treats ICTs as a peculiar technology which might be easier to apply than others, yet the understanding of the empirical difficulties is limited by the variety of data involved when looking at short experience time spans available for study (last 10-15 years). In many accounts, thus, ICTs can be more readily seen as a regular GPT and require considerably more study of the applications to which they might be put, in order to assess its adoption rate and likely impact on productivity and growth. Especially for small companies in developing countries, the significance of innovation and growth opportunities merits further inquiry, while the case for investing in ICTs to reduce costs and improve productivity in large companies offers few or no differences to those in developed economies. Chapter 2 of this work considers the theoretical context of the impact of innovation on firm productivity and effectiveness more deeply.

The proposed model of ICT adoption decision making will have two components: an objective component (largely from an economic understanding) and a managerial component (from firm level factors). All of the factors in both models will be considered at firm level and should be understood as perceived, as the data and results that create the drivers are perceptions that will come from survey respondents. The objective component will be developed from the surveyed literature and will be divided into factors related to perceived benefits and perceived costs of adoption and use. The managerial component will add factors that are firm specific; the perception of the capacity of the firm to absorb new technology, the perception of market level of competition, the perceived innovativeness of the firm and the perception of the environment around the firm. Separately, neither component provides an adequate explanation for ICT adoption decisions, but when joined, they do.

By showing that ICT adoption supports management level improvements such as innovation and market entry, this would support an expectation that innovativeness and management capabilities should prove a significant driver in ICT diffusion in developing countries.

In Latvia, where jobs often had to be created from scratch in the post-Soviet period, and because ICTs immediate effect is to reduce employment, we expect to find a negative correlation to attitudes towards change. In this dissertation these critical variables are considered through the incorporation of variables that capture cultural attitudes, management practices and disposition toward innovation [175].

In the case of Latvia over 95% of businesses have fewer than 9 employees and can be expected to have a limited management capacity to absorb and manage ICT and related processes. This needs to be balanced against research observations [62] that adoption and intensity of use is sometimes negatively associated with size and vertical integration. Small firms may be seen to be seeking to reduce market associated transaction and external coordination costs by use of ICT. This dissertation expects to find fewer and more limited justifications for ICT implementation in smaller firms operating in LV and similar business environments.

The postulated model is estimated using several types of adoption measures as dependent variables (e.g. intensity of ICT adoption in general and uses of ICT applications) in order to discriminate robust relationships and to identify differences in the pattern of explanation for the various types of adoption variables. It is expected, for example, that the use of basic elements of ICT (with a broad range of applications, e.g. general personal computer technology and applications) is driven by somewhat different forces than the introduction of collaborative and supply-chain applications whose profitability potential is unknown in a pure innovation situation.

The two major parts of the overall model provide reinforcing information. The factors in the traditional model have been validated previously, and their inclusion provides evidence of the overall validity of the general (objective + managerial components) model. The factors in the managerial component will give information that is valuable both academically and to managers. The factors included in the managerial model are ones that are important in sharpening the ability to predict adoption and use of ICT and would help management by helping them know what factors that they could/might manipulate to increase the likelihood of adoption and use.

The objective component will consider a traditional economic approach of benefits and obstacles to adoption and use of ICT. The major benefits are input efficiency, cost reduction and sales increases. Cost and pre-existing technology are obstacles in the model. The objective component also considers the effects of industry and firm size.

The managerial component will look at the explanatory value of adding technology absorptive capacity (a Human Resource issue), market level competition, innovativeness and the environment. These factors are arguably ones that management can affect. These components are depicted in diagram 1.

The context and theoretical justification for the model are found in Chapter 2 of this work.

Each factor in both parts of the model will have **associated hypotheses** to be tested. In the benefits factor of the traditional model, the following are hypothesized to promote adoption if seen as being related to adoption and/or use of technology: increases in sales and market value, improved market share, improved competitiveness, increased market and brand recognition, reduced costs and efficiency and improved communications with suppliers and employees and increased focus on core and higher values. If associated with the adoption or use of technology, the following are hypothesized to negatively impact adoption or use decisions: implementation and maintenance time and costs seen as being too high, insufficient compatibility with existing ICT and work organization, employee lack of knowledge and objections and a perception of low reliability and unclear benefits.

The **managerial component will use and test hypotheses** for four categories of factors. Technology absorptive factors are hypothesized to negatively impact adoption and use of technology if: employees had a negative attitude toward change and learning, the firm had a negative attitude toward change and if management did not have sufficient capability or was unwilling to procure resources needed for adoption or use. The factor of market competitiveness will be considered using hypotheses, that if valid, would be positively related to adoption and use: if the results and environment were predictable, if the firm had a lower investment in ICT than competitors, if ICT investments were needed to compete in local markets and if EU entry has created perceptions of competition. Innovativeness will be related to a positive likelihood of ICT adoption or use through testing of hypotheses, that if: there were a high use of collaborative practices, a high fraction of sales from new products and a formal use of more sources of information on technology improvements. The affects of environment and cultural factors will be evaluated using hypotheses that, if valid, will be held to decrease likelihood to adopt or use ICT: if there is a preference for face-to-face contact, if there is a perception of a lack of clients using online processes and a few suppliers using online processes.

The methodology section of the dissertation is in two parts. The first regards the methodology used to collect the data used and the second the statistical analysis/validation techniques used.

The research **methodology** used was an in-depth business telephone survey of 500 active businesses in Latvia. The survey was conducted from March to April 2008. Questions were asked via telephone, in either/both Latvian and Russian, as the situation called for. A Computer Assisted Telephone Interviewing (CATI) package was used to conduct the telephone interviews. The highest manager with responsibility for ICT was asked to respond.

Calling it the Latvian Benchmarking Study 2008 [LBS 2008], the study is unique in that it not only examines basic ICT ownership measures, (which, given current ICT sophistication are not very revealing), but focuses on how businesses use online technologies to change the way they operate in a range of activities, particularly e-commerce. To the authors' knowledge, no such in-depth business survey has been performed in the Republic of Latvia.

The proposed model led to creation of testable hypotheses. These hypotheses were then tested through logistical regression techniques applied to variables defined as related to the hypotheses tested. The methodology used in survey and statistical validation are described in detail in chapter 3.

The subject of research is Latvian firms.

The object of the research is ICT adoption and use in Latvian firms.

The goal of the promotion work is to identify, analyze, and explain the factors that determine the adoption and use of information and communications technologies (ICT) in Latvian companies and make recommendations to management of companies and government policy makers for how these factors could be used to enhance the likelihood of the use of ICT to promote competitiveness.

To achieve this goal, the following **tasks** were carried out in the promotion work:

1) a comprehensive literature analysis was made of the relationship between ICT, innovation, productivity and competitiveness;
2) discussed and analyze firm-level innovation processes and the factors influencing these;
3) investigated the impact of ICT on productivity and economic growth at the national, industry-level and firm-levels;
4) Rogers' Diffusion of Innovations Theory and the Technology Organization and Environment (TOE) framework was critically assessed as to its applicability to ICT adoption and use at national level;
5) based on adoption theories, firm-specific factors in ICT adoption decisions were identified and summarized in a framework;
6) explored the relevance of so-called 'network effects' to ICT adoption'
7) an in-depth survey (Latvian Benchmarking Study 2008; further- Survey) was performed concentrating on the ways in which Latvian businesses use online technologies, the decision-making processes that Latvian businesses use to make ICT purchase and implementation decisions, technology awareness and deployment, the cultural environment in which the business operates, staff attitudes and skills regarding ICT, and perceived impact of ICT adoption and use.
8) from the analysis of the theoretical aspects of ICT adoption and diffusion, using Rogers and the Technology, Organization, Environment (TOE) framework, and the results of the Survey, a proposed model consisting of an objective

component and a new, managerial component, was developed identifying the factors for ICT adoption and use at the firm-level in Latvia.

Research constraints:

1) the research did not consider the effects of adoption and use of ICT on productivity;
2) this research was about ICT adoption generally. It did not focus on the ICT industry as such, but on the population of business as a whole;
3) the empirical model proved more accurate when used to predict low levels of adoption and use. This result was to be expected once it became clear that the majority of the sample were low users and adopters;
4) the research process itself is weakened by the mere fact that the number of companies employing ICTs to a high degree is so small, that in practice a very high proportion had to take part in the study;
5) the promotion work intentionally ignored the aspects related to the production of ICTs and the effects of the ICT sector in the economy. While this is not to be regarded as a limitation to the modeling approach, it is necessary to be aware of this fact, as frequently in the literature it is not clear what is meant by diffusion of ICTs and technology innovations. The point of view taken by this promotion work is that related to the efficiencies in-use that results from ICTs, and not from the invention of better ICTs or their production.

The theoretical and methodological basis is the relevant economic, technical, management literature, foreign published scientific works and studies, scientific conferences and seminar materials, Latvian legislation, Latvian and international standards, the Latvian Central Statistical Bureau and the European Statistical Office Eurostat data, OECD data, as well as that the data and methodological materials of other international organizations**.**

To successfully achieve the goal and fulfill the tasks set, the following **research methods** were used:

1) ***monographic method*** to collect information in order to identify factors that are associated with the acquisition and deployment of ICT in general and particular for small/ developing economies. This method allowed the research object to be studied in detail, based on scientific literature and research analysis;
2) ***model creation*** that reflected accepted factors and inclusion of new factors to be tested;

3) ***logical constructive*** method of formal logic, opinions and laws. Of the constructive logical methods, the author of the study used the deductive method, which allowed the separation of essential from non-essential aspects of the research object for further exploration;
4) the creation of ***verifiable hypotheses*** to test the factors which are believed to be related to the acquisition and use of ICT;
5) ***telephone survey*** of Latvian business leader;
6) ***methods of statistical analysis***: structural analysis and regression analysis to identify factors relating to ICT adoption. These methods are used by the author in the third and fourth chapter in the analysis of adoption and use of ICT in Latvian enterprises;
7) ***graphical method*** (graphic design, diagrams, etc.) made it possible to detect relationships in the phenomenon studied, and to discover the nature and form of the relationship. The Author used this method in all chapters.

Research period was from 2007 – 2011 (August). The Survey was administered from March to April 2008. A second, confirmatory survey was completed July-August of 2011.

Scientific contributions

1) Author conducted a unique study and the results reflect how Latvian companies are using online technologies, how the decision-making process is made when purchasing ICT and its implementation, as well as gather information about technology in general, the current cultural environment for enterprises, workers' attitudes and skills for the ICT, and employees' perception impact on ICT adoption and use.
2) Developed and tested a model for adoption decision-making in developing economies. The model consists of an objective component and a new management component based on the theoretical ICT acquisition and distribution aspects of the Rogers and Technology, organizations, environmental structure and the author's survey of Latvian entrepreneurs, which identifies the ICT adoption and use factors at the enterprise level.
3) Evaluated Rogers’s diffusion theory of innovations and the Technology and Environment Organization structure in adoption and use of ICTs at the national level.

4) Identified a new adoption decision-making factors and understanding of the factors in companies operating in developing economies.
5) Performed a comprehensive literature analysis and systematized knowledge of inter-connectivity between ICT, innovation and business competitiveness.
6) Prepared recommendations for ICT adoption and use in Latvian companies.

Research hypotheses:

1) High costs, low interest in learning about new technology, lack of required skills in available human capital are significant factors that hinder the adoption and use of ICT in Latvian companies;
2) Decreasing costs, increasing effectiveness, new market possibilities are significant factors that contribute to ICT adoption and use in Latvian firms.

Arguments in the promotion work:

1) the adoption and use of ICT is one of the key elements to increase the competitiveness of Latvian companies;
2) ICT adoption and use patterns are different in Latvian companies because most companies are small and traditional cost-benefit logic and theories are not applicable.
3) planned sales improvements, cost reduction and overall efficiency improvement is significantly related to ICT adoption and use decisions;
4) estimated cost and efficiency benefits, ie, to reduce costs and improve efficiency, are important reasons for Latvian companies to learn about ICT it is even more important for small business;
5) adoption of ICT skills are essential to every company, and it follows that human resources are the main determinants of the success of adoption decision;
6) ICT adoption and use depends on cultural and environmental factors.

Promotion works theoretical and practical meaning

Approved model in promotion work can be used in different enterprises and institutions to improve efficiency and to increase Latvian business competitiveness.

The present research findings can be used for training courses about adoption and use of ICT for both management science and economic science students.

Confirmed and explained model associated with adoption theory and the introduction predictability, which can be used for business executives to identify ICT needs, the cost analysis and procurement.

Research findings can be used for national development planning, with ICT as one of the key factors in determining the direction towards the knowledge economy.

This **dissertation's contribution to knowledge** comes in two directions. First, it creates and validates a model for decision-making using firms in an emerging economy, and thus contributes to the understanding of policy for both non-firm and firm level decision. Secondly, by adding to the understanding of these adoption decisions for firms in a non-western, developing economy it adds to the research and academic knowledge by creating a more nuanced understanding of how adoption decisions are made and the impact they have at firm level.

The ability of ICTs to help Latvian companies close the development gap with competitors in the more advanced European countries is of particular importance to Latvia and for companies in other less developed new EU accession countries. The evidence that ICTs can help in closing the development gap is mixed (OECD, 2000[3]; also UNDP, 1999), and even in example cases like Ireland, that are touted as successes for emerging countries, there is a lack of insight into the causes of adoption (or lack of adoption) by the indigenous companies [5;89;152]. The study frameworks have concentrated largely on how company level factors explain ICTs adoption and diffusion from the perspective of a general purpose technology (GPT) looking to be used in well known business contexts. This is not the case of developing economies.

The two major parts of the overall model overlap and provided reinforcing information. The factors in the objective component had been validated previously, and their inclusion provides evidence of the overall validity of the general (objective + managerial component) model. The factors in the managerial component will give information that is valuable both academically and to managers. The factors included in the managerial are ones that are important in sharpening the ability to predict and modify adoption, adoption decisions and use of ICT, and would help management understand and perhaps quantify factors that they could/might manipulate to increase the likelihood of adoption, use, intensity of use.

The managerial component also can provide insight to policy makers concerned with developing policies that will positively impact firms' decision making with regards to ICT adoption. The results further point to the limitations of previous research with regards to generalisation to economies with features different from developed western economies.

[3] OECD (2000) states that countries at the edge of productivity and technological leadership have reinforced their lead in the new knowledge economy and that the benefits have not yet trickled down to Southern, Central and Eastern Europe

As long as ICT firms monopolize the market for educated ICT specialists (through wage pressure) there will be limits to the diffusion of ICT (both through adoption and sophistication) to non-ICT firms. If non-ICT firms have access to Human Resources that will increase their capacity to use ICT innovation, if validated, the model will suggest that they would become more likely to adopt ICT and deepen its sophisticated use.

In the context of individual firm's decision making, the main contribution lies in that investment decision will be shown to be more likely to be related to non-existing immediate needs than to current needs. Such an approach assumes companies who will adopt ICTs are more likely to do so for the sake of entering new markets or developing new products or services, and therefore surveying of plans, collaboration efforts and relationships, may provide a better basis to predict diffusion patterns. On the contrary, these companies in emerging country economies will find it nearly impossible to justify ICT investments based on cost savings. As a consequence, the results can be more readily used to provide strategy recommendations directed towards innovation and new activities formation, distinctly from those appropriate for efficiency improvements in existing businesses.

The model will be tested empirically in organizations representing different industries in Latvia, thus the findings of this research will be applicable for all new EU accession countries and at least smaller developing economies in general.

The **analysis** is augmented by incorporation of a specific adoption variable that looks at "sophistication of use". "Sophistication of use" measures the ability to connect the company to technology and market clusters, to become more embedded in multinational value chains and gain an orientation towards new products and processes [100;163]. This analysis provides insights into the much less researched aspect of how market opportunities drive the diffusion of ICT's [18]. While factors evaluating the impact of factor productivity from ICT adoption are the principle basis of the financial and business case in companies in developed countries, sophistication of use seeks to identify the impact from output gains which may be more relevant for companies in emerging economies.

The broadly defined concept of profitability allows identifying bottlenecks of the diffusion process such as, for example, ICT-related manpower deficiencies. Moreover, information deficiencies or lack of finance may be a problem for small firms but not for large ones; innovations on the other hand, may prove easier to smaller companies. Therefore, size-specific model estimates may show whether strategies and approaches, if necessary at all, needs to be differentiated by firm size.

The overall contribution to knowledge from this dissertation is twofold. It contributes to the understanding of policy for both non-firm and firm level decision making by creating and validating a model for adoption decision-making using firms in an emerging economy. From a research and academic perspective the largest contribution is adding and understanding of these adoption decisions for firms in a non-western, developing economy.

Dissertation is organized in three chapters. **Chapter I** provides an overview of previous related research to explain the importance of ICTs for company growth and productivity. The theoretical background includes an overview of technology diffusion modelling, ICT diffusion theories, and ICT economic impact theories. In addition, Chapter I describe the overall ranking positioning of Latvian companies in ICT adoption and ICT use internationally. **Chapter II** describes the factors in the adoption of ICTs for business processes and analyzes firm-specific adoption factors. **Chapter III** describes the management decision model and its main constructs. The chapter ends with a section that outlines the hypotheses empirically tested during the research project. Chapter III also describes the methodology used to empirically test the identified hypotheses. The chapter concludes with an analysis of the questions, method data, and presents the empirical estimates of the research including the statistical analysis of the survey data, as well as the hypothesis testing.

The appendices follow the textual part of the dissertation and include the survey used in the study, and descriptive statistics of the survey data. A list of references cited concludes the dissertation.

1. THE IMPACT OF INNOVATION ACTIVITIES ON PRODUCTIVITY AND COMPANY PERFORMANCE

This chapter is an in-depth review of the literature and research regarding the impact of innovation on productivity and organisational performance. Section 1.2 provides context for understanding the importance of ICT to innovation and how innovation does and does not impact productivity and considers the impact of firm, industry and government intervention/decisions on innovation and diffusion of technology. It goes on to discuss other factors involved in innovation. The chapter continues by describing the relevance of economic and psychological switching cost to adoption and diffusion of ICTs. Section 1.3 discusses paradoxes of technological change.

ICT as a General Purpose Technology (GPT) is discussed in Section 1.4. The relevance and use of the experience of firms in developed countries in understanding ICTs impact on innovation is found in Section 1.5. The discussion continues to include the relevance of research in developed economies in understanding the relationship of ICT to exploiting existing opportunities to innovate (Section 1.6). There is a discussion of Evolutionary Diffusion Theory and the Structural Theory of Diffusion in Section 1.6. The chapter continues by discussing ICT innovation and diffusion in developing economies (such as Latvia), and includes a review of the concept of leapfrogging with regards to diffusion of ICT (Section 1.7).

The chapter concludes with a discussion of network effects (industry and sector) in ICT diffusion and the ranking of ICT diffusion in Latvia by comparison with other EU countries and others in Section 1.8.

1.1. The process of innovation and the factors that influence it

In order to survive, companies must have the ability to adapt and change. Competition consistently develops new processes and products which continuously change the competitive landscape in the market. '…not to innovate is to die,' famously wrote Christopher Freeman (1982) in his famous study of the economics of innovation [64].

Table 1-1 Market Leaders in 2007

Industry	Market leaders	Innovative new products and services
Cell phones	Nokia	Design and new features
Internet-related industries	eBay; Google	New services
Pharmaceuticals	Pfizer; GlaxoSmithKline	Impotence; ulcer treatment drug
Automobiles	Toyota; BMW	Car design and associated product Development
Computers and software development	Intel; IBM and Microsoft; SAP	Computer chip technology, computer hardware improvements and software development

At the same time, Business Week's 2010 survey of the world's most innovative companies showed that these same firms have delivered exceptional growth and/or return to their shareholders [30].

Table 1-2 World's Most Innovative Companies, 2006-2010

2010 Rank	Company	Margin growth 2006-2009%	Stock returns 2006-2009 %
1	Apple	20	35
2	Google	2	10
3	Microsoft	-4	3
4	IBM	11	12
5	Toyota	NA	-20
6	Amazon	6	51
7	LG electronics	707	31
8	BYD	-1	99
9	GE	2,2	27,6
10	Sony	NA	99
11	Samsung	-9	10
12	Intel	12	3
13	Ford	NA	10
14	Research in Motion	-6	17
15	Volkswagen	14	8
16	Hewlett-Packard	9	9
17	Tata Group	Private	Private
18	BMW	1	-8
19	Coca Cola	3	9
20	Nintendo	3	-8

Source: Business Week, August 5, 2010

The economic history of the United States and the United Kingdom shows that industrial technological innovation has led to substantial economic benefits for the innovating *company* and the innovating *country*. Examples of technological innovations spurring economic development are found in Table 1-3.

Table 1-3 19th-century economic development fuelled by technological innovation

Innovation	Innovator	Date
Steam engine	James Watt	1770-80
Iron boat	Isambard Kingdom Brunel	1820-45
Locomotive	George Stephenson	1829
Electromagnetic induction dynamo	Michael Faraday	1830-40
Electric light bulb	Thomas Edison and Joseph Swan	1879-90

Over the past 10 years the literature on what ‘drives’ innovation has divided into two schools of thought: the market based view and the resource based view. The market based view argues that market conditions provide the context which stimulate or hinder the extent of firm innovation activity, assuming that firms recognize opportunities in the marketplace [122;167;191].

The resource-based view of innovation focuses on the firm and its resources, capabilities and skills, emphasizing that when firms have resources that are valuable, rare and not easily copied they can achieve a sustainable competitive advantage [60;182].

Aligned with these two schools of thought, a number of models of the industrial innovation process have been proposed (see Table 1-4).

Table 1-4 The chronological development of models of innovations

Date	Model	Characteristics
1950/60s	Technology-push	Simple linear sequential process; emphasis on R&D; the market is a recipient of the fruits of R&D
1970s	Market-pull	Simple linear sequential process; emphasis on marketing; the market is the source for directing R&D; R&D has a reactive role
1980s	Coupling model	Emphasis on integrating R&D and marketing
1980/90s	Interactive model	Combination of push and pull
1990s	Network model	Emphasis on knowledge accumulation and external linkages
2000s	Open innovation	Chesbrough’s (2003) emphasis on further externalization of the innovation process in terms of linkage with knowledge inputs and collaboration to exploit knowledge outputs

It can be said, therefore, that innovation is not a singular event, but a series of activities that are linked in some way to the others. A simple linear model of innovation can be applied to only a few innovations and is more applicable in certain industries than in others, i.e. the pharmaceutical industry exhibits characteristics of the technology-push model and the food industry is more of a market-pull model. Innovation in most industries and organizations is the result of a mixture of the two. Therefore, managers working within these organizations have the difficult task of managing this complex process.

This complex innovation process entails a number of elements: an economic element, a business management strategy perspective and an organizational behaviour perspective, which outlines the individuals and activities internal to the firm. This process must be viewed within the context that companies form relationships with customers, suppliers and with other companies – they sell, compete and cooperate with one another. These all impact the innovation process.

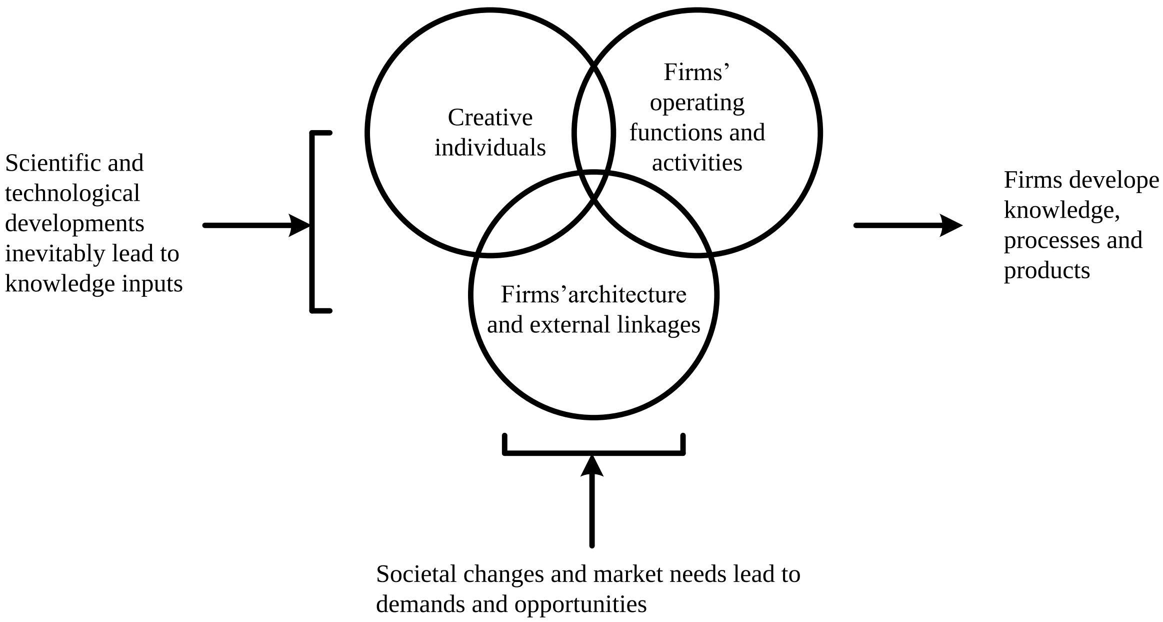

Figure 1-1 Overview of the Innovation Process

Figure 1-1 suggests the variety of activities that need to be effectively managed in order to foster innovation. There have been numerous studies of innovation, attempting to identify the success factors required to encourage, develop, manage and control firm-level innovation. A recent study by Business Week and Boston Consulting group (2006) of over 1,000 senior managers attempts to explain why certain companies are more innovative than others. A summary of their findings regarding innovative capability is shown in Table 1-5.

Table 1-5 Explanations for innovative capability

Innovative firm	Explanation for innovative capability
Apple	Innovative chief executive
Google	Scientific freedom for employees
Samsung	Speed of product development
Procter&Gamble	Utilization of external sources of technology
IBM	Share patents with collaborators
BMW	Design
Starbucks	In-depth understanding of customers and their cultures
Toyota	Close cooperation with suppliers

We can see from Table 1-5 that, for example, that Toyota is great in its cooperation with customers and that Starbucks understands its customers. For a review of some of the key studies of innovation management see Nieto [153].

1.2. The government role in facilitating innovation

As mentioned above, the global and national economy can also influence the process of innovation within a company. The relationship between a national government and industry and business differs from one country to the next. Many economies are dominated by certain industries or by certain forms of economic organizations (e.g. the Chaebol in South Korea or Keiretsu in Japan). These interrelationships generate a business environment with unique business value systems, attitudes, and ethics, creating advantages and disadvantages in management approaches and activities, including the process of innovation. Afuah (2003) and Porter (1990) have addressed the role of national governments regarding the process of innovation and have highlighted at least five reasons that government can and/or should be involved in innovation policy. First, the knowledge that underpins innovation is often public. This knowledge may come from publicly funded research or be generated by those working in publicly supported institutions. Second, there is significant uncertainty that hinders the process of innovation and government may be able to provide assurance through the use of public bodies to insure completion of research tasks. Third, government can provide access either directly or indirectly to the complementary assets needed in and for innovation. Fourth, government can oversee or coordinate the cooperation and governance that results from the nature of certain technologies. Finally, because of the often conflicting agendas and interests of the involved parties, politics is a part of the process.

Using Porter's industry attractiveness framework, Figure 1-2 outlines the possible roles that a national government can play in relation to innovation. Figure 1-2 (Porter's diamond) emphasizes a company's relationship with buyers, factor of production (e.g. labour, capital, raw materials, ICT), related and supporting industries (e.g. technology providers, input providers, etc) and other institutions that help facilitate strategic orientation and innovative capabilities [165].

These, of course, will affect the company's innovation opportunities, which must be aligned with the company's internal strategy, competences and resources.

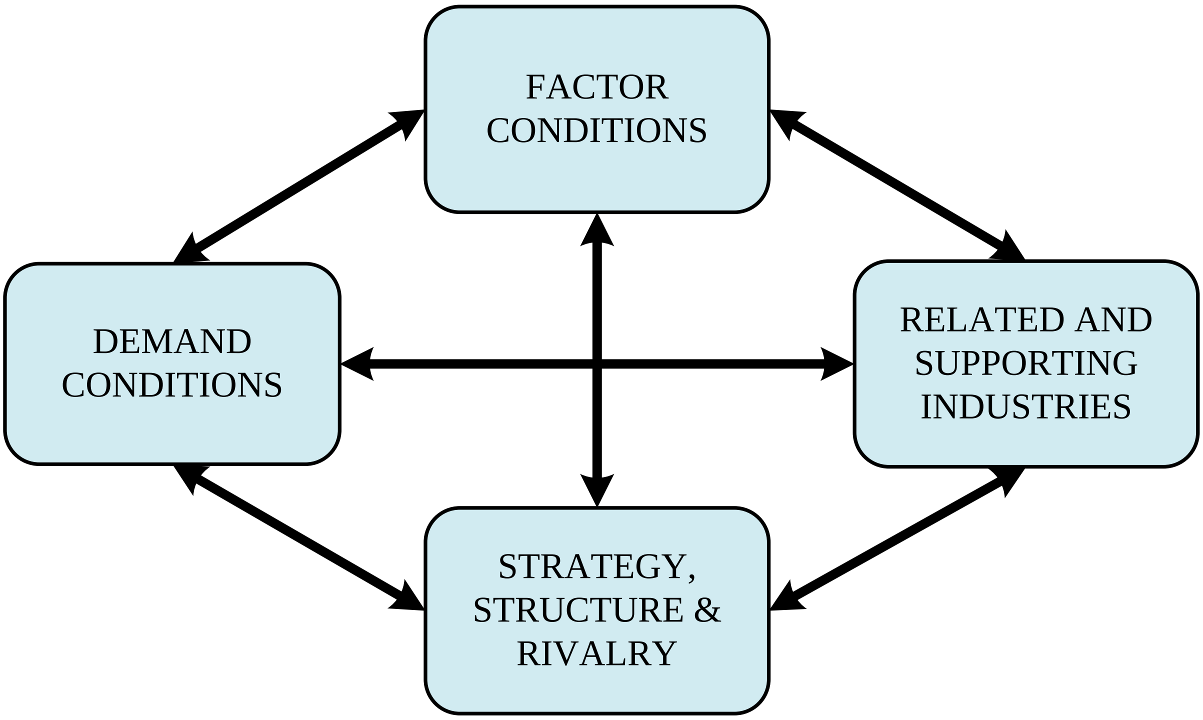

Figure 1-2 Porter's diamond

A national government can identify priority industries and foster local entrepreneurship by encouraging innovation through the financing of R&D and becoming a major purchaser of an innovative product/service. For example, in 2007, the United States had the largest defence R&D budget in the world, comprising 0.6% of GDP, and being 1.5 times the ratio of the Russian Federation and twice that of the United Kingdom [155]. The remainder of the R&D budget is allocated for health, space, general knowledge, energy, transportation, environment, and agriculture. Total government R&D spending is 2.65% of GDP.

On the other hand, Finland's government R&D spending is 3.2% of GDP, 42% of which will go to 'general advancement knowledge', including funding for research laboratories, universities, and federally-funded technology and innovation centres [194]. National governments can also finance R&D indirectly by providing tax exemptions, subsidies, loan guarantees, export credits, etc. [121;133].

According to the European Innovation Scoreboard [60], Latvia, along with Hungary, Romania, Slovenia, Malta, Czech Republic, Croatia, Portugal, Greece, Poland and Bulgaria make up the group of *catching up* countries, scoring well below that of the EU27 and the innovation leaders, but with faster than average innovation performance improvement.

See Figure 1-3 according to the Scoreboard, the Czech Republic and Lithuania, are on track to reach the EU average within the decade while Estonia has caught up to the average over the five years before 2009. For Latvia, it is estimated to take 20 years.

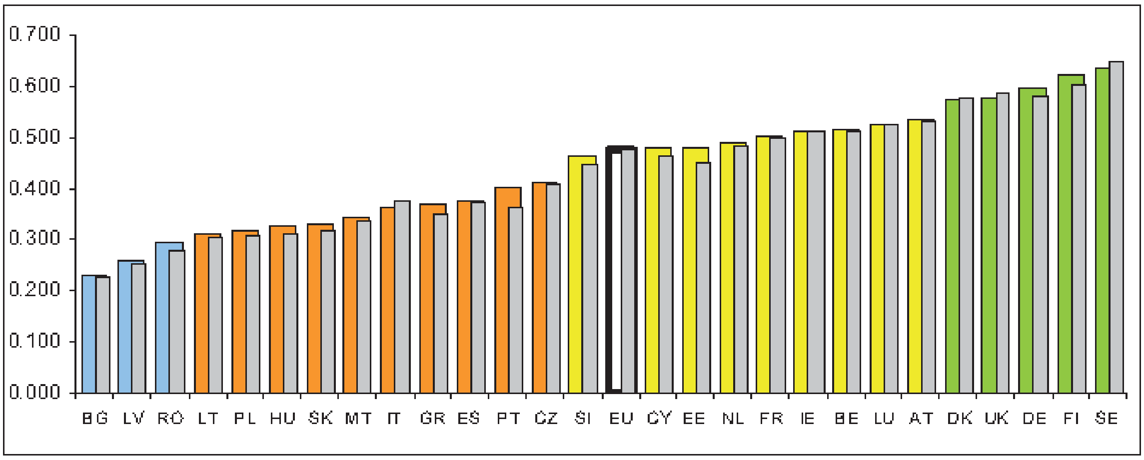

Figure 1-3 The 2009 Summary Innovation Index (SII)

See Figure 1-4. – the Index may be helpful for government policy makers in deciding which industry(s), infrastructure(s), educational programs and other human capital to invest in.

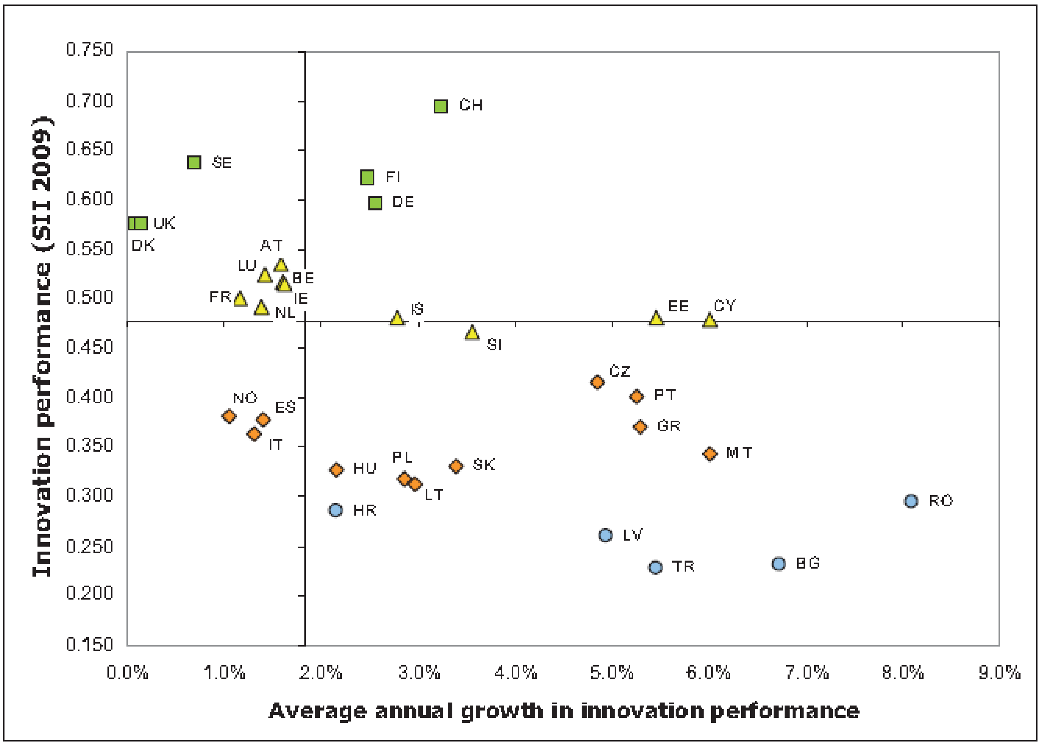

Figure 1-4 European Convergence Index, 2009

Source: http://www.proinno-europe.eu/page/european-innovation-scoreboard-2009

1.3. Paradoxes of technological change

One can also think of diffusion of innovation as the acceptance of change. Change can be simple or it can be very difficult. Reactions to new products, accepting them, and using them can range from a simple change in perception to a radical change in behaviour. This is especially true regarding the acceptance of new technology. Rogers (discussed in depth in Chapter 2) proposed a bell curve of acceptance, with “laggards” in the far right of acceptance. The so called ‘laggards’ frequently have a love-hate relationship with technology because of the many paradoxes of technological products [177]. For example, using the internet and its associated applications can save time and money but at the same time using the internet can also waste a lot of time. Such paradoxes can play an important role in developing perceptions of innovations and the adoption of these innovations by potential users. Mick and Fournier (1998) have named and outlined some of these paradoxes regarding technology acceptance, which are summarized in the Table 1-6 [142].

Table 1-6 Paradoxes of technological products

Paradox	Description	Illustration
Control-chaos	Technology can facilitate order and it can lead to disorder	Telephone answering machine can help record messages but leads to disorder due to uncertainty about whether the message has been received
Freedom-enslavement	Technology can provide independence and it can lead to dependence	The motor car clearly gives independence to the driver but many drivers feel lost without it
New-obsolete	The user is provided with the latest scientific knowledge but this is soon outmoded	Computer games industry
Efficiency-inefficiency	Technology can help reduce effort and time but it can also lead to more effort and time	Increased complexity in VCRs has led to many wasting time in setting recordings
Fulfils needs-creates needs	Technology can help fulfill needs and it can lead to more desires	The internet has satisfied the curiosity of many but has also stimulated many desires
Assimilation-Isolation	Technology can facilitate human togetherness and can lead to human separation	Email and chat rooms help communication but in some cases heavy users can become isolated
Engaging-disengaging	Technology can facilitate involvement but it can also lead to disconnection	Advances in cell phone memory means that many people no longer need or have skills to discover the telephone number from a telephone directory

Source: Adapted from Mick and Fournier, 1998

Media, especially television, have impacted these technological paradoxes by influencing traditional values and behavioural patterns in various regions in the world [193]. Related to this resistance to change and to these paradoxes is the simple notion that technology acceptance is an objective cost-benefit trade-off. Consumers frequently reject new products that offer significant improvements over existing products. Some recent examples are: VHS vs. Beta in tapes, Yahoo vs. Explorer search engines, TiVo digital recorder, and the Webvan online grocery business. It seems that these failures are a result of consumer bias, which is the systematic tendency to irrationally overvalue the benefits of an existing alternative and undervalue the benefits of a new alternative. These failures may be the result of more than just traditional *economic* switching costs, but those of *psychological* switching costs [88].

The traditional economic cost-benefit tradeoffs looks at the net benefit of the innovation being offered. If the benefits are greater than the costs, the innovation has a good chance of being adopted. If the costs are greater than the benefits, the innovation is highly likely to fail. This concept is described as ‘relative advantage’ by Everett Rogers and is a key factor in product adoption [177].

However, there is also research that shows that consumers to do not always behave in an objective manner [150;216]. Sometimes consumers psychologically overweight things they currently have, but are being asked to give up (i.e., potential ‘losses’) relative to things they don’t have, but could receive (i.e. potential ‘gains’). Therefore, while the *objective net benefit* may favour the innovation over the existing product, the *psychological net benefit* may do just the opposite.

In 2002, Daniel Kahneman, the Princeton psychologist, won the Nobel Prize in Economics for his work exploring how individuals make decisions. The focus of Kahneman’s work was Prospect Theory, a concept developed together with Amos Tversky. Prospect Theory attempting to explain a person’s response to changes in monetary and non-monetary wealth. Kahneman and Tversky were interested in how people *actually* behave, not in how economic theory suggests they *should* behave arguing that what drives behaviour are the psychological reactions to gains and losses, and not the objective gains and losses themselves. This overweighting is typically by a factor of two or three, meaning that the ‘losses’ typically prove to be two or three times more painful than comparably sized ‘gains’ prove to be pleasing [105;205].

Related to Prospect Theory, and to these ‘gains’ and ‘losses’, is the concept of the ‘endowment effect’, as the behavioural economist Richard Thaler, has named it. Thaler (1980) postulates that people value items in their possession (or part of their endowment) more than they value items not in their possession [205].

Both, the Prospect Theory and the ‘endowment effect’ are related to change, as are innovations, which almost by definition, demand change. The adoption of an innovation almost always involves *giving up or losing* current things and *getting or gaining* things not yet had. Prospect Theory and the ‘endowment effect’ emphasize that the benefits being given up (lost) will be perceived larger than the benefits to be obtained (gained) (by a factor of two or three). Similarly, the new costs encountered will appear larger than the old costs now avoided (by a factor of two or three). As a result, it is not enough for an innovation to be objectively better than the product it seeks to replace, it must be significantly better to overcome the biases adopters bring to their analysis.

Table 1-7 Examples of gains and losses or gives and gets in innovation

Innovation	What do you give up?	What do you get?	Net (+ or - ?)
Electric cars	Easy refueling, less gas	Environmental friendliness	
Webvan online grocer	Personally select fresh food	Home delivery	
Satellite radio	Free music	Better selection	
New drugs	Low cost	Fewer side effects	
Wind energy	Unattractive machines	Clean, renewable Energy	
New medical procedures	Comfort	Better outcomes	

Source: Author

The adoption of ICT systems in the organization is one of the major 'tools' that advance a firm's innovative capabilities, promotes a creative working environment, and produces an increase in a firm's efficiency and effectiveness of business processes, and its productivity [7;10;24]. As mentioned above in Figure 1-1, the effective integration of people, organizational processes, and plans is required and one of the major inputs, along with market factors, are technological factors, including ICT [62;174].

The literature in the area of ICT diffusion research is enormous and still growing. This research is subject to a wide variety of bias that is not clear in the terms of adoption and diffusion of technology broadly applied or for that of ICT specifically. Not infrequently, important underlying assumptions are derived from the use of ICTs in the specific context where they developed [102], ranging from ICTs production (hardware, software and services), and ICTs use (process applications mainly in developed economies), to ICTs infrastructure (availability and use of Internet for example; various measures of ICT assets, etc.). As a consequence, the research of ICT diffusion has also taken a very broad spectrum encompassing firm level adoption decisions, ICTs sector development, ICTs relationship to productivity (frequently mixing ICT sector's and firm level adoption's implications), ICTs relationship to company growth, ICTs development and adoption as a technology and possible leapfrogging implications, ICTs as an export oriented growth activity to solve regional imbalances, and from the point of view of regional and national policies for stimulating the adoption of ICTs. Rodrik, 1995, for example, finds that the analytical foundations of most studies aimed at policy recommendations have been too ambiguous and the preferred method ranges from casual appeal to common sense. In this context, the relevance of an empirical verification of this issue for the specific conditions of small emerging economies cannot be overemphasized [176].

This section reviewed the theoretical background of the development, adoption and extension in space (geographically, between industries, etc.) of any innovations, with the objective to increase the economic benefits to companies in their processes. But the nature of ICTs merits some additional or special considerations, on account of: firstly, their wide spectrum of use as a general purpose technology; secondly, on account of the expected impact on general productivity, and the evidence that benefits have a tendency to be lagged in time and somewhat dependent on accumulated adoption rates; and lastly, due to the need for a benchmark framework that would serve to evaluate the general stage of development of ICTs diffusion relative to other countries, and serve thus to identify and incorporate variables of general use in such comparison models. This latter aspect should reveal patterns of international variances in adoption that will serve to compare our empirical testing results for companies in emerging countries.

1.4. Economic impact of ICTs in transforming the economy as General Purpose Technologies

The term “General Purpose Technologies”, or GPTs, is usually reserved for changes that transform both household life and the ways in which firms conduct business when considering the role of technology in economic growth [25]. Electricity and IT (information technology) are often classified as GPTs for this reason. Computers have not just changed the way production works but many day-to-day activities have been transformed by the 'ICT revolution'. The massive reduction in computing and communications costs has triggered a substantial restructuring of the economy leading to potential productivity gains [28].

An important difference between ICTs and general innovation diffusion models is that the former do not have a clear market in the case of developing countries. It is an important premise in the diffusion theories that the market value is apparent, even if perceived differently. And it is obstacles in the form of factor price, licensing, regulations, capital and human learning ability, that cause differences in the speed of adoption. The market opportunity for the new technology is usually strongly related to an existing sector, where the technology replaces in some form an older generation of technologies or processes.

A GPT does not deliver productivity gains immediately upon arrival but these gains accumulate over time, as infrastructure investments and new applications accumulate. Helpman and Trajtenberg, 1998, describe the diffusion of GPT as two-phase cycle composed of a “sow” stage where resources are diverted to the development of complementary inputs that would allow taking advantage of the new GPT; and a “reap” stage, that occurs when sufficient accumulation of inputs has occurred making worthwhile switching to the new, more productive GPT [87].

David, 1999, argues that the speed with which a new GPT diffuses depends on the pool of investment opportunities that are available when it arrives. He observes that it took until the late 1960’s to deal with the significant backlog of problems of the post-war period before the benefits of productivity sat in. This finding is particularly significant for the empirical analysis in this study, since the backlog of problems from the Soviet era in Latvia is still under assimilation, quite possibly absorbing the largest share of ICTs applications. This will be tested in the empirical research by comparing the larger diffusion and innovativeness expected of larger companies based on theory, to that observed in reality [49].

Mainly studying companies in developed countries, Jovanovic and Rousseau, 2003, analyze those ICTs effects that are similar to those shown by electrification in the United States at the beginning of the 20th century [103]. The effects on productivity growth are as predicted to fall initially, and are accompanied by a rapid surge in patents (new inventions), and in trademarks (possibly indicating increased numbers of products). Some specific factors relevant to classify ICTs as a GPT are present in a significant way in the empirical sample in this work. The heightened reallocation of assets and activities following the Soviet period transition may be a cause of productivity slow down and mask productivity gains flowing from ICT diffusion [31]. The GPT nature of ICTs may make the skill premium: due to these subject to possible significant migrations of resources between sectors, especially when there is a strong ICT production sector. This situation is evident in the empirical case studied where the ratio of skilled ICTs wages/non-skilled ICTs has been very high for the period. The reallocation of assets through privatization and subsequent mergers or acquisition by foreign companies has marked most industrial sectors in the empirical study. It is nearly impossible to attribute these changes to the ICTs’ era because most of the activity was predominantly driven by low entry costs and business opportunity. The ideas and products associated with the GPT are predicted to be brought in more often by new firms. The market share and market value of young firms should rise relative to old firms. The empirical analysis should show a positive correlation to demonstrate this case to be present. The expected characteristics of the behaviour of interest rates and trade deficit are present in the empirical case [16]. The rise in desired consumption relative to output should cause interest rates to rise or the trade balance to worsen.

Rincon and Vecchi, 2004, suggest that the complementary integration of GPTs implies the existence of strong static and dynamic spillovers and provide references of empirical studies to support this view. As noted in the previous section of this chapter however, the basis of these studies often refers to specific measures and circumstances, and the examples reviewed, of Ireland and China, where the extent of spillover is limited, do not support this conclusion.

For companies in developed countries a prima facie case can be made for ICTs to behave in this manner, because they enable process simplifications and business uses that compete with known, existing ones mostly on the basis of lowering the use of human resources or speeding up information and transactions [129;222]. For companies in developing countries however, these assumptions are more questionable. In a country like Latvia, where 96% of the companies have fewer than 9 employees, the significance of ICTs as a driver for economic gain is expected to be significantly less clear. It is also expected that companies require much more of a strategic intent to develop something completely new in the form services or markets, which could more directly relate to management capabilities and orientation to innovation, and to ICTs functioning more as a cost factor than a driver of change. Nevertheless, the innovativeness capability can be treated as one more element of the general case of company differences that lead to ICT adoption, even if it cannot be proven empirically which is the cause and which the effect.

In summary, the characteristic of ICTs diffusion as a GPT is the underlying basis for touting its potential to become a widespread tool potentially enabling companies in less developed countries to close the productivity gap with those in more developed countries. But while this is proposition has a strong intuitive appeal , this literature review shows that the facts speak against such expectation.

1.5. ICTs impact on productivity; learning from companies in developed economies

Information and communication technologies (ICT) are a powerful driver for economy-wide productivity, growth and jobs. The ICT sector contributes to a quarter of the EU’s GDP growth and investment and innovation in ICT generate around 45% of its productivity growth. Internet or other computer networks sales represented 8.5 % of total enterprises' sales according to the Community 2006 survey [225].

The question of productivity growth and economic growth has been at the core of the speculation around ICTs. The Internet in particular, is widely seen as having the potential to "break the bounds of isolation and bring remote communities in with the rest of the world"

[204]. This study is primarily concerned with the question of the impact of ICTs diffusion as it relates to its application in other industries, including the Internet. The question of ICTs production belongs to a separate class of analysis, which is also frequently treated as technology diffusion, but referring to the hardware, software and consulting industries around the ICTs as an economic sector [78;163].

In addition the rapidly developing outsourcing business, of which India and Ireland are prime exponents, are examples of ICTs as an economic sector. These latter aspects are not the focus of this research. A more in-depth review of Irish case, and a cursory look at the case of India, though not an exhaustive analysis, serve to support the fact that spillovers are much fewer than generally claimed, and thus provide some confidence to ignore the ICTs sector co-influence on the broader issue of ICTs adoption and use in the analytical model.

The review of extensive literature on the productivity impact of ICTs' adoption in companies shows a great variety of conclusions, from positive, to negative or inconclusive, largely depending on the type of data and analysis undertaken. In the United States, Jovanovic and Rousseau, 2003, summarize this aspect of the analysis concluding that: "To some extent it seems that we are still waiting for computers to show up in the productivity figures." They reason that despite the historically enormous surge in patents the impact of ICTs [103].

This view, however, is contradicted by others that find considerable impact on output growth from ICT capital deepening in the US (see e.g. Oliner and Sichel 2000, Jorgenson and Stiroh 2000 and Stiroh 2002 cited in Gordon [80]). Gordon, 2004, finds that productivity growth accelerated after 2000 when the ICT investment boom was collapsing in the U.S. while it slowed down in Europe. He attributes it to an emerging consensus that U.S. companies foster creative destruction and financial markets that welcome innovation, while Europe remains under the control of corporatist institutions that dampen competition and inhibit new entry [80].

The most encouraging aspect of ICTs impact on the economy in the United States, is the rapid surge in new patents and trademarks associated with the IT era, and the continued fast pace of diffusion, which lead the authors in the field to expect a cumulative impact on productivity that will greatly surpass that experienced as a result of electrification. This is empirically supported by the growing experiences with the broader transformations from the introduction of ICTs at the firm level, in business and other processes creating potentially new services, products or even industries [28;44].

Christensen, 1997, shows, using examples for the hard disk industry among others, that there are sound empirical reasons why younger firms in the same originating country, tend to be the ones who develop the new applications, while incumbent businesses gain more from perfecting and modernizing existing processes [37].

Several firm-level studies find that spillovers from ICT capital exist [28]. Brynjolfsson and Hitt (2002) analyse the contribution of computer spending to productivity growth at the firm level in the United States, using a large sample of 600 firms for the period 1987-1994. They find evidence of a substantial relationship between computers and multi-factor productivity growth, and that these contributions rise significantly in the long-term because computers complement productivity-enhancing organisational changes carried out over a period of years.

The differences between the United States and Europe show that the apparent gap in the size and diffusion of the ICT sector in continental Europe with respect to the US, has been progressively closing over the decade [183]. However, Guerrieri et al., 2005, have suggested that the perception of the gap is not understood and that the problems that Europe faces, in terms of low rates of growth and high rates of unemployment, link partly to the unsatisfactory performance of European countries in ICTs in particular. The evidence seems to reinforce scepticism on possible “automatic” prospects for productivity growth in Europe in the near future [154;214]. The most recent ICT adoption and uptake in enterprises has a continuously important impact on the business processes, organisations, performance and competitiveness of enterprises. Respectively, ICT spending has increased.

In the Netherlands and Finland, for an example of exceptions, Van Leeuwen and van der Wiel, 2003, suggest that ICT spillovers matter to the total factor productivity (TFP) growth of firms in service sector in the Netherlands [211].

The experiences of emerging economies show that human learning capacity, and institutional and cultural backgrounds play a large role in adoption of technology, as do the opportunities for the application of these technologies. Pilat and Devlin, point out that firms in countries with higher levels of income and productivity have greater incentive to invest in ICTs [32;161].

It is possible however to discover social transformations that have favoured the export of processes and technologies to lower wage countries, partly on account of technology or cost obstacles at home [52], but also on account of organizational factors and environmental factors (such as work practices, labor unions, etc.) Thus, Ireland’s case indicates that the country was successful in attracting a large number of first class foreign companies to establish operations there [5].

Other authors indicate that Ireland exemplifies ICTs leapfrogging [40] and it should serve “…as a valuable benchmark for developing countries seeking to join the IT production bandwagon”. However, the real innovation was in Outsourcing as a business process, as evidenced by the successive move from light assembly to call centres to pharmaceutical research and software development [200]. At the same time, the evidence shows that these foreign companies functioned deeply within multinational supply chains, with limited linkages to the indigenous firms [5;21].

The case of Ireland seems to offer a clear example where leapfrogging has in fact not taken place, and where productivity gains in the indigenous sector of the Irish economy have followed an evolutionary path gradually absorbing competencies from the Multinational corporations (MNCs). Thus, the theoretical model in this work will dismiss spillovers from ICTs sector developments’, and concentrate on the role ICTs play in developing countries, under the assumption that ICTs enabled applications are more likely to provide sustainable economic growth [76].

1.6. ICTs relation to existing opportunities to innovate in companies in developed countries

ICTs are an innovation which can be traced back to the 1970’s with the advent of the first Intel chip for the personal computer[4] [103]. Because of their wide application possibilities as fundamental components of most existing machinery, communications and processes, they have been studied extensively, and have become in many ways a preferred example to study innovation in general. Christensen, 2003, states that the fast pace of innovations in this field have permitted for the first time to study multiple generations of a technology to understand innovation processes, in order to derive real insights that would allow development of predictive models. The approach espoused by Christensen points to the need of studying the technology adoption and diffusion processes under a different light from that of earlier general descriptive theories [38]. The former heightens the need to focus on a particular industry over a longer period of time to observe the types of innovations that occur, while the latter, takes a macro-economic perspective over multiple industries and explore the dynamics of regional spreading of applications. Due to the massive amount of detailed company data required and little availability, the majority of research available corresponds still to the second approach described.

[4] Jovanovic and Rosseau, 2003, measure the beginning of the IT era based on the date of Intel’s invention in 1971 of the “4004 computer chip” (the key component of the personal computer), and the start of diffusion in the US

The academic literature on general technology diffusion was reviewed by Meade, 2006, and the global diffusion aspect by Jeyaraj, 2006 and Eaton and Kortum, 1999 [100;137]. In the field of ICTs, many different theoretical frameworks and approaches have been used to study diffusion processes [55;56;90]. Investigations of a number of these theories and models indicate that each has a narrow perspective and no single theory completely and uniquely is able to explain the circumstances of any particular case [101,120]. Despite these limitations, it can be said that in general, the literature discusses different, though related theories, which while not mutually exclusive are conceptually distinct.

Evolutionary Diffusion Theory (EDT) emerged from 'evolutionary economics', a discipline which describes economic phenomenon and deals with situations of change, open systems and innovation processes [152;167]. The idea of technological advancement as an evolutionary process has been developed by scholars from many disciplines, including: sociology [17;224]; technological history [60;86;146;178]; and economic modelling [86;141;182;220].

The evolutionary theory states that technology adoption takes place from a lower order to a higher order, from simpler to complex, from an earlier version to a later version, from old to new, from unfamiliar to familiar. The assumption is that both technology and consumers evolve simultaneously. Evolutionary theory posits that consumers do not adopt later versions of technology unless they are familiar with older versions. Further, evolutionary theory holds that consumers unfamiliar with older versions of technology are less likely to adopt later versions and that evolution applies to both technology and consumers simultaneously. Evolutionary theories are diachronic rather than synchronic in their perspective.

The author's research expects to validate that the diffusion of ICTs use with respect to local factors of adoption will show a positive correlation with previous experience through the variables of company size and industry, and that more sophisticated uses will be related to export opportunities, thus respecting the tenets of evolutionary theory.

Structural theory of diffusion of innovations assumes that adoption takes place because consumers are embedded in structures of activities, life patterns, and infrastructural and social networks. For consumers, these structures are important both functionally and symbolically. As these structures meet enduring as well as changing consumer needs, they provide stability and flexibility to consumer life patterns, and have utilitarian value. Technologies diffuse because the existing technological infrastructures and the social apparatus are supportive. This assumes that social and technological conditions and networks are key elements for the diffusion. These can be structures of relationships between people, technological infrastructure, and other physical organic elements.

A variation of structural theory is contagion theory which argues that technologies flourish where the conditions are supportive. One important ingredient of contagion theory is the notion of critical mass, a well established condition of diffusion models [107]. Yet another area is the role of needed complementary investments (“co-invention”) to adapt general technologies to the idiosyncratic needs of organizations, which extend to new markets as well [24]. Technologies such as consumer electronic commerce or business-to-business integration require substantial co-invention, and have consequently diffused more slowly than access to the World Wide Web and email [64]. This is a particularly relevant analysis to the Latvian case as likely resistances should arise from new uses of ICT that require significant co-invention in order to be useful.

An example of a structure that technology diffuses through is consumer channels. These could be communications channels, channels of physical space, and channels of relationships. The more crowded or dense the channels are with other competing technologies, the less likely is the possibility of a new technology diffusing. Diffusion takes place primarily through active marketing processes [212].

The research reported in this dissertation will seek to identify the importance of structural factors through the construct of clustering that define structures of competition and collaboration between firms, and through the construct of contagion, that analyzed the effect of a higher number of firms adopting ICTs in a given industrial sector, on the adoption by individual firms. The prediction is to find a positive correlation with both these factors.

1.7. ICTs relation to existing opportunities to innovate in companies in developing countries

Some authors argue that the Internet presents companies in developing economies with the opportunity to leapfrog several generations of technology development, to gain equal access to world markets [158]. These widely espoused views are popular with policy making bodies (see for example the Latvian National Development Plan) but are largely without a strong empirical or theoretical foundation. Firstly, the applications of ICTs to processes (use of ICTs) reflect the processes of the market where they evolve in, as evidenced by the incredibly fast growth of patents and trademarks during the ICT era in the home countries [38;103], and the wider diffusion of ICTs in companies in those countries (see for example OECD 2002). Secondly, in the context of ICTs’ use, a violation of the basic assumptions of evolutionary and structural theories would occur, if the adopting country companies did not have previous experience in similar uses, which are normally not present in the scale or scope of more developed countries. Thirdly, from the point of view of exports of ICTs the evidence shows (Joseph [102] for India; and Alfaro [5] for Ireland) that the exporting country functions more as a "negative importer", in that it hosts an outsourcing capability that uses the importer's know-how with very little spillover to the local companies [5;102].

These outposts of technology belong to and operate within the foreign investor's network, thus not permitting identifying the local capability as a leapfrogging. Moreover, these outposts of export oriented ICTs can be shown to reduce growth in the rest of the local economy, by absorbing scarce human resources and making them too costly for other sectors of the economy [102]. Technology leapfrogging cannot be generalized to occur with the same effectiveness across countries, within countries, or across industrial sectors. This is because countries are known to be different in terms of the factors that facilitate or hinder the process of technology leapfrogging [130]. Before any general policy recommendations of practical value are possible, the claims thus, that the software industry (in India as an example in Economist 2006) can provide leapfrogging effects, need to be scrutinized more closely in every case.

In this dissertation the emphasis is clearly on diffusion of the use of ICTs by individual firms, and not ICTs production. The relationship between these two aspects should not be underestimated, but its study would require a different line of investigation than that followed in the dissertation. Mainly a view of adoption decisions, factor costs and factor utilization in the ICTs production sector and other industry sectors would need to be compared. The research assumes that the access to ICT competencies is the same for all firms and therefore does not contribute to differentiate the adoption decision. The construct of company size is used to differentiate from the point of view of purchasing power between the firms.

The leapfrogging theory is frequently offered in opposition to evolutionary theory [162]. In recent years, 'technology leapfrogging' has appeared as a proposed explanation as to how some countries, and therefore local companies, have managed to accelerate the catching up process in economic development [89;201].

According to leapfrogging theory, under certain social economic, and technological conditions, companies, communities or countries can jump several steps to reach a higher level of technological production and consumption and attain parity with countries at the top of the ladder in that particular domain [26;52]. The reasons for this are postulated on the existence of disincentives in the country of origin of the new technology for its rapid adoption, such an existing infrastructure, or high wages associated to expertise, related to a previous generation of technology. The concept makes the assumption of the technology being fairly well defined by patents for example, and that the process of diffusion takes places in well understood contexts as supported by both evolutionary and structural theories. Desmet [53] (2001) relaxes these conditions by allowing for spillovers[5] where indirect transference of knowledge can occur between industry sectors [53]. In comparing diffusion rates between countries it would be desirable to be able to identify the effects of ICTs sector foreign implants and their relationship to the other sectors to account for the effects discussed here. This however would impose undue burdens to construct data from too diverse and scarce sources. From the point of view of the broader transformations ICTs can introduce in business and other processes[6] creating potentially new services, products or even industries [28; 45; 179], the argument of spillovers or leapfrogging because of higher costs in the home country is here found not to apply.

1.8. Network effects of ICT diffusion and adoption in industry sectors and its potential to increase synergies across sectors

From a strategy point of view, ICTs receive great attention for the paradoxical effect of being able to reduce economic differences between industry sectors and create growth, and the remarkable effect of creating a growing gap between regions who have and regions which do not have sectors with ICT capabilities. The overall objective of strategies have been to contribute to the diffusion and adoption of ICTs but little is understood of how specific circumstances of companies in developing countries need to be considered in order to take advantage of the general purpose technologies offered by ICTs. This seemed a very urgent task since, despite the extensive research in the field; little is understood in any depth of the reasons behind the slow adoption of companies in less developed world regions, giving rise to the phenomenon known as the digital divide [20;154]. This phenomenon is present in Latvia perhaps not in an absolute way, as clearly an infrastructure and use of ICTs are present to a considerable degree as the study shows. Nevertheless, this divide does exist in more subtle ways that are revealed by how much these ICTs are used and for what purposes. At the same time, the controversy regarding the effect of ICTs on productivity and economic growth signalled that there was a significant gap between strategies and policy statements and empirical practice [5;172;173;198].

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[5] For instance, Boldrin and Scheinkman, 1988, have analyzed learning spillovers between sectors (or technologies) in a theoretical framework. Empirical evidence can be found in Glaeser, Kallal, Scheinkman and Schleifer, 1991.

[6] ICTs is used to speed communications between trading partners, shorten product life cycle, establish better relationships with customers, suppliers and partners and reduce expenditures (Franklin, 1997).

According to Order-models, firms adopt the new technology in a progression that follows the net return that they obtain from it [68;97]. The order effect arises from the existence of a fixed critical input into production such skilled labour for software developers. The evaluation of the level of criticality is however, dependent on the perceived problem these resources solve. If as pointed out above, in developing countries the problems to solve do not require in an obvious way the use of ICTs that are more sophisticated or any ICTs at all, then the active intervention of policy makers seems a valuable element to formulate a direction that would or could trigger the start of ICT adoption between firms. Also because of this order effect, initially it will only be profitable for a limited number of firms to adopt. However, over time, the net return on adoption increases (for the same reasons as in rank models) so that eventually more and more firms adopt.

During this phase, the role of policy and incentives could play a critical role in adoption to promote earlier adoption and more ambitious goals than would be granted by following a natural order process. Policy has the capability to ensure positive returns where net return on adoption is negative for firms that are slow to adopt relative to their rivals in more developed countries. Policy in this sense requires demonstrating a capability to speed-up innovations from ICTs. Policy in this respect has attempted for example to make opportunities to apply ICTs more economically attractive (for example in the drive most governments have followed to promote e-government in some way).

The use of policy incentives also receives attention due to the initial obstacles to first adopters in emerging economy countries. The Stock-model view sustains the idea that the net return on adoption for any firm depends on the total stock of firms that have adopted, with the net return on adoption declining as the stock increases [168;171]. When the adoption of a new technology by a subset of firms in the industry lowers their average production costs to such an extent that output prices fall, Stock-effects may arise. Lower output prices in turn, reduce the net return on adoption.

Given this stock effect, initially it will only be profitable for a certain number of firms to adopt, but this effect does not depend on heterogeneity among firms or on the order in which firms adopt. The stock models hypothesize that firms adopt at different times because the net return on adoption falls as the stock of adopters grows. The stock models imply that innovations diffuse at different speeds because for some technologies, the stock effect is stronger than for others (because, for example, the new technology has a larger impact on firm costs and therefore on output prices) or because for some technologies, the net return on adoption increases faster than for other innovations. In market conditions, where there is little volume to be gained, an effort towards planned innovations supported by public policy could be an inevitable need.

1.9. Ranking ICT adoption and use by Latvian companies relative to other EU countries

The comparison of general indicators of ICT adoption across countries including Latvia, serves to gain a general perspective of Latvian companies' relative stage of development in ICT adoption. The e-business readiness index[7] is one of the policy sub-indicators selected by the Council Resolution of 28 January 2003 (5197/03) of the European Union to monitor progress in the implementation of the eEurope 2005 Action Plan (COM 2002, 263 final). For this reason it is selected as the basis for comparison of the general position of Latvia.

This index for the most part reflects a quantitative measurement of a narrow base of factors and does not attempt to analyze the context of their use. This index describes the results of the composite indicator on e-business readiness for European countries, using data from the 2005 European Union ISS (Information Society Statistics) enterprise survey, as collected by National Statistical Institutes of Latvia and collected and verified by Eurostat, as available from Eurostat in August 2006.

The composite index is made of two core dimensions: **adoption of (ICT)** by business, and **use of ICT** by business. The following comparisons are intended to provide a general overview only. The thesis will clarify the exact meaning of the term ICT diffusion in the circumstances of companies in small developing economies, which is not made explicit or clear in general index comparisons. The factors considered in this index are the following:

Table 1-8 2005 e-business readiness Index: list of basic indicators for adoption of ICT

Adoption of ICT: basic indicators
Percentage of enterprises that use Internet
Percentage of enterprises that have web/home page
Percentage of enterprises that use at least two 2 security facilities at the time of the survey
Percentage of total number of persons employees using computer with their normal work routine
Percentage of enterprises having broadband connection to internet
Percentage of enterprises with LAN and using an Intranet and Extranet

[7] William Castaings, Stefano Tarantola, Ari Latvala, The 2006 European e-Business Readiness Index, Directorate General Joint Research Centre and Directorate General for Enterprise and Industry.

Table 1-9 2005 e-business readiness Index: list of base indicators for use of ICT (Pennoni, 2005)

Use of ICT: basic indicators
Percentage of enterprises that have purchased products / services via the internet, EDI[8] or any other computer mediated network where these are >1% of total purchases
Percentage of enterprises that have received orders via the internet, EDI or any other computer mediated network where these are >1% of total turnover
Percentage of enterprises whose IT systems for managing orders or purchases are linked automatically with other internal IT systems
Percentage enterprises whose IT systems are linked automatically to IT systems of suppliers or customers outside their enterprise group
Percentage of enterprises with Internet access using the internet for banking and financial services
Percentage of enterprises that have sold products to other enterprises via a presence on specialised internet market places

There are significant differences across the 27 European countries in both categories of adoption and use. Enterprises in many countries have made significant progress during the last observation period (from 2007 to 2008). Although the correlation between the rankings of adoption and use of ICT is quite high, some countries do well in adoption and much poorer in use of ICT.

The scores and rankings (see Table 1-10) for adoption of ICT provide a relative gauge of e-business progress in European countries. The Nordic countries, Sweden, Finland and Denmark steadily occupy the top ranks as they have done consistently for the last 3 years. Latvia by contrast is at the bottom of the table. Thus, Latvia is in a distinctly low position surrounded by a highly technologically oriented region. The main conclusion that can be drawn from this fact is that Latvian companies are not well positioned when it comes to integrating into supply-chains or networks of companies within the region, which could have the largest single impact on providing avenues for business development.

Latvia is not alone in this situation however. Together with Portugal and Greece, most of the States from the Eastern part of Europe which joined the EU in 2004 are still in the developing stage of their e-business environment. The general perception is that these countries suffer from the existence of barriers, costs and infrastructure problems which will probably be alleviated by the efforts dedicated to cohesion among the Member States of the

[8] Electronic Data Interchange

European Union. This thesis however, identifies individual firm adoption factors that broaden considerably the understanding of the causes for low adoption and use [223].

The situation regarding use (Table 1-9) is described by Caistings et al., 2008: "The leading position of Denmark is really outstanding. Since the tremendous growth in ICT is mainly due to ICT services, as expected, the country performs very well for all ICT use indicators. As emphasized in an Interim Report prepared for the European Commission in 2004, 'there are huge public investments in IT, extensive funding of research institutions and new incubator environments. There is strong support and commitment from the Public Sector in promoting the ICT Sector in Denmark, thus providing opportunities for public/private initiatives and projects.'" [60].

The contrast to Latvia again could not be higher which also in uses ranks even more markedly at the bottom of the table. The authors of this benchmark analysis observe a higher variability of this ranking of uses (225) which may be the result of the overall lower understanding of this measure. The present thesis will analyze in more depth the conditions and opportunities of use to shed light on this issue.

Table 1-10 2008 e-Business Readiness ICT Adoption and Use – Scores and rankings (Tarantola, Castaings 2008)

ICT Adoption	Score	Rank
Finland	79.50	1
Sweden	77.10	2
Denmark	75.18	3
Germany	73.92	4
Belgium	73.23	5
Netherlands	72.56	6
Norway	72.47	7
Luxembourg	69.61	8
France	68.44	9
United Kingdom	68.35	10
Austria	68.26	11
Malta	67.49	12
Slovakia	66.56	13
Ireland	66.52	14
Slovenia	66.20	15
Czech Republic	64.49	16
Spain	64.24	17
Estonia	61.78	18
Italy	61.68	19
Greece	59.19	20
Portugal	58.16	21
Cyprus	54.91	22
Poland	54.19	23
Hungary	53.81	24
Lithuania	52.36	25
Latvia	47.45	26
Bulgaria	42.91	27
Romania	36.79	28
EU27	**65.22**	

ICT Use	Score	Rank
Denmark	40.79	1
Netherlands	37.81	2
Germany	37.39	3
Norway	36.00	4
Luxembourg	35.39	5
Belgium	35.09	6
Austria	34.54	7
Sweden	34.49	8
Ireland	34.27	9
United Kingdom	33.64	10
Finland	31.26	11
Malta	29.37	12
France	27.18	13
Greece	26.31	14
Slovenia	26.22	15
Italy	25.86	16
Portugal	25.63	17
Czech Republic	24.05	18
Slovakia	23.62	19
Spain	22.67	20
Lithuania	22.54	21
Estonia	22.19	22
Cyprus	20.29	23
Poland	19.32	24
Romania	14.52	25
Latvia	14.35	26
Hungary	14.08	27
Bulgaria	10.67	28
EU27	**28.52**	

2. INFORMATION AND COMMUNICATIONS TECHNOLOGIES – THEORIES OF ADOPTION AND DIFFUSION

This Chapter explores the theoretical assumptions and models used in creating the model of firm level adoption of ICTs that will be validated in this dissertation. Section 2.2 reviews general theories of adoption and their relevance to the particular case of ICT adoption. Section 2.3 continues by discussing the relevance of organisation and management to understanding adoption and has a discussion of the 5 key factors related to adoption decisions. The following section (2.4) reviews the Technology and Environment (TOE) Framework. The TOE Framework gives a structure to external structures and characteristics of technology that might be relevant factors in adoption decisions. Finally, 2.5 describe the specific parts of the models elucidated that are used in constructing the adoption model to be validated in this work.

2.1. General Theories of Adoption

Managers are explicitly and implicitly interested in the diffusion of innovations. Developing the ability to understand and analyze how innovations diffuse leads to the manager being better capable of predicting, managing and exploiting that particular diffusion. This frequently applies to launching and the adoption of new products into the market and can also apply to ICT adoption in an organization. Innovation theories try to explain how an innovation is diffused in a social system over time. The adoption of an innovation, therefore, is part of the wider diffusion process.

Much research has focused on investigating the reasons for adoption at the aggregate level and in developed countries. An example is the Stages Theory, which was proposed approximately thirty five years ago, and was developed to help managers understand the role and evolution of computers in their organizations. It is based on the discovery that plotting the annual computer expenditures of an organization formed an '*S*-shaped' curve, following the patterns of so-called 'learning curves' and 'experience curves'.

Perceived innovation characteristics theory focuses on understanding the impact of 'people differences' and includes analysis down to the individual level. Shifting the main burden of diffusion from the structure to the adopter or the user (the agent or change agent) has also been deemed as agentic theory. Both the perceived innovation characteristics and the agentic theory are espoused by the popular innovation diffusion theory of Everett Rogers [177]. Similar adoption theories are: the theory of reasoned action (TRA) [3], the theory of planned behaviour (TPB) [4;143] and the technology acceptance model (TAM) [8;9;51], all of which include adoption analysis down to the individual level. Yet, diffusion of innovation theories, frequently neglect other important factors such as the influences of workplace and management characteristics, competition, psychological or personal characteristics, cultural attributes, technology perceptions, communications behaviour, economic and socio-demographic attributes all of which may impact the diffusion and adoption process.

2.2. The relevance of the organization and management to ICT adoption and diffusion

Agentic theory shifts the main burden of diffusion from the structure to the adopter or the user (the agent or change agent) of new technologies. This is the most commonly cited diffusion theory in IS (information systems) literature, first published in 1961 and is called Rogers' Classical DOI (diffusion of innovations) theory [177]. A very good review of studies in this area is provided by Fichman, 1992 and 2000. Fichman (1992) coined the term Classical Diffusion Theory referring to Rogers' initial work, which was subsequently extended and adapted by a number of IS researchers [62;148;177].

Rogers' DOI theory discusses the role of five key factors in the firm's decision to adopt: relative advantage, complexity, compatibility, trial ability, and observability. He relies heavily also on the characteristics of the adopters as the primary determinant of adoption. Using these characteristics, the adopters are traditionally classified into four categories: innovators, early majority, late majority, and the laggards [175]. See Figure 2-1 when the focus shifts from adopters to users (end users), the user typology is based on the user profile – e.g., lead users [215], intense users, specialized users, non-specialized users, and low users [212].

Another feature of Rogers' original DOI theory is that it emphasizes the shape of the diffusion curve, describing innovation as a process that moves through an initial phase of generating variety in technology, to selecting across that variety to produce patterns of change resulting in feedback from the selection process, to the development of further variation [177].

Since Rogers' theory, innovation studies have begun to focus more on the underlying factors contributing to the diffusion curve [141;151;177]. Hence, some researchers conclude that technology adoption is more non-linear, dynamic and a less predictable process, rather than the staged model that is presented in Classical DOI Theory [210].

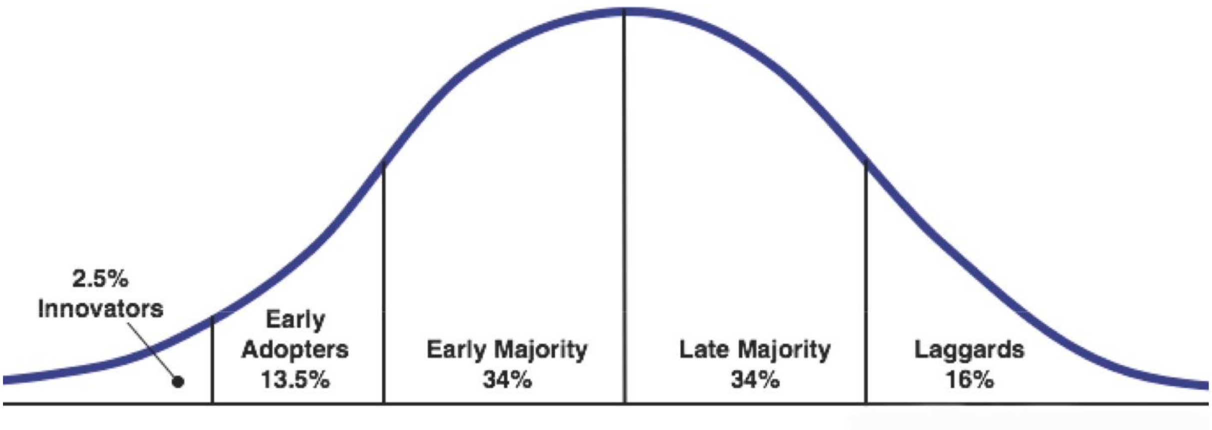

Figure 2-1 Categorization of Innovation Adopters

Source: Adapted from Everett Rogers, Diffusion of Innovations (1995), p. 262

Criticism of Classical DOI Theory is well documented in the literature [40;72;145;148]. The Classical DOI Theory ignores the adoption decisions of other firms, and focuses on individual firms and a 'single innovation' perspective. Thus, while it can be very much applied to the development of online technologies [224], it is not suited to understand diffusion as the sum of the seemingly arbitrary decisions of many firms. The current work is concerned with adoption decisions and does not address diffusion.

Co-invention is another example of how to accomplish non-linear progress either through innovative activity by users or by third parties. For example, third parties such as ICT outsourcing firms or Internet Service Providers may have economies of scale advantages because of their ability to spread the fixed costs of innovation across multiple clients [6;82]. These aspects involve identifying two simultaneous and discrete decisions: outsourcing and adoption, and would require a time series of data, preferably in a single-industry setting, which is beyond the scope of this study.

2.3. The Technology Organization and Environment (TOE) Framework

ICTs diffusion is not completely static (although it can be applied to online technologies, as stated above), and is influenced by supplementing factors. For example, the diffusion process is influenced by external environmental factors which are not fully taken into account in the above mentioned DOI theories [177]. Culture, government policy, technology, and workforce attitudes and skills, all appear to have an influence in ICT adoption and diffusion behaviours [36;75;157;226]. Tornatzky and Klein (1982) were major critics of the dichotomous view (adopt vs. not adopt) of technology adoption and Tornatzky and Fleischer (1990) subsequently developed the technology-organization-environment (TOE) to provide a framework describing innovation adoption [207].

The TOE framework postulates that the decision to adopt a technological innovation is based on factors in the organizational and external environment as well as characteristics of the technology itself [116]. TOE specifies three types of factors that influence adoption: the technological context (including both internal and external technologies of the firm), organizational context (defined in terms of size and scope, characteristics of the management structure, and quality and degree of its human and slack resources), and environmental (or institutional) context which refers to the firm's industry and dealings with business partners, competitors and government [207].

The TOE framework has been examined in a number of empirical studies and is considered to provide a solid theoretical basis for identifying facilitators and inhibitors of e-business adoption [94;227]. For example, in the past few years, Electronic Data Exchange (EDI), a predecessor of Internet-based e-business, has been studied extensively using the TOE framework [39;94;116;170].

The TOE framework has also been examined in the e-business world, since e-business is enabled by technology development [107], requires organization enablers, may require necessary business and organizational reconfiguration [34], and may shape, and be shaped by, the strategic environment [115]. For example, Zhu applied the TOE framework in the financial industry to explain determinants of e-business intent to adopt, finding support for the importance of technology readiness, financial resources, and firm size, as well as the regulatory environment [227].

2.4. Models used to analyze the adoption and diffusion of ICTs in Latvian companies

From the perspective of theoretical frameworks, the agentic theory of Rogers and the TOE framework are used for the construction of the theoretical model [207]. These models highlight the importance of idiosyncratic and firm specific factors in the adoption decision, and guide this interpretation of technology diffusion considering ICTs as a general purpose technology (GPT) in search for innovative uses in emerging economies. A "rank model" is then used as the methodological framework for empirical testing of the importance of individual firm's decision factors.

The firm specific factors of technology adoption (Table 2-1) provide insights that will allow selecting and formulating hypotheses.

Table 2-1 Firm specific factors influencing ICTs adoption

Perceived benefits	Cost reduction
	Market opportunities
	Input factor efficiencies
Perceived obstacles	Cost
	Technology sufficiency
	Technology compatibility and intensity of changes
	Human capacity to absorb the new technology
Other factors	Environment and culture
	Work environment and management practices
	Market and competition factors
	Innovation orientation of the firm and its leadership

A combination of epidemic, rank, order, stock and supply-side effects can influence the diffusion of a given technology. In fact, a broad range of factors is likely to affect technology diffusion. As discussed in Karshenas and Stoneman (1993), theories of technology diffusion fall into four categories: epidemic models, rank models, order models, and stock models. The factors emphasized in the theoretical models include information and learning, the characteristics of the potential adopters, specific characteristics of the particular technology and resources. Dissemination of information about the new technology drives diffusion in the epidemic model. Adoption in rank, order, and stock models results from learning by doing and the spread of technical information cause. Differences in firm-specific characteristics such as capital vintage, firm size, beliefs about the return on the new technology, search costs, input prices, factor productivity, and regulatory costs, drive diffusion in the rank model. In all the models the characteristics of the new technology such as risk, average return, and intellectual property restrictions affect the net return on adoption. Limitations on the supply of a critical input into the new technology drive diffusion in order models. The effect of adoption on average production costs and on the price of output drives diffusion in stock models [106].

The method to analyze the adoption decision from a methodological point of view will be a rank-model. According to rank-models, observed diffusion patterns depend on the heterogeneity among firms. In this view, firms differ with regard to some critical variable that affects the expected present discounted profitability of the new technology relative to the old one - the "net return on adoption" for short. The critical variables in this type of model are capital vintage, firm size, expected benefits, search costs, input prices, factor productivity, and regulatory costs.

Given that firms are heterogeneous across these variables, they may be 'ranked' according to their net return on adoption. Rank models hypothesize that firms adopt at different times because they differ with respect to some critical variable that affects their net return on adoption. This is the main reason to select rank models to build the empirical testing tool used in this study.

The “rank models” address the shortcomings of the epidemic model [132]. According to this theory, as diffusion proceeds, non-adopters glean technical information from adopters via their day-to-day interactions with them, just as one may contract a disease by casual contact with an infected person. Importantly, the probability of a non-adopter becoming "infected" by contact with an adopter is not the same for every technology; it depends on characteristics of the technology such as profitability, risk, and the size of the investment required. Epidemic models have been criticized because they assume that all firms have an equal chance of becoming infected [49;196]. This clearly is not the case, as firms with large cash reserves, higher rates of capital replacement, and better managers, would naturally seem more prone to adopt than other firms are; and also, because there is no explicit explanation for how firms' profit maximizing goals could generate the hypothesized aggregate behaviour.

2.5. Analysis of firm specific factors in adoption decisions

Efficiency and productivity has become a prominent field of research due to the changed work practices introduced by the rapid spread ICTs over the last 15 years. In addition to attempts to link ICTs to macro-economic, results discussed in the previous chapters, this review looks at studies that have studied the micro level of **perceived benefits** of reducing costs, increasing the efficiency of inputs and increasing sales.

There are three classes of studies of ICTs induced efficiency. First, those research efforts on the benefits of specific ICTs [39;94;116;170]. Second, research that uses firm specific and environmental factors to explain productivity growth. Third, research efforts that have analyzed how the introduction or more intense use of ICTs in the presence of complementary organizational changes [16;28].

Ramamurthy et al. (1999) identified the benefits from EDI as including lower costs, improved coordination with trading partners and customers, and improved productivity. B2B e-commerce benefits are seemingly similar: lowering purchasing costs, reduced inventory levels, and shorter cycle times [73;170]. In US industries, for example, cost savings from B2B e-commerce – as a percentage of total input costs – vary from 2% in coal to 40% in electronic components [43]. Poon identifies the value of Internet processes improve communications, effectiveness to gather research and competitor information, and support promotions to increase sales [164]. Napier et al., 2001, pointed out that by implementing and using e-commerce, sellers can access narrow market segments and buyers can benefit by accessing global markets with larger product availability from a variety of sellers at reduced costs. Perceived benefits leading to increased sales include also improvement in product quality and the creation of new methods of selling existing products [35].

For firms in developed economy, Bresnahan et al., 2002, report that ICTs use is closely associated with practices that represent significant economic benefits [25]. These include a transition from mass production to flexible manufacturing technologies, changing interaction between suppliers and customers (mostly resulting in closer relationships), decentralized decision making and other organizational transformations, greater ease of coordination, and enhanced communication. These complementary technological and organizational changes enhance the market value of firms [29].

For small and medium sized enterprises (SMEs), e-commerce can ‘level the playing field’ with larger businesses, provide location and time independence, and ease communication [94]. SMEs have greatly benefited, by exploiting international opportunities, on a global scale, utilizing the internet [47;124].

These perceived benefits relate more closely to incremental benefits and should be positively related to intensive use of ICTs. The expectations of the theoretical model are that in the circumstances of an emerging economy, incremental benefits will influence sophistication of use of ICTs to a lesser degree than in developed economies, and compared to innovativeness related benefits.

The **perceived costs** and the technological integration and implementation difficulties act as main barriers to adopt and implement ICTs.

There is substantial empirical evidence to support that the availability and use of financial resources are an important factor in adoption decisions [168;170], especially by SMEs [166;195]. However, in a recent study of SMEs in the UK, cost was not perceived as an inhibitor to adopting e-commerce [188].

Bryniolfsson and Hitt stress the importance of ‘complementary investments’, including training, as being up to ‘ten times as large as direct investments in computers’

[28;65]. Firms that are able to make a greater investment in hardware, software and technical training are likely to conduct e-commerce more extensively [75].

The specific class of **technologies** and/or business processes need to be considered in the discussion of acceptance of technology and its adoption [14]. A review of the broad literature on acceptance and adoption of technology by organizations identifies at least eight models of technology acceptance [52;213].

Technology readiness and competence have been identified as important determinants in specific ICTs adoption, for example, e-commerce [39;94]. The principal determinants are the firm's technical competence including infrastructure, IT expertise and e-business know-how [116], the firm's size and business sector and its commitment to 'deep usage' of Internet technologies [225].

The idea of 'deep usage' means the integration of separate data bases and different information systems to improve responsiveness and reduce incompatibility among computer applications [225]. However, the technical difficulties to implement technically integrated systems increase the perceived cost and the required competencies.

When evaluating a technology as above, the characteristics can differ from firm to firm. Companies in service industries are more likely to adopt the Internet than those in manufacturing industries. Also, the Internet is less expensive than EDI to implement (higher relative advantage) (UNCTAD 2000b, 11) and has higher observability [41].

The firm's ability to absorb and use knowledge from external sources for its own innovativeness is a major determinant of innovation performance in general and of technology adoption in particular. However available and low cost ICTs may continue to become, their use in the context of a firm requires learning and adaptation. These "**absorptive capabilities**" [219] consist of the endowment with human and knowledge capital (for example, the accumulated earlier experience with more simple versions of processes and ICTs; the education level of the labour; training, etc.). Similarly, Bresnahan et al., 2002, present evidence of the connection among three related innovations: technological change, complementary workplace reorganization, and new products and services [24]. These constitute a significant skill-based technical change in the labour market. They found that companies need to decentralize decision making and adopt other 'high performance' workplace practices, in order to implement new technologies successfully.

Evidence for the importance of learning effects is presented, for example, by Caselli and Coleman, 2001, Lee, 2000, Kendall et al., 2001, Colombo and Mosconi, 1995, McWilliams and Zilberman, 1996, or Kiiski and Pohjola, 2002. For example, companies that provide e-business training for their employees and increase their knowledge of e-business can expect to achieve higher levels of e-business systems adoption [32;108;110;119;120;134]. Establishing these knowledge management mechanisms and leveraging these knowledge assets are requirements for successful technological and organizational innovation and adoption [20;84].

Recruiting of skilled labour will also increase the firm's absorptive capabilities [1]. Bresnahan et al., 2002, even suggest that organizational investments in assets which are complementary to ICTs may contribute more to raising the relative demand for skilled labour than the diffusion of ICTs themselves [24]. Basu et al., 2003, suggest that these complementary investments will have positive, lagged effects on a company's future performance [13]. Absorptive capacity should be positively related to intensive use of ICTs and their sophistication of application.

2.5.5. Innovativeness (market competitiveness, value chain presence, clustering)

Nicholas Carr (2003) argues that IT-intensive processes are becoming less and less sources of competitive advantage because they are becoming homogenized [32]. However, many scholars still believe that with proper planning and execution IT processes can be a source of competitive advantage and can make a positive difference in the performance of a company [108]. This is especially the case when the firm pursues benefits from the sustained introduction of unique products and services, rather than rely on low-cost inputs [165]. This choice seeks to connect the firm with the opportunities in the environment and affects all aspects of a company's business, from product positioning to internal organization. This definition allows understanding that the impact of ICTs requires discriminating differences between adoption and usage. The commitment to 'deep usage' of Internet technologies is one of the characteristics of innovative applications that extend the value of the business. One way to think of deep usage is also as intra-firm diffusion relative to inter-firm diffusion [196]. Intra-firm diffusion is the phenomenon of technology use and diffusion within a specific firm.

The intensity of competition refers to the degree that a company is affected by its competitors. One view is the probability of adoption by a firm at a given date is positively related to the proportion of firms in the industry who have already adopted [99]. Porter and Millar (1985) analyzed the strategic rationale underlying this hypothesis suggesting that, by adopting ICTs, firms might be able to alter the relative positions of competition, affect the industry structure, and leverage new ways to outperform rivals, thus changing the competitive landscape [165; 227]. Devaraj & Kohli, 2003, argue that ICT usage is a much better predictor of performance than is ICT adoption at the firm level. Hence, there are much broader factors, other than the technology itself, which are frequently intertwined, that play a role in technology and e-commerce diffusion, acceptance and use.

Three aspects of ICTs impact on innovativeness are integration of processes, enabling of communications through collaborative processes, and the integration and communication across technology clusters. First, integration of processes provides effectiveness and efficiency which can unveil hidden complementary resources which are difficult for competitors to imitate, hence creating significant e-business value and driving continued use of e-business in organizations [227]. For example, Mukhopadhyay and several co-authors have examined the impact of ICT investment on supply chain performance [45;92;126;149]. The greater the mutual dependence between a firm and its suppliers, the greater the likelihood that firms will diffuse ICTs among its supplier networks. This supplier interdependence lowers the switching costs of business-to-business relationships with suppliers which, in turn, cause dynamics with respect to the choice of supply chain partners to increase favouring innovation [117].

Second, the use of ICTs to facilitate communication among managers (collaborative practices) is very common across functional and geographic areas, especially in MNCs, and facilitates superior financial performance through implementation of strategic opportunities. Traditionally, face-to-face personal interaction has been the most-practiced method of exchange of knowledge in business [125].

Now the exchange of knowledge can also be facilitated electronically. From a process perspective, there is higher uncertainty and complexity associated with information being transferred electronically [69;209]. The use of computers and electronic correspondence best accommodates communications needs that support the exchange of unstructured and non-quantifiable soft information [58;70;209]. However, a lack of readiness of customers and suppliers to integrate their supply chains has been identified as a key barrier to e-business adoption. Findings in South Africa indicate that e-commerce benefits are, by and large, limited to improvements in intra- and inter-organizational communications. More strategic benefits relating to market access, customer/supplier linkages or cost savings were not found in the majority (more than 80%) of organizations surveyed.

In SMEs, e-commerce adoption is thought to progress through several stages and evolve as businesses recognize the benefits. An early study of SME Internet adoption finds SMEs followed a path similar to large firms [163]. Costello and Tuchen (1998) suggest that firms first publish information on the Web, and then interact with customers and finally processes are transacted electronically. A further stage of integration focuses on full supply chain integration [45]. While Internet systems are necessary to develop these processes, value arises once businesses use the knowledge and experience to produce outputs accessible through the Internet [223].

Another aspect of importance is the concept of technology clusters. The notion of clustering derives from the fact that a technology does not develop alone but is related to and depends on other technologies as well as infrastructures, institutions, networks of actors etc. As postulated by Silverberg (1991), adoption and diffusion of technology occurs as a collective evolutionary process.

The members of a cluster are related by multiple links that contribute to magnify their economic, social and environmental impacts [83;85;187]. Innovativeness in the empirical study should be positively related, through all the above factors to sophistication and depth of use of ICTs.

2.5.6. Regulatory and cultural determinants

The above mentioned research tends to assume that adoption of innovations is a rational decision aimed at improving technical efficiency [203]. This may not be the case. For example, the adoption of interactive technologies, such as the Internet, is also influenced by the institutional environments in which the firm is embedded [75]. These institutional environments consist of suppliers, competitors, customers, regulatory agencies, etc., and are important in shaping organizational structure and actions [184;185].

Although external pressures to adopt come from customers, and suppliers, employees are also a major influencing factor [164]. Employee readiness for internet adoption is directly linked to **attitudes and past experiences regarding the adoption of technology** by the organization [53]. E-commerce initiatives will not reach their full potential if the organization’s workers cannot adapt to the changes in processes caused by e-commerce [134]. Managerial factors, especially the project leader, play a major role and is mentioned as being essential in innovation processes in firms [177].

The effectiveness of most types of e-business increases as user numbers increase, and thus e-business has network externalities characteristics [127]. For example, the lack of readiness of customers and suppliers has been identified as a key barrier to e-business adoption [11]. As benefits rise with increasing numbers, so too does pressure for other supply chain organizations to adopt [201].

Organizational culture plays a role in the accepting and adopting of ICT. It then comes as no surprise that companies that are attracted to e-commerce tend to be more entrepreneurial, risk takers, innovative and creative [163]. In addition, the nature of the cultural influence may be dictated by industry conditions [204].

For SMEs, the major factors embracing Internet adoption include the enthusiasm of top management [43;197], organizational readiness, compatibility of e-commerce with the work of the company, relative advantage perceived from e-commerce, and knowledge of the company's employees about computers [138;144].

Government policy and the regulatory environment can play a significant role in firms' ICT adoption [53]. Although research has shown that government support and incentives have been less effective in developed countries such as France, Germany and the Netherlands [27;114;154;181], government incentives and subsidies have been identified as important factors of ICTs adoption in newly industrializing countries such as Singapore and Taiwan [36;226] and developing countries such as China, India, Mexico, Brazil and other Latin American countries [48;147;154;157;201;206].

An inadequate legal system, or inadequate laws, which do not protect business, may hinder the spread of e-commerce. One of the biggest barriers to e-commerce use is privacy or security concerns about fraud or credit card misuse due to the lack of protection of Internet transactions [76]. Countries without 'rule of law' with regard to adequate legal infrastructure and protection that facilitate transactional safety for e-commerce will fall behind those that do [156].

As cited by Indjikian and Siegel, 2005, a recent study by McKinsey, 2004, noted that the main impediments in India are the 'monopolistic position of the foreign owned telecom carrier, lack of supporting environment, and a right set of government policies'. Even in the United States, government legislation has not worked with regard to recognizing electronic signatures, which have not caught on [95]. On the other hand, "boosted by superior ICT government readiness and usage," Estonia was cited as a positive 'surprise', ranking No. 24 overall, in the GITR 2002-03 study made by the WEF (World Economic Forum 2002-03), because of its focus on e-government.

Firm size and firm age are two explanatory variables which are used in most studies of adoption behaviour [106]. The analysis for this dissertation showed that no correlation to age was present, partly due to the irrelevance of the measurement prior to liberalization of the economy after the end of the Soviet rule period. Therefore, the variable of firm age was eliminated from the analysis altogether, without loss of significance, since the theoretical arguments with respect to the role of firm age are not conclusive [55].

The analysis considered only firm size, which is expected to be positively related to adoption. Firstly, firm size may be a determinant of adoption, to the extent that it stands for firm-specific effects not explicitly modelled (capacity to absorb risks related to future ICT developments, economies of scale, breadth of marketing objectives, complexity of business processes, etc.). Secondly, firm size may function as a proxy for variables of the model when it is strongly correlated with them (size-dependence of the model).

3. MANAGEMENT MODEL FOR ICT ADOPTION AT THE FIRM LEVEL IN DEVELOPING ECONOMY COUNTRIES

The main objective of this section is to formulate an equation explaining the decision to adopt ICTs based on a set of firm-specific factors determining the profitability, and the potential of use of new technology. Firstly, the model will incorporate those factors that are known through previous empirical studies in more developed countries, to assess the relative differences in explanatory power of the same factors, in a less developed economy. Secondly, the model will attempt to identify factors that are of specific relevance to the circumstances of an emerging economy.

The characteristics of emerging economies that deserve special consideration are: the relative lack of immediate available objectives to apply ICTs in a sophisticated way; the limited value of copying application patterns corresponding to more developed economies; and, the still substantial backlog of process adaptation from a very low level in the post-Soviet era, which saddled the economy with a significant burden of process adaptation and job creation. In particular, the model incorporates factors to measure the importance of an orientation towards innovation and competitiveness; and, factors to measure the prognosticated higher influence of cultural determinants. This model, and the empirical validation with Latvian data, seeks to add an in-depth look of diffusion of ICTs outside the main markets so broadly studied before, and where many of the usual paradigms seem not to apply (see analysis in Chapter 2).

This chapter presents the theoretical support for the constructs used in the model, and presents the hypothesized behaviour of the variables.

3.1. General Framework

The approach of the dissertation belongs to the category of "rank models" within the general conceptual framework proposed by Karshenas and Stoneman, 1995. Rank models consider diffusion patterns as the result of the sum of independent decisions by heterogeneous firms. In the rank model, it is assumed that potential users of a new technology differ from each other in important dimensions, so that some firms obtain a greater return from new technology than others do. For the adoption of ICTs the model postulates that, firms perceiving a greater net advantage from adoption due to more predictable process factors will adopt ICTs more intensely; while, those firms perceiving innovation and competitive opportunities, will adopt ICTs in more sophisticated ways (more uses); and, those with greater perceived environmental obstacles, will show lesser intensity and sophistication (fewer uses) in their adoption of ICTs [106].

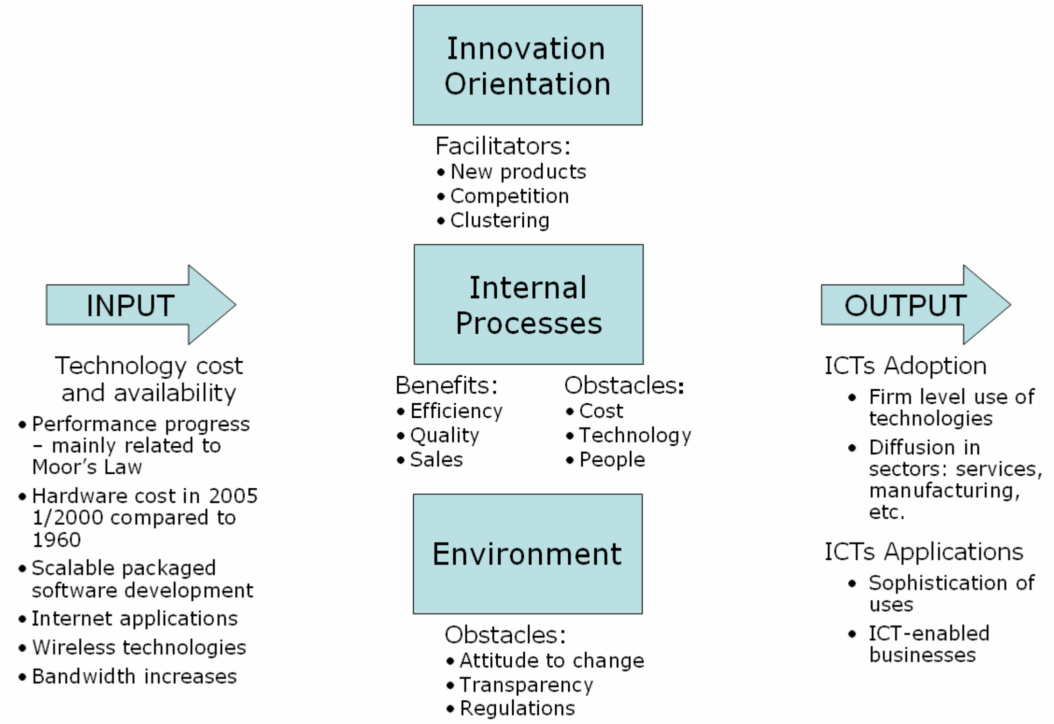

Figure 3-1 ICTs adoption factors

Source: Author

Figure 3-1 describes the relationships studied in the model that will be examined in detail in the present Chapter. The availability of inputs in the form of fast evolving technologies, of broad applicability and falling costs, characterize ICTs as general purpose technologies (GPTs) and provide generally favourable conditions for adoption. Several groups of factors can potentially influence (positively or negatively) a firm's profitability from adopting new ICTs and therefore the decision to introduce it at a certain time.

In the basic model, the self-determined circumstances of each firm discriminate between a first group of factors, consisting of the net benefits associated with efficiency, quality and sales improvement; and, a second group, consisting of obstacles such as cost and technology. In the extended model, the analysis broadens the explaining factors with new potential opportunities represented by innovation and deeper embedding in value chains; the presence or lack of human capital to absorb the necessary knowledge; firm size; and a group of environmental variables that measure the cultural context.

3.2. The effect of internal process improvement objectives and barriers on ICTs adoption in emerging economy firms

The first group of factors (Figure 3-2) is related to the internal processes of the firm, and refers to variables that are prognosticated to provide a positive influence on the adoption decision, in the form of favouring a more intensive use of ICTs. These variables include anticipated benefits of ICTs such as: higher sales, through for example, better information exchange with customers, reduced transaction costs, more accurate coordination of sales, access to more clients or new markets. In addition, ICTs may lead to higher product quality in various ways, for example through increased consistency of specifications and repeatability of processes, increased manufacturing flexibility and supply of complementary services that may ensure higher customer satisfaction and performance of the products sold. Secondly, benefits also include reduced costs and efficiencies of a general nature (e.g. higher flexibility, improvement of product quality, etc.) in various ways [27;45;179]. Applied to internal processes of the firm, ICTs may reduce capital needs through, for example, shorter cycle times that reduce working capital requirements. They may enable labour to accomplish more work reducing the total amount of labour required, or substitute for specific labour skills (e.g. sales staff, low-skill workers). Thirdly, ICTs may increase the efficient use of inputs in general for example achieving better supplier agreements, higher yields of raw materials, and utilization rates of equipment, for example trough better planning and information.

A second group of factors in the basic model (Figure 3-2) is also related to the firm's internal processes, represented by variables that, according to literature, should negatively influence the adoption of ICTs. The obstacles are grouped in two variables: one, the costs associated to implement or operate the new systems, including the time and effort distraction from other business needs, when perceived as high by the firm; and two, the availability of technical competencies and the difficulties to implement the technologies (e.g. compatibility with existing systems, degree of system and process changes, need for systems integration, etc.

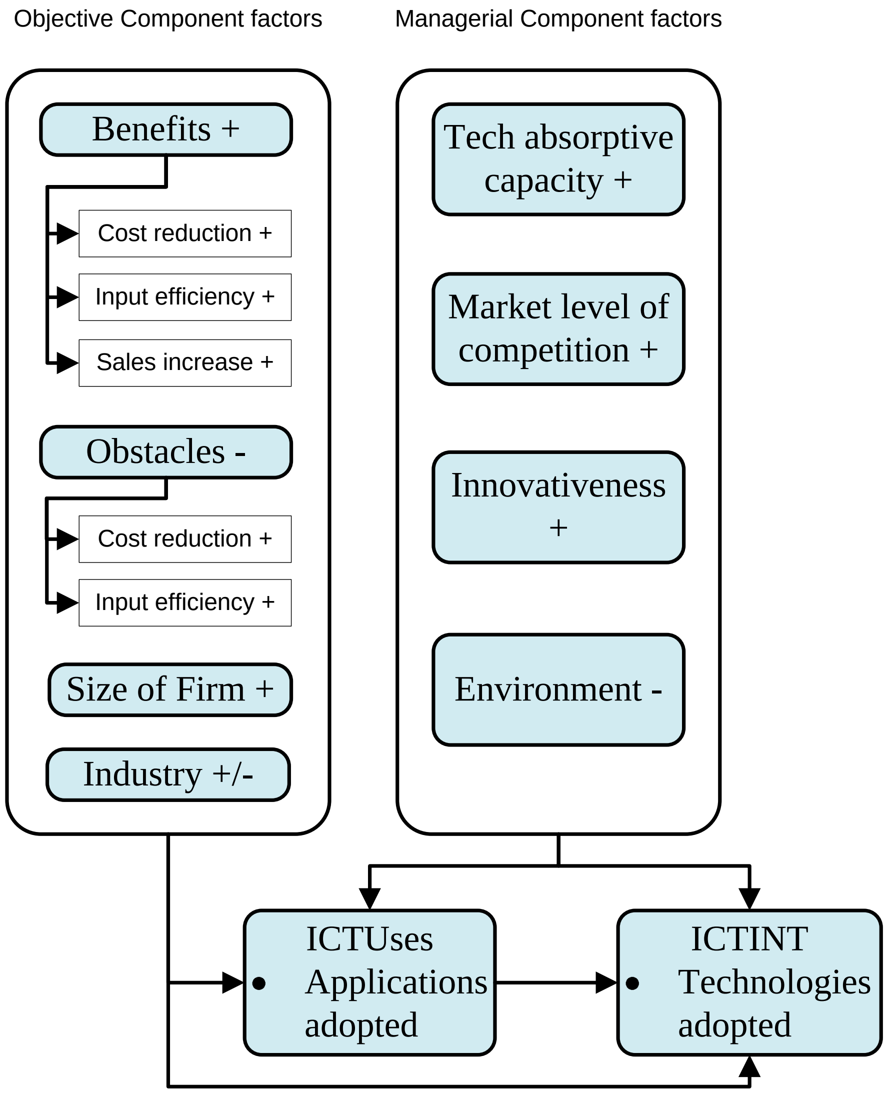

Figure 3-2 ICTs adoption and use diffusion model

Source: Author

3.3. The effect of the perception of innovation and new market opportunities on ICTs' uses - advanced applications (and drive ICTs adoption) in emerging economies

In contrast to those factors in the first group, related principally to efficiency, these variables (Figure 3-2, right side) reflect more closely perceived growth opportunities in new markets or segments, and human resources determined capabilities to adapt to these opportunities. First, is the human technology absorption capacity [112;221], represented by the availability of ICT skills, training, availability and accessibility of information and knowledge, in addition to top management competencies in the area of ICTs adoption and change. Management capabilities, workplace practices and organisation are considered due to the positive impact on productivity from ICTs adoption [10].

A second variable is measured by the expected impact of competition and perceived situation in the market, including the expectations and results of prior experiences. A third variable is innovativeness measured by the percentage of sales coming from new or modified products and services, and innovations introduced resulting from collaborative efforts with suppliers and clients. The impact of these variables is hard to estimate, because they are not granted so much by the existing business processes, consistent with [48], as much as by collaboration and other opportunities to create new products and services. Theory allows to expect that larger firms should produce more innovations and have more uses of ICTs, however the prediction of the empirical analysis expects to uncover that in an emerging economy, smaller and newer companies will evidence a higher disposition to develop new products and services collaboratively, and display a higher use of ICTs, than larger and more affluent companies.

3.4. The influence of the environment, through external regulation and cultural attitudes on the adoption of ICTs and their uses, in emerging economies

A further contribution of the empirical study is to compare the influence of system externalities by the incorporation of variables for the perceived regulatory and cultural obstacles and incentives. Cultural variables include for example attitudes towards change (e.g. within the company, from suppliers and customers); attitudes towards collaboration (attitudes towards sharing information and operating collaboration processes); and, clustering effects (multiple interrelated technology and business process diffusion contribute to the evolution of new business models, products and services) [187]. Other external variables include the degree to which regulations and transparency are perceived as obstacles to adoption (e.g. predictability of future expectations, obstacles and standards set by regulations). These variables could have a potentially positive or negative effect on the adoption of ICTs [98], and, in the case of more ICT uses, should reveal a negative influence. In particular, larger and older firms are expected to be more sensitive to the adaptation backlog from cultural factors, and to the regulatory burden, negatively impacting adoption of more sophisticated ICT applications.

The further sections of this chapter present the main constructs of the model, and propose testable hypotheses for use during the empirical validation of the model.

3.5. Definition of the variables used in the model (Research Constructs) and prediction of their impact on the adoption decision by firms

3.5.1. ICTs adoption variables

The database collected during this thesis allows constructing various adoption variables. The first category of measures refers the intensity of use of ICTs at a given point in time measuring what are regarded as the general applications and tools of ICT in recent index benchmarking studies (for example, The 2008 European e-Business Readiness Index) and recent empirical studies [93]. In addition, there is information on the actual and planned use of the Internet for e-mail, online sales and online purchases.

The general adoption scores on all international benchmarks are very low for Latvia (as indicated in Chapter 1) and the construct shall serve to investigate this situation in more depth. However, based on the review of theory (see Chapter 1 through 3), the expectation from the empirical research is that it will indicate that adoption is low due to a combination of factors in the basic model: firstly, a low perception of benefits (e.g. related to a low wage environment, many small firms and entry level business processes); and secondly, high perceived obstacles (e.g. backlog problems from the Soviet period, the lack of a cultural experience of collaborative experiences to solve efficiency issues) principally not related to cost, as cost would become noticeable only when attempting ore complex objectives. On a sector level, the model will seek to identify differences and expects to find that the cluster effects and external regulations have a significant explanatory power (e.g. higher adoption in services and communications, lower in construction, and grey areas in government, manufacturing and others).

The information on the within-firm diffusion of certain technologies (*Table 3-1*) is used to construct the variable for adoption intensity (ICTINTENSE). The results refers to the adoption of ICTs which is calculated in a four level ordinal measure of the overall ICT adoption, defined as the number of ICT elements (listed in *Table 3-2*), ranging from value 3 for the highest adoption (up to all 15 ICTs) to value zero for firms adopting 3 or less ICTs.

Table 3-1 Adoption variables

	Variable Definition
ICTINTENSE	Overall intensity of ICT use in 2005 Based on the number of ICT elements adopted up to 2005 (see Table 2) 10-15 tech (value 3), 7-9 tech (value 2), 3-6 tech (value 1), less than 3 tech (value 0)

The count data information (0 up to 15 technologies) is rescaled into ordered categories (ordinal variables) to reduce the effect of the difference importance each of the elements may have.

Table 3-2 ICTINTENSE, ICT elements measured for adoption

Variable: ICTINTENSE	
1	Webpage
2	Internal e-mail
3	External e-mail
4	LAN
5	WAN
6	Intranet
7	Extranet
8	PBN
9	EDI
10	Video conferences
11	PDA, Laptops, WAP-telephones
12	Remote terminals
13	Wireless LAN
14	Wireless WAN
15	Numerical control processes

3.5.2. ICTs usage variables

Table 3-3 gives an overview on the empirical specification of the variables which reflect the factors determining technology adoption as set out in Chapter 2. The model presents results for five variables; however, due to low general implementation of these uses, the variables were combined into one dependent variable only (ICTUSES).

Table 3-3 ICTUSE, ICT applications in place

	Variable Definition
INTRAPPS	Based on the number of intranet applications adopted up to 2005; 9-11 apps (value 3), 6-8 apps (value 2), 3-5 apps (value 1), less than 3 apps (value 0)
VCHAINPLAN	Based on the number of value chain apps for collaborative planning adopted up to 2005; 9-11 apps (value 3), 6-8 apps (value 2), 1-5 apps (value 1), 0 apps (value 0)
VCHAINTOOLS	Based on the number of tools in use for value chain purposes adopted up to 2005; 9-12 apps (value 3), 6-8 apps (value 2), 1-5 apps (value 1), 0 apps (value 0)
ONLTRANS	Based on the number of Information and Transaction types online up to 2005; 9-13 transaction types (value 3), 6-8 transaction types (value 2), 1-5 transaction types (value 1), 0 trans. types (value 0)
INTERINT	Based on the number of internal systems integrated up to 2005; 5-6 systems (value 3), 3-4 systems (value 2), 1-2 systems (value 1), 0 systems (value 0)
ICTUSES (summary variable)	Based on the number of all types of applications adopted up to 2005; 9-25 apps (value 3), 4-8 apps (value 2), 1-3 apps (value 1), 0 apps (value 0)

3.5.3. Objective component of the model adoption explanatory variables – Benefits

This set of variables refers to the objectives of ICT adoption which are interpreted as proxies for anticipated revenue increases (benefits) due to the use of new ICTs. The evidence to support this interpretation can be justified on grounds of the research presented in Chapter 2. The variables listed in Table 9 are factor scores resulting from a principal component factor analysis of 21 objectives of the use of ICTs included in the questionnaire (for details on the factor solution see Table A.5.e and A.5.f in the Appendix).

Table 3-4 Objective component explanatory variables – benefits (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	**Variable definition – hypothesis**	**Predicted Impact (sign)**	
		Adoption	**Uses**
MKT_BIZVALUE	Increase sales and market value promotes adoption	+	+
MKT_SHARE	Improve market share, number of clients in new and existing markets	+	+
MKT_COMPETE	Improve competitiveness relative to others in the market	+	+
MKT_EFFICIENT	Increase market and brand recognition from ICT adoption	+	+
COST_RED	Reduce costs and improve efficiency are reasons to adopt ICT	+	+
INPUT_SUPP_CLI_COMMS	Improve communications with suppliers and employees increases efficiency and promotes adoption	+	+
INPUT_VALUEADDED	Focus on core and higher value added result from ICT adoption	+	+

The first four factors are related to anticipated benefits on the revenue side; in addition to higher sales in general, ICTs are expected to yield benefits from higher quality, more variety, the supply of complementary services, stronger presence at the market and stronger customer-orientation.

Factor five is related to the expected cost reduction and efficiency gains. The sixth and seventh factors refer to advantages from improving relationships on the input side (labour and cooperation with suppliers, and internal efficiencies).

The expected influence from these seven variables on the adoption of ICTs should be positive according to the literature (see Chapter 2).

3.5.4. Objective component of the model of adoption explanatory variables – Obstacles

Table 3-5 gives an overview of the obstacles to the adoption of ICTs identified in Chapter II that should show a negative sign leading to less intensive adoption of ICTs. The variables reflecting impediments to the use of ICT, from a cost and technology sufficiency points of view, are the result of a principal component factor analysis (for details of the four-factor solution, which is based on the firm's assessment of the relevance of 9 obstacles to adoption and explains 63% of the variance, see Table A.5.g. in the Appendix).

The four variables, with the exception of the factor standing for problems of ICTs implementation costs and investments, reflect people abilities, uncertainties, and adjustment costs, related to the introduction of ICTs. The variable (IMP_OBST_ TECHN_RELIAB) captures the fact that in some instances there is hardly a "real potential" for using ICT. These variables have up until now been considered only in very few studies [91] and have not been studied in the context of developing economies.

Table 3-5 Objective component explanatory variables – obstacles (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	Variable definition - hypothesis	Predicted Impact (sign)	
		Adoption	Uses
IMP_OBST_COST	Implementation costs too expensive, maintenance costs to large, lack of time obstruct adoption	-	-
IMP_OBST_TECHN_SYSTINTG	Insufficient compatibility with existing ICT and work organization obstruct adoption	-	-
IMP_OBST_TECHN_KNOWHOW	Lack of knowledge of the technologies and personnel objections obstruct adoption	-	-
IMP_OBST_TECHN_RELIAB	Low reliability and unclear benefits obstruct adoption	-	-

3.5.5. Objective component of adoption explanatory variables – Firm size and industry

Firm size is measured by dummy variables related to four size classes based on the number of employees with large firms (250 and more employees) as reference group. Table 3-6 in this specification, a positive sign stands for negative size effects. A negative sign thus, with reference to the large firm group, would indicate a positive effect of smaller firms. The expected theoretical result in the model is uncertain. On the one hand, theory (see Chapter 2) suggests large firms would typically have more resources and opportunities to benefit; on the other hand innovativeness (Chapter 2) is expected to be stronger in smaller companies in consideration of the backlog of adaptive changes required in larger companies, suggesting more obstacles and implementation difficulties for the later. Thus, the prediction of size effects is uncertain.

Industry dummies are introduced using the financial services sector as the reference category. Table 3-6 in this specification, a positive sign stands for negative industry effect. This last element of the basic empirical model, captures differences with respect to opportunities and demand prospects (more scope for ICTs in industries using technologies intensively e.g. banking) and other not explicitly specified factors determining a firm's propensity to adopt ICTs.

Table 3-6 Objective component explanatory variables – firm size and industry (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	**Variable definition - hypothesis**	**Predicted Impact (sign)**	
		Adoption	**Uses**
SIZE	4 dummy variables based on the number of employees: S0-9, S10-50, S51-250, S251 (firms with 250 and more employees as reference group)	+/-	+/-
IND	8 dummies; primary, manufacturing, construction, retail & wholesale, transportation & communications, finance, services, government	+	+

3.5.6. Managerial component of adoption explanatory variables – Technology absorptive capacity

Table 3-7 gives an overview of the technology absorptive capacities for the adoption of ICTs identified in Chapter 2. The technology absorption capacity is expressed by four variables, resulting from scores of a principal component factor analysis of the importance of 7 factors (see table A.5.h in the Appendix). The questions are formulated and scored in such way that a positive answer should show a negative sign leading to less intensive adoption of ICTs and less uses.

Table 3-7 Managerial component explanatory variables – Technology absorptive capacity (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	**Variable definition - hypothesis**	**Predicted Impact (sign)**	
		Adoption	**Uses**
ABSORB_ATT	Negative attitudes of personnel towards change, people attitude to learn do not support adoption	-	-
ABSORB_FIRM_ATTITUDE	Negative attitude of the Firm to change promotes adoption and use	-	-
ABSORB_CAP	Insufficient capabilities of mgmt know-how, and use of training and outside resources do not supports adoption	-	-
ABSORB_EMPL_KNOW	Employee level of knowledge	-	-

The first two variables used to measure the availability of human and knowledge capital are general measures of the firm's attitude to assess technological opportunities and to use external knowledge for own innovative activities. The variables measure on a five-point scale the attitudes towards change (from "avoid change at all cost" to "change is normal and we adapt to it"). The third and fourth variables are more directly linked with ICTs understanding and capability to implement the changes; they measures the practices of training and the use of third party resources as a proxy for the firm's specific availability or ability to get knowledge in ICT.

The amplification of the concept of training by the use of third parties complements the variables considered previously in the literature. The ABSORB_CAP variable in this group is the self-assessed readiness of management to perform technology and process changes, a dichotomous measure used to take into account the theories of Rogers (see Chapter II) according to which the presence of a leader or change agent is a precondition for successfully adapting to change.

3.5.7. Managerial component of adoption explanatory variables – Market competitiveness

The managerial component of the model includes as additional variables various elements of market conditions and general levels of competitiveness as an incentive to adopt ICTs and use them in more sophisticated ways. The market competitiveness is expressed by four variables (Table 3-8), resulting from scores of a principal component factor analysis of the importance of 6 factors (see table A.5.i in the Appendix).

The first variable measures the effect of predictability of the environment and is expected to show a positive influence on adoption and use, when predictability is present. The variable is measured on a four point scale (from “regular and predictable developments”, “somewhat irregular and not easy to anticipate”; “very irregular and impossible to predict”; to “none”).

Table 3-8 Managerial component explanatory variables – Market competitiveness (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	**Variable definition - hypothesis**	**Predicted Impact sign)**	
		Adoption	**Uses**
COMP_CONDITIONS	A high predictability of results and environmental changes favours adoption and more uses	+	+
COMP_ICTUSES	A lower use of ICTs compared to other firms in the market favours investing more in ICTs	+	+
COMP_LEVEL_LOC	A need to compete in local markets favours adopting more ICTs and uses	+	+
COMP_EU	The entrance in the EU has created new sources of competition that drive adoption of more ICTs and uses	+	+

The second variable measures the effect of other firms in the market being perceived as having more ICTs. According to theory, the effect of competition (see Chapter 2), would suggest a positive effect from perceiving others in the industry as having higher ICTs. Lower ICTs would signal a risk of exposing the firm to higher costs, and not necessarily enjoying benefits, since there would be few others to share the processes (transactional processes in particular). The variable is measured on a three point scale (from “more prepared”, “similarly prepared”; “less prepared”).

Variables three and four measure the level of competition on the product market, in the country, and as a result of the entry in the EU, is measured indirectly by the firm’s assessed level of competitive pressure and position export propensity. These variables are expected to favour adoption and use when competition is perceived as higher.

3.5.8. Managerial component of adoption explanatory variables – Innovativeness

The innovativeness inclination factors are expected to positively influence the adoption and use of ICTs through measuring two variables (Table 3-9).

Table 3-9 Managerial component explanatory variables – Innovativeness (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	**Variable definition - hypothesis**	**Predicted Impact (sign)**	
		Adoption	**Uses**
INNOV_COLLAB	A high use of collaborative practices resulting in new products promotes adoption and use of ICTs	+	+
INNOV_NEWPROD	A high proportion of sales coming from new products promotes the adoption and use of ICTs	+	+
INFOFUT	The formal use of more sources of information on technology improvements and opportunities favors adoption and use of ICTs	+	+

The innovativeness is expressed by two variables, resulting from scores of a principal component factor analysis of the importance of 4 factors (see table A.5.k in the Appendix). The first variable measures the importance of collaboration relationships that would positively influence the adoption and use of ICT enabled processes. It takes into account the collaboration with suppliers and with clients, measuring the proportion of new products and services derived from collaborative efforts on a five point scale (from “almost all”, “above 50% of new products”; “about 50%”; “less than 50%”; to “none”).

The second variable indicates what proportion of sales came respectively from new products or services, respectively from product or service modifications, and from innovations based on new processes, in the three years reference period (2002-2005), measured in five categories (0%, up to 10%, 11-20%, 21-30%, 31% or more of sales). This takes into account the finding of Cohen and Levinthal according to which internal innovative activity is a precondition for successfully using external knowledge [219].

Lastly, a third variable INFOFUT combines thirteen factors (See Appendix A.5.l) regarding the formal opportunity identification process. These factors are all expected to positively impact the use of ICTs in more sophisticated ways, as well as determine a higher adoption rate.

3.5.9. Managerial component of adoption explanatory variables – environmental and cultural factors

The last element of the model is the consideration of cultural and environment variables identified in theory (see Chapter 2), expressed by three variables, resulting from scores of a principal component factor analysis of the importance of 4 factors (see table A.5.k in the Appendix) presented in Table 3-10. Company culture, expressed by its management practices and identified in theory as a driver of adoption, was dropped from the model due to lack of empirical data.

The first variable of market culture measures the preferences of the suppliers and customers for personal contact in a dichotomous variable. The variables two and three, also dichotomous, measure the presence or absence of sufficient clients and suppliers with whom to conduct online processes. These variables are expected to negatively influence the adoption and use of ICTs.

Table 3-10 Managerial component explanatory variables – Environment and cultural factors (negative sign signifies expected negative impact; positive sign a positive impact)

Variable	Variable definition - hypothesis	Predicted Impact (sign)	
		Adoption	Uses
ENVIR_FACE2FACE	A preference for face to face contact does not favor adoption of ICTs	-	-
ENVIR_FEW_ONLINE_CLI	A lack of clients that use online processes limits the adoption opportunities of ICTs	-	-
ENVIR_FEW_ONLINE_SUPP	A lack of suppliers that use online processes limits the adoption opportunities of ICTs	-	-

3.6. Data Collection Methodology and Description

The LBS 2008 survey was performed using telephone interviews with the top managers (owners) of companies who make decisions regarding IT issues in Latvia. This method was used because one of the tasks was to obtain comparable data with other previously conducted studies[9]. This meant an analogous use of methodology.

Author selected **method of sample formation and justification**. The "general population" was defined as all active operating private companies, and not labelled as "inactive", that are registered in Latvia as registered by the Central Statistics Bureau[10] (CSP). The CSP applies this approach when calculating the number of economically active companies and this is reflected in CSP publications.

A total of 500 companies were included in the sample. This sample size has been reflected in similar studies as an adequate representation of a country's business population. A stratified simple random sample was used based on the parameter "size of the company" (measured by the number of employees in the firm).

According to statistics, the breakdown of firms registered in Latvia, according to the number of employees, is the following (see table 3-11)[11].

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[9] Eurostat's Eurobarometer, DTI's International Benchmarking Survey, ITU and OECD working papers, national surveys

[10] CSP, Centrālā Statistikas Pārvalde

[11] Economically active businesses in Latvia 2000 – 2003, CSB

Table 3-11 Analysis of Latvian firm sizes

Strata	Descriptor	Percentage of Firms
Micro companies	1 – 9 employees	75.9%
Small companies	10 – 49 employees	19.5%
Medium-size companies	50 – 249 employees	4.0%
Large companies	250 and more employees	0.6%

Author formulated **sample**. In order to obtain representative answers for each company group, as well as to keep the sample structure similar to previous studies, the clusters were formed to have similar representation.

Taking into account the required proportions of different sized companies, the structure of the sample was defined (the number of companies in each strata was determined). The sample was developed as a stratified simple random sample.

The sample frame divided the companies into four strata (Table 3-12). The strata were defined based on the company size parameter (micro, small, medium and large companies).

Table 3-12 Definition of sampling requirements

Strata	Size of strata	Number of firms required in the sample	Number of companies obtained from CSB
Micro companies	25.0%	125	1000
Small companies	25.0%	125	1000
Medium – size companies	25.0%	125	750
Large companies	25.0%	125	250
Total	**100%**	**500**	**3000**

The selection of the firms was performed from the CSB database[12], excluding organizations which could not be classified as having an economic purpose[13] and excluding

[12] All the active companies based upon the data of CSB as of August 19, 2005 were included in the selection frame.

those that were inactive or undergoing liquidation[14]. Thus, the selection frame contained 47694 firms.

Based upon the sample structure (established strata) the number of the firms to be selected was calculated (Table 3-13). Three thousand firms randomly selected yielded 500 successful interviews.

Table 3-13 Selected sample

Strata	**Number of firms required in the sample**	**Number of firms in the selection frame**	**Number of selected firms**
Micro companies	125	34374	1000
Small companies	125	8824	1000
Medium – size companies	125	1816	750
Large companies	125	286	250
Total	**500**	**3000**	**100%**

It is to be noted that the sample for strata four represented the near totality of firms in the CSB database.

For the purpose of insuring the **content quality of the survey questionnaire**, five pilot interviews were performed in different companies (different with respect to size, location and industry). Both, Latvian and Russian languages were used in the pilot interviews.

[13] In accordance with the typological classification of the CSB, the following companies were not included in the selection: companies where the share of the state, municipalities or their entities in the equity capital is equal to or over 50% and which do not have any participation of foreign capital; companies where the share of the state, municipalities or their entities in the equity capital is equal to or over 50% and which have the participation of foreign capital; budget entities; foundations, societies; political organizations; religious organizations; farms; rural craftsman enterprises; family enterprises; individual work; fisheries; subsidiaries of individual merchants; non-commercial subsidiaries of foreign merchants.

[14] All the companies on which in the CSB data base of the economically active companies the following features of liquidation have been marked were excluded from the selection frame (the information source or the status of the company is noted): newspapers; bankruptcy notification from the Privatization Agency; operation has been temporary suspended or has not been commenced Notification of the State Revenue Service for liquidation has been received; insolvency Latvijas Vēstnesis; operation has been terminated without legal liquidation (information from CSB surveys); company has been legally liquidated; ordinances of ministries or municipality resolutions on liquidation of companies; company has not been re-registered in the Commercial Register; operation has been terminated without legal liquidation (information from regional surveys); court judgment on liquidation; Government ordinance.

Author will describe **organization of fieldwork and quality control**. In accordance with the defined structure of the sample, and based upon the companies selected by CSB, a total of 505 interviews were performed (the required number of companies/ respondents were surveyed in each cluster).

Interviews with the compliant respondents were performed in two stages:

1) Contacting the potential respondents by telephone;
2) Performance of the telephone interviews.

For the purpose of finding the appropriate respondent (company manager or owner who is decision maker regarding IT issues), to receive his/ her acceptance to participate in the survey, and agree on the time of the interview, initial phone calls were made to the selected companies. The call centre of the research centre SKDS was utilized for this function. Interviewers of SKDS trained for the performance of phone interviews called all of the companies listed in the data base to obtain their acceptance to participate in the survey. The objectives, tasks, importance of the survey, as well as the motivation of the selection of the particular respondent were explained to the potential respondents. In cases of a positive reply, an agreement on the time of the interview was made.

The respondent was informed about the length of the interview (approximately 30 minutes). In accordance to the agreements made with the respondents, telephone interviews were performed either immediately or later in the prior agreed time.

Prior to the survey, all the interviewers who participated in the project were trained on the content of the questionnaire and the methods of the particular survey in a special training seminar.

The pre-programmed CATI system RM PLUS was used during the interviews.

The CATI system was programmed to choose the respondents from the sample and automatically follow the numbers of completed interviews in clusters.

Since the sample was not representative to the distribution of companies by total number of persons employed, the **weighting** should be applied to guarantee the correspondence of data to the statistics.

For the calculation of sample weights, the inclusion probabilities of the companies in the sample should be determined. The design weights (D_i) are inversely proportional to the inclusion probability (W_i).

$$D_i = \frac{1}{W_i} \quad (3.1)$$

The inclusion probabilities (Wi) are calculated as follows:

$$W_i = \frac{x_i}{y_i} \quad (3.2)$$

W_i – inclusion probability for i-th respondent

x_i – the number of respondents for i-th group in the reached sample

y_i – the coefficient that shows the number of respondents for i-th group that should be in an ideal sample according to statistics (general population)

$$y_i = \frac{C_i * S}{G} \quad (3.3)$$

C_i – number of respondents in i-th group in general population
S – sample size
G – total number of respondents in general population
G – number of units in the general aggregate

The sample size considered the possible **response rates** to achieve the target 500 nearly complete responses (see detailed review of non responses in Appendix Table A.2). Non responses followed a random behaviour and are presumed not to have affected the results of the sampling.
Data examination for completeness and reliability of the data

The use of logistic regression analysis does not require testing for normality, but the presence of missing values and outliers reveals the reliability and repeatability of the survey. In the following sections the validity and reliability of aggregated data in multi-item constructs is tested using the Cronbach's Alpha and principal factor analysis.

3.7. Examination of data for missing values (individual level)

The low intensity in general of ICTs diffusion in Latvia presented earlier (see Chapter 1) finds a corresponding low level of item responses for some constructs that were expected to prove the types of uses of ICTs. The analysis in further sections will show that the firms employ few uses of ICTs and correspondingly the more subtle factors of innovation and growth are not fully detectable through this survey tool.

The usual procedure of dropping observations with incomplete data may produce biased estimates of means, proportions and regression coefficients. To solve this problem, the analysis used the "multiple imputation" procedure, thus avoiding a loss of observations.

In the cases where very high levels of "Item" non-response were observed, the constructs were eliminated from the model (Table 3-14).

Table 3-14 Data screening (data individual level)

Construct	**Variable type**	**Confirmation/ treatment**
Sales on line	Dependent	Dropped, 85% missing Values
No use	Independent	Dropped, 50% missing Values
Innovativeness, collaboration with suppliers and clients	Independent	30-45% missing values, selective analysis
Environment influences	Independent	Dropped, 30-40% missing values
Cluster effects	Independent	Dropped, 40% missing Values

The dependent variable of SALES_ONLINE was dropped due to the high number of missing values (85%), confirming the low diffusion of online sales in the Latvian market. The missing values for the variables related to NOUSE, indicating various measures of non-applicability or value of ICTs as evaluated by the respondent, indicate that the questions were not clear or that the respondents did not have clear answers to offer.

For the remaining construct missing item data, the ME procedure in SPSS was used to replace the missing values, under the assumption that the pattern of missing data is related to the observed data only. This assumption allows estimates to be adjusted using available information.

The missing answers in the collaboration for innovation are interpreted to mean that this is not a common practice in general, and this is confirmed later in the regression analysis for the remaining innovation variables. It had been expected to find somewhat broader support for the hypothesis that new activities and innovations would explain higher and more sophisticated use of ICTs.

Similarly, the data for cluster (effects of other firms in the industry adopting ICTs to a higher extent, practice of other firms) and environment factors (disposition of suppliers and clients to accept changes in ICTs compared to face to face dealings, use of ICTs by sufficient suppliers and clients, effect of regulations) is sparse, and does not support quantitative conclusions. The scope of the study did not allow pursuing in-depth interviews to interpret the situation in more detail.

The lack of strength and clarity in these variables does however point to a possible non-determining influence, which would confirm the hypothesis, that the lack of immediately available opportunities to apply ICTs can significantly reduce diffusion in emerging countries. Additional interviews could ratify that this underlies the low concern for innovation, environment, and regulation and work practices as influence factors.

3.8. Construct reliability (pre-factorial analysis)

Reliability measures the extent to which the procedure will yield the same results in repeated trials. In the present study reliability refers to the degree that respondent answers on several items measuring the same construct agree among each other. Cronbach’s α is a generally applicable reliability test with the critical value 80 [197].

The dependent variable ICT uses required grouping all applications in one variable (ICTUSES) with three categorical levels (0, for no use; 1 for up to 25 applications in use; and, 2 for more than 25 applications in use) (Table 3-15).

Table 3-15 Analysis of Internal Consistency (Cronbach's α)

Construct items	Number of items	N	Cronbach's α	Reliability of model
ICTINTENSE (number of ICTs used)	17	505	.813	Good
ICTUSES (combined in one variable)	71	447		Good
- ICTs use for client web services	12	447	.857	Combined into USES
- ICTs use for biz processes	13	447	.733	Combined into USES
- Resources planning apps	11	268	.466	Combined into USES
- Systems integration	16	45	.677	Combined into USES
- Intranet uses	13	91	.600	Combined into USES
- Purchase / order online	6	447	Negative	Dropped, no clear meaning
OBJECTIVES (market, cost, efficiency)	25	447	.839	Good
TECHNOLOGY & COST OBSTACLES	14	447	.321	weak
OBSTACLES to attempt ICT impl.	10	58	.424	Dropped, too many missing
CONSEQUENCES (negative) fro ICTS	6	447	.211	Dropped, not reliable
TECHNOLOGY ABSORPTION	6	313	.311	weak
MARKET (competition drivers)	5	505	.629	weak
WORK PLACE ORGANIZATION	5	459	Negative	Dropped, no clear meaning
ENVIRONMENT AND CULTURE	7	165	.362	weak
INNOVATIVENESS	4	363	.661	weak
INNOVATION INFO (sources used)	16	505	.707	weak

The independent variable for workplace organization (delegation and supervision) was dropped from the basic model due to the low reliability. Several other constructs show weak internal consistency, and will be confirmed in the next section.

3.9. Convergent and discriminant analysis

Factor analysis is used to assess convergent and discriminant validity [199]. Convergent validity is a generally accepted test that describes the extent to which multiple attempts to measure the same construct, by using the specific items, correlates with the construct as measured by the remaining items [166].

Discriminant validity shows that the items comprising the construct are not correlated with other, similar constructs [141]. In the factor analysis high loading of a factor (construct) indicates convergent validity, while low loadings on other factors, entered simultaneously in the analysis, indicate discriminant validity.

The method followed in this study corresponds to the Principal Factor Analysis[15] is selected based on the advantages it offers for relatively small samples and multi-item constructs [191]. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated to show how much of every item can be explained by other items, to indicate the reliability of the results. A KMO value above 0.60 is considered acceptable [113, 55][16].

Table 3-16 Analysis of Convergent Validity

Constructs	Number of factors	N	KMO (reliability)	Variance Explained
ICTINTENSE	4	505	.845	58%
ICTUSES				
- ICTs use for client web services	4	447	.851	63%
- ICTs use for biz processes	5	447	.807	55%
- Resources planning apps	3	268	.786	63%
- Systems integration		45	Combined due to missing data	
- Intranet uses		91	Combined due to missing data	
OBJECTIVES	8	447	.777	61%
- Market improvement	4	447	.726	59%
- Cost and input efficiency	4	447	.662	63%
TECHNOLOGY & COST OBSTACLES	4	447	.513	63%
TECHNOLOGY ABSORPTION	4	313	.564	69%
MARKET (competition drivers)	4	505	.625	83%
WORK PLACE ORGANIZATION	5	459	.299	82%
ENVIRONMENT AND CULTURE	3	165	.623	70%
SOURCES OF INNOVATION INFO	5	505	.780	65%
INNOVATIVENESS	2	363	.550	83%
INNOVATION INFO	5	505	.780	65%

[15] If the analysis is designed to account for only the variance in the correlation coefficients and ignore the error variance (i.e., the variance not accounted for by the correlation coefficients), it is called a factor analysis. If the analysis is designed to account for all of the variance including that found in the correlation coefficients and error variance, it is called a principal components analysis. In both cases, the analysis calculates factors that underlie the correlations involved.

[16] The analysis was performed using the SPSS Data reduction Factor procedure (Principal Axis Factoring) with Varimax rotation.

Analysis of convergent validity (Table 3-16) of the multi-item constructs supported the findings of the reliability analysis, that some constructs offer weak quantitative support for the model. These constructs are those primarily measuring the human capacities to absorb technology (knowledge in employees and management, and training practices); the importance of competition drivers (perceived level of competition, predictability of future needs); and, the influence of the environment (disposition of suppliers and clients to accept changes in ICTs compared to face to face dealings, use of ICTs by sufficient suppliers and clients, effect of regulations).

The analysis of discriminant validity was performed separately for each multi-item construct, extracting the orthogonal factors with Eigenvalues greater than 1.0. The analysis showed few cross-loadings of factors thus proving high discriminant validity for the extracted factors (see detailed results in tables A.5.a to A.5.l in the Appendix.)

The analysis of discriminant validity of different types of ICTs used revealed four factors (Table 3-17). The main explanatory factors found comprised the use of remote technologies (WAN, LAN, wireless, remote terminals, mobile) and the use of web based elements (e-mail, Internet and webpage). Two weaker factors corresponded to the use of Intranet and Extranet, and systems integration technologies (EDI, PBX). The decision was however to maintain the definition of the dependent variable ICTINTENSE as the sum of the number of technologies used.

The variable for ICT uses was similarly preserved to the combined number of uses by each firm irrespective of the use. The factor analysis however reveals the main types of use and shows a predominance of web tools and information tracking applications, with significantly less online transactions and very low systems integration.

Table 3-17 Analysis of Discriminant Validity, adoption and use factors

Constructs and Factors	Number of factors	N	KMO, reliability	Variance explained
ICTINTENSE		505	.845	58%
- WAN, LAN, wireless, terminals, Mobile				33.63
- Email, Internet and webpage				11.73
- Intranet, Extranet				7.11
- EDI, PBX				6.81
ICTUSES				
- ICTs use for client web services		447	.851	63%
- Product and service information				36.22
- Order, Pay, track				10.88
- Account status and post sales				8.30
- Other sales and service info				7.88
- ICTs use for biz processes	5	447	.807	55%
- Supply management, order track				24.4
- Online banking, e-markets				9.8
- Online research, inventory, - production				8.2
- Online collaboration				7.7
- Techs support				5.2
- ICTs uses for Resources planning	3	268	.786	63%
- Online info on plans, needs				38.71
- Online client databases & projects				12.92
- No planning/needs systems				11.14

The factors identified through the use of discriminant analysis constitute the explanatory factors of the empirical model. The results are presented in Table 3-18 summarize the basic model factors, and those presented in Table 3-19 summarize the factors selected for the expanded model.

Table 3-18 Discriminant Validity of objective model explanatory variables

Constructs and Factors	Factor ID	N	KMO, reliability	Variance explained
OBJECTIVES		447	.777	61%
- Market improvement		447	.726	59%
- Increase market/brand recognition/market size, effectiveness	MKT_EFFICIENT			26.06
- Improve market share, number of clients in new and existing markets	MKT_SHARE			12.11
- Improve competitiveness relative to market	MKT_COMPETE			11.86
- Increase sales and market value	MKT_BIZVALUE			8.90
- Cost reduction & input efficiency		447	.662	63%
- Improve quality and precision	INPUT_SUPP _CLI_COMMS			26.2
- Reduce costs and improve efficiency	COST_RED			15.2
- Focus on core value added	INPUT_VALUEADDE D			12.0
- General IT knowledge	INPUT_GEN			10.9
OBSTACLES		447	.513	63%
- Implement and maintenance costs	IMP_OBST_COST			17.8
- System integration	IMP_OBST_ TECHN_SYSTINTG			16.9
- Lack of knowledge and personnel objections	IMP_OBST_ TECHN_KNOWHOW			14.6
- Low reliability and low benefits	IMP_OBST_ TECHN_RELIAB			13.5

The factors identified represent approximately 60% of the variability observed and can therefore be included in the model, as indicated, by the theoretical analysis. There is however a substantial part of the result that is not explained, suggesting that other variables exists, which are not identified in the theory.

Table 3-19 Discriminant Validity of objective model explanatory variables

Constructs and Factors	Factor ID	N	KMO, reliability	Variance explained
TECHNOLOGY ABSORPTION		313	.564	69%
- Firm, management and personnel attitudes towards ICTs	ABSORB_ATT			24.64
- Management capabilities and options employed to deal with ICT implementation needs	ABSORB_CAP			16.49
- Firm attitude to change	ABSORB_FIRM_ ATTITUDE			15.18
- Employee level of knowledge	ABSORB_EMPL_ KNOW			13.01
MARKET (competition drivers)		505	.625	83%
- Ability to forecast environment	COMP_CONDITIONS			34.11
- Comparable use of ICTS	COMP_ICTUSES			22.04
- Local competitiveness of firm	COMP_LEVEL_LOC			14.71
- EU effects on competition level	COMP_EU			11.88
WORK PLACE ORGANIZATION	Dropped	505	.299	unreliable
ENVIRONMENT AND CULTURE		165	.623	70%
- Prefer face to face clients/suppliers	ENVIR_FACE2FACE			34.89
- Few online client	ENVIR_FEW_ ONLINE_CLI			17.88
- Few online suppliers	ENVIR_FEW_ ONLINE_SUPP			17.09
INNOVATIVENESS		363	.550	83%
- Proportion of new products done in collaboration with suppliers or clients	INNOV_COLLAB			50.41
- Percentage of sales from new products in the last 3 years	INNOV_NEWPROD			32.95
INNOVATION INFO (sources used)	INFOFUT	505	.780	65%
- Associations				27.75
- Consultants and own research				14.27
- Employees, other, none				20.91

The factors identified in the managerial component of the model variables represent 70%-80% of the observed variance suggesting that the constructs identified in theory represent adequately the underlying reality in the Latvian case. The KMO values are however weak, suggesting that the discriminant validity overall is not so significant. The subsequent logistical regression will demonstrate how this affects the goodness of fit of the over-all model. The factors referring to the sources and contacts used to identify innovations and opportunities to apply ICTs are summarized in one variable (INFOFUT).

3.10. Ordered Logistic Regression Model (validation of the empirical model)

Confirmation of the theoretical model proposed in chapter 3 was accomplished using Ordered Logistical Regression analysis. Logistic regression allows predicting a discrete outcome like the adoption of ICTs in the presence of a set of variables that may be continuous, discrete, dichotomous, or a mix of any of these. The confirmation procedure followed the principles and procedures suggested by Tabachnick and Fidell [199].

Logistic regression is part of a category of statistical models called generalized linear models Agresti [2]. Generally, the response variable is dichotomous, such as presence/absence or success/failure. In the case of the ICTs' adoption model, the responses are grouped in 'ranks' representing subsequent higher levels of presence or adoption. This type of model corresponds to a variation of the basic regression model, so called (Ordered) Logistical Regression (Tabachnick and Fidell use the term polychotomous) [199].

Since the dependent variable ICTINTENSE and the variable ICTUSE represent ordered levels of adoption, these variables are ordinal and can be best modelled with the ordered logistical regression analysis. Each dependent variable is modelled separately; each can take the value 1 with a probability of success θ, or the value 0 (zero) with probability of failure $1-\theta$ distributed in successive ranks, each rank thus representing a segment of probability, together adding up to 1.

The independent predictor variables in logistic regression make no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance within each group. The relationship between the predictor and response variables is not a linear function in logistic regression, and corresponds to the following logit transformation of θ:

$$\theta = \frac{e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_i x_i)}}{1+e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_i x_i)}} \tag{3.4}$$

Where α = the constant of the equation and, $\beta\kappa$ = the coefficient of the predictor variables (k=1, 2, …*i*). An alternative form of the logistic regression equation is:

$$\mathbf{logit}\left[\theta(\mathbf{x})\right] = \mathbf{log}\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i \tag{3.5}$$

The goal of logistic regression is to correctly predict the category of outcome for individual cases using the most parsimonious model. To accomplish this goal, a model is created that includes all predictor variables that are useful in predicting the response variable. Several different options are available during model creation. The scenarios (cases) are specified to test the fit of the model and study the effect of the relationship between variables.

3.10.1. Goodness of fit Analysis (model level)

To evaluate if the model overall gives good predictions, before looking at the individual predictors in the model, two tests were used. Firstly, a -2 log-likelihood test was computed using the SPSS procedure. This compares the values for the intercept only (baseline) model and the final model (with the predictors). Secondly, a test of parallel lines (slope) was calculated to reject the null hypothesis that the individual coefficients do not significantly add to the explanatory power of the model. While the log-likelihood statistics themselves are suspect due to the large number of empty cells in the model, the difference of log-likelihoods can usually still be interpreted as chi-square distributed statistics [135]. The chi-square reported in the table is just that: the difference between -2 times the log-likelihood for the intercept-only model and that for the final model, within rounding error.

Additionally, a pseudo R2 (McFadden) measure is also calculated for purposes of comparing the various specifications of the model. This measure is not a true least square distances R2 as in OLS regression, and it is most useful when comparing competing models for the same data.

Lastly, the percentages of correct predictions (correctly classified firms) is computed comparing to the sample, to estimate the ability the model offers to predict correctly firms belonging to each level of ICT adoption and use. On this account, the model is notably more accurate for the lower adoption and use categorization, which is to be expected given the higher presence of low adopters and users in the sample (see Table 4-22). The analysis below also reveals that the more complex drivers of high adoption and use are less clearly defined, and point to differences not captured by the model,

The results of the tests (Tables 3-20 and 3-21) prove that the model adequately and significantly adds to the baseline, and thus the coefficients can be analyzed for their meaningfulness. The structure of the tables, which repeats for all results tables (3-23 through 3-24), presents four specifications for ICT intensity, and five specifications for ICT uses.

Table 3-20 Intensity of the Adoption of ICTs model fit

		Specifications			
		1	2	3	4
N		505	505	505	505
Slope Test	sig.	73 (**)	73 (*)	89 (*)	101 (*)
McFadden R2		0.239	0.224	0.158	0.135
2Log Likelihood Chi2	sig.	264 (*)	247 (*)	174 (*)	149 (*)
Percent correct prediction					
- 0 technologies		48%	45%	32%	26%
- 1-4 technologies		86%	85%	90%	93%
- 5-9 technologies		29%	22%	18%	13%
- 10-15 technologies		9%	5%	5%	9%
Overall		64%	62%	61%	61%
The statistical significance of the estimates is indicated with ***, ** and * representing the 1%, 5% and 10% level respectively.					

The ICT intensity model is calculated for the factors identified from theory, including size of firm and industry sector (specification 1); specification 2 and 3 test the effect of eliminating the industry sector and firm size respectively; and, specification 4 eliminates both effects. A similar set of specifications is used for ICT uses, where a fifth specification is included to represent the effect of ICT intensity on ICT uses.

Table 3-21 Uses of ICTs model fit

		Specifications				
		1	2	3	4	5
N		505	505	505	505	505
Slope Test	sig.	138 (*)	80 (**)	130 (*)	109 (*)	41 (*)
McFadden R2		0.154	0.142	0.139	0.132	0.278
2Log Likelihood Chi2	sig.	210 (*)	193 (*)	190 (*)	179 (*)	378 (*)
Percent correct prediction						
- 0 applications		56%	53%	52%	51%	78%
- 1-3 Applications		75%	74%	76%	77%	86%
- 4-8 Applications		7%	5%	6%	8%	6%
- 9-24 applications		41%	42%	40%	41%	41%
Overall		50%	49%	49%	49%	59%

The statistical significance of the estimates is indicated with ***, ** and * representing the 1%, 5% and 10% level respectively

Table 3-22 Sample frequencies of adoption and use

		N	Marginal Percentage	
			%	Cumulative
ICTINTENSE	0 tech	96	19.0%	19.0%
	1-4 tech	287	56.8%	74.8%
	5-9 tech	100	19.8%	94.6%
	10-15 tech	22	4.4%	100.0%
ICTUSES	0 Apps	116	23.0%	23.0%
	1-3 Apps	188	37.2%	60.2%
	4-8 Apps	111	22.0%	82.2%
	9-24 Apps	90	17.8%	100.0%
Valid		505	100.0%	
Missing		0		
Total		505		

3.10.2. Goodness of fit Analysis (coefficient level)

A Wald test was used to test the statistical significance (Table A.6 in the Appendix) of each coefficient in the model. A Wald test calculates a *Z* statistic, which is:

$$z = \frac{\hat{B}}{SE} \qquad (3.6)$$

This z value is then squared, yielding a Wald statistic with a chi-square distribution. Several authors have identified problems with the use of the Wald statistic. Menard (1995) warns that for large coefficients, standard error is inflated, lowering the Wald statistic (chi-square) value. In the model all the variables were standardized and therefore this problem does not arise [139].

3.11. Empirical results

3.11.1. ICT adoption intensity

Table 28 shows the results of estimations for ICTINT, the variable representing the intensity of use of ICT based on the number of ICT elements. The coefficients are comparable since all the variables have been standardized, thus the magnitudes are indicative of the relative importance. The sign (+ or -) is indicative of the effect the factors (logit) have, positive or negative on the dependent variable, per unit change in the predictor variable.

Table 3-23 ICT adoption intensity, ordered logit estimates of the importance of the factors

		Specifications			
Explanatory Variable		1	2	3	4
Intercept1	Est.(sig)	-4.404 (*)	-3.617 (*)	-2.887 (*)	-1.916 (*)
	Std.	0.532	0.271	0.469	0.138
Intercept2	Est.(sig)	-0.511	0.173	0.449	1.294 (*)
	Std.	0.487	0.194	0.451	0.119
Intercept3	Est.(sig)	2.019 (*)	2.652 (*)	2.764 (*)	3.555 (*)
	Std.	0.125	0.274	0.486	0.244

Objectives					
MKT_EFFICIENT	Est. (sig)	0.824 (*)	0.789 (*)	0.426 (*)	0.353 (**)
	Std.	0.161	0.159	0.150	0.149
COST_RED	Est. (sig)	0.132	0.131	0.292 (*)	.298 (*)
	Std.	0.104	0.102	0.100	0.098
INPUT_VALUEADDED	Est. (sig)	-0.218 (**)	-0.198 (**)	-0.182 (***)	-0.152 (***)
	Std.	0.105	0.130	0.106	0.104
Human technology absorptive capacity					
ABSORB_ATT	Est. (sig)	-0.565 (*)	-0.537 (*)	-0.697(*)	-0.694 (*)
	Std.	0.131	0.128	0.136	0.133
ABSORB_CAP	Est.(sig)	-0.515 (*)	-0.505 (*)	-0.472 (*)	-0.456 (*)
	Std.	0.140	0.139	0.136	0.130
ABSORB_FIRM_ATT	Est. (sig)	(0.146)	(0.141)	-0.189 (***)	-0.158
	Std.	0.122	0.119	0.121	0.071
Firm Size					
size1 0-9	Est.(sig)	-2.987 (*)	-2.983 (*)		
	Std.	0.342	0.332		
size2 10-50	Est.(sig)	-1.749 (*)	-1.846 (*)		
	Std.	0.303	0.298		
size3 50-250	Est.(sig)	-0.898 (*)	-0.933 (*)		
	Std.	0.276	0.273		
size4 >250	Est.(sig)	0	0		
Innovativeness capacity					
INFOFUT	Est.(sig)	0.197 (*)	0.196 (*)	0.226 (*)	0.237 (*)
	Std.	0.049	0.048	0.047	0.047
		Specifications			
Explanatory Variable		1	2	3	4
Cultural and environment factors					
ENVIR_FACE2FACE	Est.(sig)	-0.358 (*)	-0.348 (*)	-0.323 (*)	-0.324 (*)
	Std.	0.134	0.132	0.129	0.127
ENVIR_FEW_ONLINE_CLI	Est.(sig)	-0.432 (*)	-0.408 (*)	-0.03	0.031
	Std.	0.142	0.139	0.125	0.123
ENVIR_FEW_ONLINE_SUPP	Est.(sig)	0.187 (**)	0.193 (**)	0.117	0.116
	Std.	0.09	0.089	0.087	0.086
Market factor					
COMP_LEVEL_LOC	Est.(sig)	0.348 (*)	0.347 (*)	0.331(*)	0.371 (*)
	Std.	0.104	0.102	0.101	0.099

COMP_EU	Est.(sig)	0.141 (***)	0.11	0.275 (*)	0.253 (*)
	Std.	0.1	0.098	0.096	0.099
COMP_CONDITIONS	Est.(sig)	0.294 (*)	0.290 (*)	0.284 (*)	0.305 (*)
	Std.	0.108	0.106	0.105	0.102
COMP_ICTUSES	Est.(sig)	-0.252 (*)	-0.281 (*)	-0.328 (*)	- 0.374 (*)
	Std.	0.103	0.101	0.1	0.098
Industry dummies					
AGRO		- (*) strong		- (*) strong	
CONSTRUCTION				-	
TRANSP&COMMS				-	
MANUFACTURING		- (***)		-	
COMMERCE		- (***)		- (*)	
SERVICES		- (***)		- (*)	
GOVERNEMNT				+	
FINANCE		baseline		baseline	
The statistical significance of the estimates is indicated with ***, ** and * representing the 1%, 5% and 10% level respectively.					

The estimation results for all categories of explanatory variables identified in Chapter 3, though not to the same extent, have a statistically significant impact. The core of the adoption model is confirmed, and allows concluding that a multidimensional modelling of anticipated benefits and costs of ICT adoption, applies even in a country characterized by a generally low level of adoption.

Among the anticipated benefits, those related to market and customer orientation (MKT_EFFICIENT) are the most important ones, signifying the high importance information provided to customers, which is also confirmed by the most typical uses in the sample (analyzed in the next section).

Human absorption capacity, as predicted, is very strong and explains the importance of the learning, know-how and readiness to adapt to change. The direction of the prediction is opposite and is thus interpreted as an obstacle to adoption (lack of capacities); this however creates a problem of interpreting the information.

The obstacles of cost and technical did not show any relationship, and were eliminated from the core model. This probably reflects the absence of compatibility, systems integration and change problems in early stage adoption, and in smaller firms, where no integration to previous systems is needed. The low use of Intranets and integrated systems supports this conclusion. Cost and input-related benefits (COST_RED, INPUT_VALUEADDED) are also significantly less significant, and reflect the low level of transactional, planning and supply chain uses as is analyzed in the following section.

The firm size dummies, with companies employing 250 or more persons as reference group, show a negative relation to adoption, signifying a higher propensity to adopt in case of large firms. This finding is consistent with non-industry specific studies but contradicts some industry specific studies [64]. These differences could be related to the particular industry structure of the sample or to differences between emerging economies and the western economies typically studied. These results are similar to those of another study in a developing economy. Ben Youssef and Hadhri [14] found a positive relationship between firm size and ICT adoption in firms in Tunisia. A closer look at these size effects based on a comparison of the results of specification 3 and 4 (no size dummies), with those reported for specification 1 and 2 (size variables included), points to a certain interaction between firm size and some variables of the model. For example, when firm size is included in the model, the influence of anticipated market benefits decreases, as does the importance of clients also using online systems (ENVIR_FEW_ONLINE_CLI), while competition from EU entrance increases; small firms expect thus lower market benefits from adoption of ICTs than large ones, and are more likely to adopt ICTs in response to new EU competitive threats.

In spite of these interactions, the basic pattern of the results remains quite the same, pointing to the robustness of the rank effects explicitly modelled. Interestingly, there is significant loss of explanatory power when firm size dummies are dropped. Hence, there is evidence for independent size effects which would cover effects not explicitly specified in the model; the size-dependence of the model will be investigated below.

The industry dummies (finance sector as reference group) are not statistically significant. They are presumed to capture differences among industries with respect to market conditions and technological opportunities, but seem to confirm the hypothesis that these opportunities are not clear or are non-existent a priori in a developing country environment as discussed in Chapter 1 through 3.

The other explanatory variables as well as the model fit are hardly influenced when industry variables are dropped, independent of the adoption variable used (see specification 1 vs. 2).

3.11.2. Uses of ICTs

Table 3-24 shows the results of estimations for ICTUSE, the variable representing the use of ICT based on the number of applications used. The structure of the table is the same as for the previous section (specification 1 to 4 plus the addition of a specification including the ICTINT as an independent variable).

Table 3-24 ICT uses, ordered logit estimates of the importance of the factors

		Specifications				
Explanatory Variable		1	2	3	4	5
Intercept1	Est.(sig)	-1.307 (*)	-2.039 (*)	-2.561 (*)	-1.638 (*)	-3.663 (*)
	Std.	0.29	0.208	0.476	0.126	0.497
Intercept2	Est.(sig)	0.114	-0.094	-0.426	0.459 (*)	-0.768 (***)
	Std.	0.287	0.186	0.466	0.104	0.462
Intercept3	Est.(sig)	1.172 (*)	1.463 (*)	0.955 (**)	1.837 (*)	0.668
	Std.	0.294	0.201	0.467	0.135	0.462
Objectives						
MKT_EFFICIENT	Est.(sig)	0.169 (***)	0.231 (***)	0.152	0.131	0.138
	Std.	0.093	0.153	0.154	0.151	0.163
MKT_COMPETE	Est.(sig)	-0.173 (*)	-0.284 (*)	-0.292 (*)	-0.266 (*)	-0.238 (**)
	Std.	0.066	0.103	0.106	0.103	0.111
MKT_BIZVALUE	Est.(sig)	0.094(***)	0.150 (***)	0.12	0.138	-0.094
	Std.	0.062	0.1	0.102	0.1	0.098
COST_RED	Est.(sig)	0.198 (*)	0.325 (*)	0.388 (*)	0.392 (*)	0.266 (*)
	Std.	0.061	0.097	0.097	0.095	0.1
INPUT_SUPP_CLI_COMMS	Est.(sig)	0.167 (**)	0.263 (**)	0.305 (*)	0.302 (*)	0.299 (**)
	Std.	0.074	0.121	0.121	0.12	0.127
INPUT_VALUEADDED	Est.(sig)	-0.098 (***)	-0.226 (**)	-0.244 (**)	-0.217 (**)	-0.16
	Std.	0.065	0.111	0.111	0.112	0.116
		Specifications				
Explanatory Variable		1	2	3	4	5
Obstacles						
IMP_OBST_COST	Est.(sig)	-0.067	-0.127	-0.097	-0.082	-0.094
(cost)	Std.	0.06	0.094	0.094	0.093	0.098
IMP_OBST_ABSORB	Est.(sig)	-0.105 (***)	-0.307 (*)	-0.228 (**)	-0.255 (*)	-0.275 (*)
(human absorption capacity)	Std.	0.069	0.108	0.106	0.105	0.112
IMP_OBST_SYSTINTG	Est.(sig)	-0.105 (***)	-0.364 (*)	-0.336 (*)	-0.340 (*)	-0.255 (**)
(technology)	Std.	0.071	0.118	0.118	0.117	0.121
IMP_OBST_RELIAB	Est.(sig)	-0.037	0.065	0.059	0.069	0.022
(technology)	Std.	0.059	0.09	0.09	0.089	0.0094
Human technology absorptive capacity						
ABSORB_ATT	Est.(sig)	-0.232 (*)	-0.338 (*)	-0.412 (*)	-0.409 (*)	-0.091
	Std.	0.08	0.12	0.12	0.12	0.127
ABSORB_CAP	Est.(sig)	-0.528 (*)	-0.680 (*)	-0.691 (*)	-0.694 (*)	-0.324 (*)
	Std.	0.109	0.153	0.151	0.153	0.119
ABSORB_FIRM_ATT	Est.(sig)	-0.018	-0.065	-0.107	-0.084	-0.018
	Std.	0.076	0.113	0.115	0.112	0.114
Firm Size						
size1 0-9	Est.(sig)	-0.572 (*)	-0.923 (*)			

	Std.	0.182	0.275			
size2 10-50	Est.(sig)	-0.272 (***)	-0.568 (*)			
	Std.	0.166	0.258			
size3 50-250	Est.(sig)	0.016	-0.147			
	Std.	0.158	0.252			
size4 >250	Est.(sig)	0	0			
				Specifications		
Explanatory Variable		1	2	3	4	5
Cultural and environment factors						
ENVIR_FACE2FACE	Est.(sig)	-0.350 (*)	-0.460 (*)	-0.451 (*)	-0.464 (*)	-0.363 (*)
	Std.	0.086	0.128	0.129	0.128	0.134
ENVIR_FEW_ONLINE_CLI	Est.(sig)	-0.09	0.074	0.177	0.189 (***)	-0.048
	Std.	0.085	0.129	0.125	0.123	0.143
ENVIR_FEW_ONLINE_SUPP	Est.(sig)	0.180 (*)	0.548 (*)	0.500 (*)	0.505 (*)	0.386 (*)
	Std.	0.068	0.118	0.118	0.116	0.118
Innovativeness capacity						
INNOV_COLLAB	Est.(sig)	-0.067	-0.139 (***)	-0.119	-0.135 (***)	-0.07
	Std.	0.057	0.089	0.09	0.088	0.096
INNOV_NEWPROD	Est.(sig)	-0.156 (*)	-0.212 (**)	-0.214 (**)	-0.212 (**)	-0.187 (**)
	Std.	0.06	0.095	0.096	0.094	0.108
INFOFUT	Est.(sig)	0.139 (*)	0.245 (*)	0.258 (*)	0.257 (*)	0.164 (*)
	Std.	0.028	0.048	0.049	0.048	0.05
Market factor						
COMP_LEVEL_LOC	Est.(sig)	0.188 (*)	0.385 (*)	0.365 (*)	0.390 (*)	0.202 (**)
	Std.	0.063	0.096	0.097	0.095	0.105
COMP_EU	Est.(sig)	0.171 (*)	0.181 (**)	0.252 (*)	0.236 (*)	0.084
	Std.	0.06	0.095	0.094	0.093	0.097
COMP_CONDITIONS	Est.(sig)	0.018	0.082	0.073	0.102	-0.09
	Std.	0.067	0.102	0.103	0.101	0.112
COMP_ICTUSES	Est.(sig)	-0.101 (***)	-0.094	-0.119	0.139 (***)	0.03
	Std.	0.061	0.094	0.094	0.092	0.101
				Specifications		
Explanatory Variable		1	2	3	4	5
Use of ICTs						
0 tech	Est.(sig)					-5.717 (*)
	Std.					0.641
1-4 tech	Est.(sig)					-1.103 (**)
	Std.					0.479
5-9 tech	Est.(sig)					-0.606
	Std.					0.488
10-15 tech	Est.(sig)					Baseline
Industry dummies						
AGRO	Est.(sig)	- (**)		- (*)		
CONSTRUCTION	Est.(sig)	- (**)		- (***)		
TRANSP&COMMS	Est.(sig)			- (***)		
MANUFACTURING	Est.(sig)			- (***)		
COMMERCE	Est.(sig)	- (*)		- (**)		

SERVICES	Est.(sig)			- (***)			
GOVERNEMNT	Est.(sig)						
FINANCE	Est.(sig)	baseline		baseline			
The statistical significance of the estimates is indicated with ***, ** and * representing the 1%, 5% and 10% level respectively.							

The explanatory power of the model explaining the use of ICTs (ICTUSE) is significantly lower than for the case of the overall ICT technology adoption (ICTINTENSE). The pattern of explanation is also different. First, the factors for cost reduction and input efficiency show a higher relevance compared to market and customer orientation. This is particularly noticeable when the firm size dummies are dropped (specification 3 vs. 1), which indicates that smaller firms embark on more complex uses of ICTs for these reasons. It is to be noted that for this variable, the correlation to firm size is much weaker, and seems not to play a role after the size of 50 employees or more.

Second, among the obstacles to adoption, human learning capacity to absorb and implement changes (IMP_OBST_ABSORB and ABSORB_CAP, human absorption capacity) and systems integration (IMP_OBST_SYSTINTG) are a bigger problem indicating that in case of an already larger ICT infrastructure investment needs are increasing (transition to more complex, network-oriented technologies).

Third, the interaction between firm size and some of the explanatory variables (compare the results of specification 1 including size dummies vs. 3-4 where these variables are dropped), shows that the model fit in case of the measure of uses of ICTs is not significantly better when size dummies are included. The lack of evidence for an independent impact of firm size (representing not explicitly specified influences) is further confirmed in the next section.

3.11.3. Size influence in adoption and use behaviour

In order to study more closely any interaction of firm size with other explanatory variables (size-dependence of the model), in the following, the model is divided to look separately at small and large firms. In this way the driving forces behind the adoption of ICT and its uses are shown to differ between these two classes. A threshold of 50 employees was used to separate small from larger firms, corresponding approximately to the median of the sample, and to the point where size dummies stop being relevant at least for explaining the ICT uses.

Table 3-25 Effect of Firm Size on the adoption and use of ICTs decision

		Specifications			
		ICTINT		ICTUSES	
		By Firm Size		By Firm Size	
		<50	>=50	<50	>=50
N		275	230	275	230
Slope Test	sig.	415 (*)	85 (*)	206 (*)	25
McFadden R2		0.243	0.171	0.207	0.104
2Log Likelihood Chi2	sig.	133 (*)	80 (*)	152 (*)	58 (**)
Percent correct prediction					
0 tech // 0 applications		65%	9%	79%	0%
1-4 tech // 1 -3 Applications		89%	87%	57%	92%
5-9 tech // 4-8 Applications		26%	38%	42%	0%
10-15 tech // 9-24 applications		33%	16%	39%	33%
Overall		73%	63%	59%	52%

The statistical significance of the estimates is indicated with ***, ** and * representing the 1%, 5% and 10% level respectively.

Table 3-26 Effect of industry on adoption and uses of ICTs, Ordered logit estimates

		Specifications By Firm Size			
		ICTINT		ICTUSES	
Explanatory Variable		<50	>=50	<50	>=50
Intercept1	Est.(sig)	-1.0682	-5.225 (*)	-1.562 (***)	-3.715 (*)
	Std.	0.939	0.695	0.977	0.639
Intercept2	Est.(sig)	2.836 (*)	-0.875 (***)	0.197	-0.671
	Std.	0.96	0.581	0.972	0.594
Intercept3	Est.(sig)	6.253 (*)	1.566 (*)	2.021 (**)	0.448
	Std.	1.205	0.59	0.98	0.592
Objectives					
MKT_EFFICIENT	Est.(sig)	0.694 (*)	0.879 (*)	0.169 (***)	0.128
	Std.	0.239	0.243	0.093	0.231
MKT_COMPETE	Est.(sig)			-0.173 (*)	-0.269 (**)
	Std.			0.066	0.132
MKT_BIZVALUE	Est.(sig)			0.094(***)	0.049
	Std.			0.062	0.133
COST_RED	Est.(sig)	0.250 (**)	0.187	0.607 (*)	0.293 (***)
	Std.	0.158	0.158	0.145	0.152
INPUT_SUPP_CLI_COMMS	Est.(sig)	0.087	-0.211	0.626 (*)	0.117
	Std.	0.210	0.159	0.231	0.158
INPUT_VALUEADDED	Est.(sig)	-0.124	-0.321 (***)	-0.398 (***)	-0.312 (***)
	Std.	0.19	0.19	0.224	0.179
Obstacles					

IMP_OBST_COST (cost)	Est.(sig)	-0.094	-0.094	-0.197	-0.009
	Std.	0.098	0.098	0.14	0.137
IMP_OBST_ABSORB (human absorption capacity)	Est.(sig)	-0.275 (*)	-0.275 (*)	-0.218	-0.295 (**)
	Std.	0.112	0.112	0.174	0.147
IMP_OBST_SYSTINTG (technology)	Est.(sig)	-0.255 (**)	-0.255 (**)	-0.332	-0.300 (**)
	Std.	0.121	0.121	0.282	0.15
IMP_OBST_RELIAB (technology)	Est.(sig)	0.022	0.022	0.105	0.281
	Std.	0.0094	0.0094	0.1	0.206
		Specifications By Firm Size			
		ICTINT		ICTUSES	
Explanatory Variable		<50	>=50	<50	>=50
Human technology absorptive capacity					
ABSORB_ATT	Est.(sig)	-1.079 (*)	-0.694 (*)	-0.715 (*)	0.03
	Std.	0.266	0.133	0.193	0.185
ABSORB_CAP	Est.(sig)	-0.544 (*)	-0.456 (*)	-1.426 (*)	-0.294 (***)
	Std.	0.208	0.130	0.282	0.195
ABSORB_FIRM_ATT	Est.(sig)	0.387 (**)	-0.158	-0.088	0.118
	Std.	0.195	0.071	0.184	0.171
Cultural and environment factors					
ENVIR_FACE2FACE	Est.(sig)	-0.825 (*)	-0.363 (*)	-1.035 (*)	-0.326 (**)
	Std.	0.265	0.134	0.255	0.165
ENVIR_FEW_ONLINE_CLI	Est.(sig)	-0.154	-0.048	-0.05	0.069
	Std.	0.230	0.143	0.24	0.175
ENVIR_FEW_ONLINE_SUPP	Est.(sig)	0.303 (***)	0.386 (*)	0.458 (*)	0.463 (*)
	Std.	0.17	0.118	0.181	0.17
Innovativeness capacity					
INNOV_COLLAB	Est.(sig)	-0.085	-0.363 (*)	-0.167	-0.034
	Std.	0.144	0.134	0.132	0.134
INNOV_NEWPROD	Est.(sig)	0.045	-0.048	-0.129	0.141
	Std.	0.157	0.143	0.148	0.143
INFOFUT	Est.(sig)	0.288 (*)	0.237 (*)	0.235 (*)	0.228 (*)
	Std.	0.07	0.047	0.071	0.078
Market factor					
COMP_LEVEL_LOC	Est.(sig)	0.266 (***)	0.202 (**)	0.338 (*)	0.329 (**)
	Std.	0.167	0.105	0.143	0.158
COMP_EU	Est.(sig)	0.278 (**)	0.084	0.245	0.220 (***)
	Std.	0.137	0.097	0.166	0.132
COMP_CONDITIONS	Est.(sig)	0.064	-0.09	0.205	-0.131
	Std.	0.177	0.112	0.163	0.166
COMP_ICTUSES	Est.(sig)	-0.420 (*)	0.03	-0.049	-0.149
	Std.	0.151	0.101	0.145	0.139
		Specifications By Firm Size			
		ICTINT		ICTUSES	
Explanatory Variable		<50	>=50	<50	>=50
Industry dummies					
AGRO	Est.(sig)		- (*)		
CONSTRUCTION	Est.(sig)	+ (**)	- (*)		- (***)
TRANSP&COMMS	Est.(sig)				

MANUFACTURING	Est.(sig)		- (*)		- (***)
COMMERCE	Est.(sig)		- (*)		- (***)
SERVICES	Est.(sig)		- (*)		- (***)
GOVERNEMNT	Est.(sig)	+ (***)	- (**)		
FINANCE	Est.(sig)	baseline	baseline	baseline	baseline

The statistical significance of the estimates is indicated with ***, ** and * representing the 1%, 5% and 10% level respectively.

Table 3-25 shows the overall fit of the estimates differentiated by small and larger firms for the adoption of ICTs (intensity of adoption) and uses of ICTs (applications, uses). The model shows a better fit for smaller firms regarding ICT adoption, and a particularly worse fit for ICT uses in large firms. For both size classes, all categories of variables of the model contribute significantly to explaining adoption behaviour.

Examining the results more closely reveals some differences between the two size classes with respect to the role played by individual variables. Although anticipated benefits have the same pattern of impact on ICT in qualitative terms, there are some important differences with respect to the magnitude of the parameters (as already mentioned, these can be directly compared since the variables are standardised).

The explanatory power of the model is higher for small firms, particularly the cost and input efficiency factors being of higher significance; while the market factors play a larger role for large firms. These size-specific differences with respect to the expected net benefits ("revenues net of "costs", i.e. obstacles) seem to be consistent with the more urgent need to get a quick return on investments in ICT in small companies (either no adoption at all or adoption directly oriented towards input and output markets).

With respect to the relevance of competition as a factor forcing firms to adopt ICTs or use ICTs, exposure to EU competition is a more important driver of adoption for small firms than for larger ones.

Considering the obstacles to adoption, the differences are larger, in the first instance in case of ICT intensity, whereas the variables for the absorption capacity and the environmental factors play a significantly higher role for small firms. The latter aspect can be understood from the cluster effects predicted from theory, where the benefits depend largely on the group adoption rates.

The results indicate that this type of analysis seems to be an appropriate instrument to uncover systematic differences of adoption behaviour of firms belonging to different size classes. This procedure complements the (more traditional) analysis of size-effects based on parameter estimates for firm size included as a separate variable in an adoption model ("independent size-effects").

3.11.4. Confirmation of hypotheses for the factors influencing adoption and use of ICTs in individual firms

Confirmation of hypotheses for the factors influencing adoption and use of ICTs in individual firms is shown in Table 3-27.

Table 3-27 Confirmation of hypotheses of impact of the factors in the model on the decision to adopt and to use ICT

Variable definition - hypothesis	**Predicted Impact (sign)**		**Results**
	Adopt	Use	
Higher perceived benefits drive adoption and uses of ICTs	+	+	Confirmed
Increase sales and market value promotes adoption and use	+	+	Confirmed for uses, not for adoption
Improve market share, number of clients in new and existing markets	+	+	Confirmed for uses, not for adoption
Improve competitiveness relative to others in the market	+	+	Confirmed for uses, not for adoption
Increase market and brand recognition from ICT adoption	+	+	Inconclusive
Reduce costs and improve efficiency are reasons to adopt ICT	+	+	Confirmed
Improve communications with suppliers and employees increases efficiency and promotes adoption	+	+	Confirmed for uses , not for adoption
Focus on core and higher value added result f adoption	+	+	Confirmed for uses , not for adoption
higher perceived obstacles reduce adoption an ICTs	-	-	Confirmed (principally true for uses)
Implementation costs too expensive, maintena large, lack of time obstruct adoption	-	-	Confirmed for uses, not for adoption
Insufficient compatibility with existing ICT and work organization obstruct adoption	-	-	Confirmed for uses, not for adoption
Lack of knowledge of the technologies and personnel objections obstruct adoption	-	-	Confirmed for uses, not for adoption
Low reliability and unclear benefits obstruct adoption	-	-	Confirmed for uses, not for adoption
Variable definition - hypothesis	**Predicted Impact (sign)**		**Results**
	Adopt	Use	
Negative attitudes of personnel towards change, people attitude to learn do not support adoption	-	-	Confirmed for uses, not for adoption
Negative attitude of the Firm to change promotes adoption and use	-	-	Confirmed for uses, not for adoption

Insufficient capabilities of mgmt know-how, and use of training and outside resources do not supports adoption	-	-	Inconclusive
Employee level of knowledge	-	-	Inconclusive
Larger firms are more likely to adopt and have more uses of ICTs	+/-	+/-	Confirmed for adoption; in the case of uses the evidence is inconclusive
A firm is more likely to adopt and use ICTs if the industry where it operates shares this practice	+	+	Inconclusive
Higher perceived competition threats and opportunities stimulate adoption and uses of ICTs	+	+	Confirmed
A high predictability of results and environmental changes favors adoption and more uses	+	+	Inconclusive
A lower use of ICTs compared to other firms in the market favors investing more in ICTs	+	+	Confirmed for adoption
A need to compete in local markets favors adopting more ICTs and uses	+	+	Confirmed
The entrance in the EU has created new sources of competition that drive adoption of more ICTs and uses	+	+	Confirmed
Perceived innovation opportunities positively influence the adoption and uses of ICTs	+	+	Confirmed
Variable definition - hypothesis	**Predicted Impact (sign)**		**Results**
	Adopt	Use	
A high use of collaborative practices resulting in new products promotes adoption and use of ICTs	+	+	Inconclusive
A high proportion of sales coming from new products promotes the adoption and use of ICTs	+	+	Inconclusive
The formal use of more sources of information on technology improvements and opportunities favors adoption and use of ICTs	+	+	Confirmed
Cultural and environmental factors negatively influence the adoption and uses of ICTs	-	-	Confirmed
A preference for face to face contact does not favor adoption of ICTs	-	-	Confirmed
A lack of clients that use online processes limits the adoption opportunities of ICTs	-	-	Confirmed
A lack of suppliers that use online processes limits the adoption opportunities of ICTs	-	-	Confirmed

3.12. Relevant Adoption Factors

The adoption behaviour of Latvian firms in the field of ICT is characterised by a basic pattern of explanation which is quite strong across model estimations with different adoption variables. All the identified categories of explanatory variables are significant and relevant to various degrees. The most important factors are the anticipated cost and efficiency benefits, which are of higher importance for smaller firms, and sales and market improvement factors, which are more important to larger firms.

The firm's ability to absorb knowledge is important for all firms and reflects the relevance of human capital as a key determinant of adoption possibilities. Absorption capacity is directly related to the ability to benefit from other firms and institutions, information spillovers between firms, experience with earlier vintages of technology and (local and international) competitive pressure.

In addition to these firm-specific effects, there is also strong evidence for industry effects, with certain industries exhibiting a higher probability of adoption (in financial services for example), that reflect different technological opportunities.

Moreover, there are some interesting differences resulting from low adoption by suppliers, customers and competitors, which reduce the benefits of early adopters and could have therefore a general effect of slowing development in the industry sector.

The role of firm size, which belongs to the most prominent variables included in models of technology adoption, is analysed in some detail. It turns out that firm size is only of modest importance as an independent explanatory variable (covering size-specific variables not explicitly accounted for in the model), with relatively similar patterns across small and large firms. However, the adoption model is size-dependent in that firm size interacts with other explanatory variables. The approach allowed analysing size-effects to uncover systematic differences of adoption behaviour of firms belonging to different size classes. For example, the analysis of anticipated benefits and costs of adoption shows that small firms choose to engage in ICTs striving principally for cost efficiencies. Large firms, as mentioned before, strive for stronger customer- and supplier-orientation.

The analysis, with an extended version of the empirical model, yielded strong evidence for the influential role played by environment, cultural, and by perceived competition. The environmental and cultural factors play a significant role through the preferences of customers for face to face and direct contact, and the resistance of employees to change. This is consistent in the case of Latvia, with the hypothesis set out at the beginning of the study that the backlog of adaptation requirements following the Soviet era was considerable and were not still fully absorbed.

One main area left out in the model corresponds to the factors related to workplace organisation, and their influence for decisions to adopt ICT or to intensify their use. The data was very incomplete and exhibited unreliable patterns. Therefore, the expected ability to conclude on team-working, decentralised decision-making and flattening of hierarchical structures was not possible, and these factors were dropped from the empirical model.

3.13. Usefulness of the modelling approach, contributions for practice and limitations of the modelling approach

The results confirm in a robust manner that modelling anticipated profitability of technology adoption provides meaningful information and therefore is useful for policy formulation and business decision making. This value is derived from taking a more detailed perspective especially of the types of applications to which ICTs are applied. This adds depth and qualitative explanatory power in comparison to the more common empirical models used so far.

The empirical testing of the model in the context of Latvia, as an example of an emerging economy, provides a solid basis for the model in the specific circumstances that differ to a large degree from those of developed economies. In particular, the adoption of ICTs for productivity improvements takes a second place in comparison to the use of ICTs for information sharing. Thus the cost-reducing effects are limited. On the positive side, the evidence proves that the technology has also a great potential to generating product innovations, increasing customer-orientation, etc., as it does in more developed countries. In addition, the more important obstacles are revealed to be the slow adoption in industry sectors and cultural preferences in the first place, and only secondly financial, know-how, technological uncertainties and switching costs.

The results estimating the relationship between adoption of ICT technologies and their uses indicate that ICT intensity and ICT uses seem to interact; the direction of causality yields statistically significant results however only from ICT intensity to ICT uses, and not from uses leading to more ICT intensity. This finding suggests that familiarity with technology breeds ideas for their application, which suggests in turn that ICTs adoption is favourable regardless of use as a necessary formation ground for potential future uses.

The empirical model proved more accurate when used to predict low levels of adoption and use. This result was to be expected once it became clear that the majority of the sample were low users and adopters. Thus the data to understand the factors leading to higher adoption is less conclusive and suggests the need for complementary use of qualitative research and in-depth interviews, in order to understand the drivers of adoption from an individual firm's perspective. Nevertheless, the model provides a sufficient approach to define policies to bridge the seemingly big step to begin towards a high adoption path.

The research process itself is weakened by the mere fact that the number of companies employing ICTs to a high degree is so small, that in practice a very high proportion had to take part in the study. This severely limits the repeatability of the study as it was intended, suggesting a more qualitatively oriented panel of companies to share voluntary information, and possible agree to make the information more widely accessible to some degree.

The dissertation intentionally ignored the aspects related to the production of ICTs and the effects of the ICT sector in the economy. While this is not to be regarded as a limitation to the modelling approach, it is necessary to be aware of this fact, as frequently in the literature it is not clear what is meant by diffusion of ICTs and technology innovations. The point of view taken by this dissertation is that related to the efficiencies in-use that results from ICTs, and not from the invention of better ICTs or their production.

3.14. Confirmation Survey

In consideration of the significant economic changes that occurred in Latvia during the research period of 2007-2010, it was decided that a follow-up survey was needed to ascertain how and whether ICT use had changed in Latvia since the beginning of the survey period.

A 41 item, 4 category Likert (5 point scale) survey was designed and administered to managers of Latvian firms. The survey was administered during a three week period in the summer of 2011. The managers were MBA students at RTU Riga Business School. 100 surveys were distributed and 97 returned. The 97 were entered into an online (www.surveymonkey.com) service and the data analysed using categorical analysis tools in SPSS.

The following areas of ICT use were surveyed:

1. The importance of ICT use (how it has changed;
2. How ICT efficiency benefit goals have changed;

3. How obstacle to investments in software and hardware have changed (at firm level);
4. How ICT absorption methods have changed.

For each category the managers were asked questions about the changes with regards to specific areas of improvement in those general categories (for example use of technology to improve supply chain or increasing client numbers). The responses were coded for no change, some change, or significant change and compared in firms reporting high ICT use, medium use or low use. An Item Response Theory model was created by which to test the responses [2]. Overall, there were no significant changes in use of ICT reported by Latvian firms. Intergroup (comparing high with medium or low for example) did show that high use groups reported significantly more changes than did low intensity use groups, but still the intensity of use did not change from 2008-2011. Generally, it can be stated that ICT use has changed very little in the time period 2008-2011.

3.15. Recommendations to promote ICT adoption and use within Latvian enterprises

Based on the use of the validated model, the research and the main findings, the author makes the following **recommendations** to promote ICT adoption and use within Latvian enterprises and increase their competitiveness. Main areas of necessary improvements to promote ICT adoption and use within Latvian enterprises author summarized in Figure 3-3 and explained in detail afterwards.

The model suggests the importance of a strong innovation culture and the need for developing improved **absorption capacity**. This clearly leads to a recommendation that management must implement systems to increase **teamwork** decentralize decision-making and flatten hierarchical structures. This would help to increase perceived benefits. This would encourage cross-pollinization of experience, generation and consideration of multiple viewpoints and openness that might otherwise prevent intra-firm diffusion of ICT and future adoption decisions. Maximizing these team-related improvements is essential to both discovering the potential of ICTs, create long-term sustainable advantages and reducing the risks and costs of implementing specific solutions.

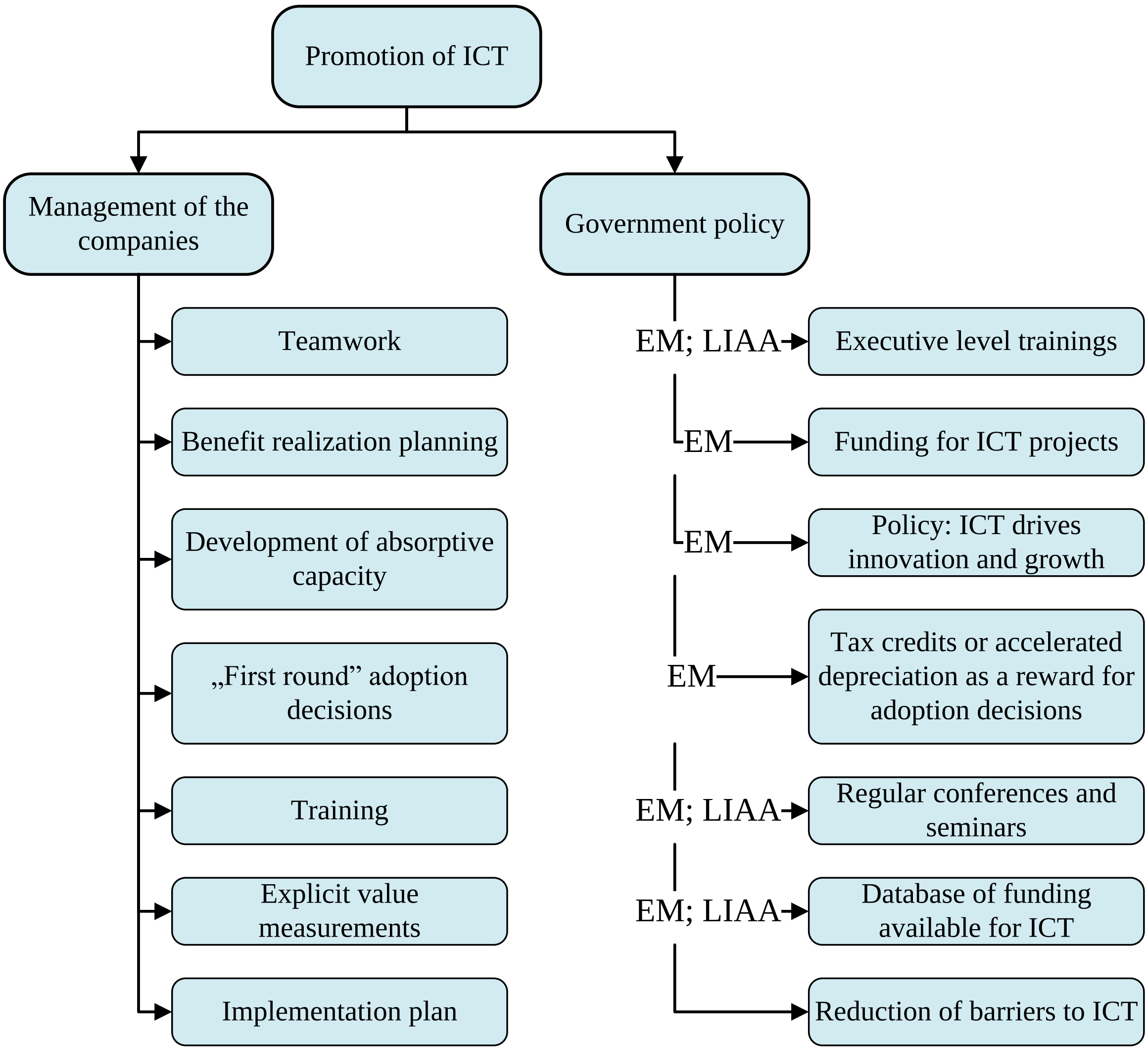

Figure 3-3 Main areas of necessary improvements and activities to promote ICT adoption and use within Latvian enterprises

Source: Author

One important element of the validated model is the importance of perceived benefits to improving the likelihood of adoption and use decisions. In order to facilitate the perception of benefits, managers should take actions that **make these benefits obvious**. Management must require that all ICT implementations are seen as a significant organizational change initiative by **requiring a benefits realization plan**, detailing the source of the benefits, responsibilities for making changes and timescale for achievement. Management (at board and executive level) should ensure that costs and benefits are explicitly recognized and acknowledged so that adoption decisions are made rationally and with full information. In essence, the behaviours with respect to ICT tend to fall into one of the following three modes: rational, trust and self-interest. While owners of companies, or senior managers, are more likely to subscribe to a rational view, they need to accept that there will be those who have a vested interest to protect and also that existing relationships among some stakeholders are a source of power for either beneficial change or resistance. Based on the current positioning of each stakeholder and the required level of resources or support they need to provide, an **action plan** to move their perceptions or deal with their concerns needs to be devised.

Development of absorptive capacity is an important area identified by the validated model that should be addressed by managers. If evaluation of absorptive capacity shows that a firm lags or that it is a weakness management must use evaluation and training planning as opportunities to increase the company's technology absorption capacity. Management could facilitate the exchange of experiences at all levels of the organization by creating and contracting for training that would increase technical knowledge and give employees the opportunity to share their explicit and tacit knowledge of the benefits available from other firms and institutions, information spillovers between firms, experience with earlier vintages of technology and (local and international) competitive pressure.

The model clearly shows that adoption decisions (especially successful ones) lead to new adoption decisions. This suggests that managers should take actions that encourage or facilitate **"first round" adoption decisions**. This can be done if management explicitly rewards employees for making adoption decisions and innovation using ICT-enabled opportunities. The data suggests that such decisions can lead to more positive adoption decisions and experiences. Employees analyzing data, collecting competitive intelligence, and using Web 2.0 technologies can be important sources of new business process innovations. This should lead to rewarding employees for innovation and implementation of internal business processes through employee ICT recommendations.

As the model shows that absorptive capacity is important to the success of adoption decisions and then use, it is important that strategic level managers ensure that **training is a part of all implementation projects**. The training should be as "real world" as possible; using business cases and simulations that will allow employees to clearly see the benefits of making their own adoption decision. Tools that can be used to both speed intra-firm diffusion and set the stage for more positive adoption decisions. One respondent to the promotion work survey responded "….it is surprising that so many Latvian companies spend tens of thousands of lats on hardware and software, but assume that the system will work by itself". Latvian companies need to identify users, schedule trainers, determine location and conduct training as part of the project plan. Training should use real data and actual business scenarios and coincide with users' ability to put training into practice upon returning to their jobs. Training should also be followed by evaluation for both process effectiveness and depth of diffusion to those trained. The effectiveness of training will later manifest in more positive attitudes toward more adoption decisions.

The model demonstrates that perception of benefits is a positive driver of adoption decisions so managers must include **explicit value measurements** (monetary, market and other) as a direct part of any ICT implementation project. Measuring the value from ICTs is a way for managers to demonstrate for themselves, internal and external audiences the value of the adoption decision that they make and make future decisions easier. A specific, 'best practices' example of a methodology for implementing and measuring ICT's impact that can be adapted by Latvian companies is Intel's "IT Business Value Program" (ITBV). Intel's formal ITBV program includes the following. A standard set of financial measurements of business value, which are called business value dials, which serve a common language throughout the company and are based on customer business objectives can help demonstrate movement toward objectives valued by all stakeholders. A standard measurement methodology to determine the impact of ICT solutions would also allow managers to further their ICT adoption agendas by creating and reinforcing absorption capacity. A common valuation process with finance acting as independent auditors could add to the ability of managers to lower the perceived risks to new adoption decisions. A business-value portfolio of the forecasted and delivered results determined by customer generated critical success factors would provide financial data justifying new adoption by clearly recognizing the benefits of adoption decisions. A set of ground rules used to define the program's operation and to drive accountability for the business value realized by customers would be a positive step. The ITBV team has also added an organizational performance evaluation metric to Intel's employee bonus (EB) program to ensure motivation and to encourage everyone to work towards the same end.

The model shows that perception of obstacles is an important impediment to adoption. Managers must insist that any ICT implementation project has a complete, **well thought implementation plan**. Such a plan should include both soft (human resource, training and publicity) and hard (actual technical issues). In Latvia, Schmit and Zitmanis (2009) [228] showed the value of a carefully thought through implementation plan to both gain acceptance and create positive perceptions to make new adoption decisions easier. The ICT group at Riga Technical University created a single entry portal (ORTUS) using open source platforms. Before creating this project the team solicited end-user input that was strongly considered in creating the portal. The team provided training on both a mandatory and as needed basis. Trainers were available for both training and help-desk services. As roll-out passed and initial acceptance was gained, training shifted to training for new add-ons and more sophisticated uses. The authors believed that the initial training and positive experiences led to easier acceptance of new modules added to the portal. Intra-firm diffusion, in effect, created an audience for add-ons to the ICT already in use. This type of experience qualitatively verifies the model and suggests its use in deciding how to influence adoption decisions.

The model creates a rich picture of the ways that adoption decisions can be made more likely and more likely to succeed. The model can be used as a basis for helping managers understand the factors that would improve the likelihood of making the positive adoption decisions and making those adoptions lead to use. The Ministry of Economics (EM), Latvian Investement and Development Agency (LIAA) must use **ESF training funds to create executive level trainings** to sensitize managers at upper levels to the long term benefits of adoption decisions. These trainings should support government policy that sees facilitating firm level adoption decisions as paramount. The general low level of ICTs use makes any adoption leader suffer an initial cost disadvantage not sufficiently compensated by efficiency gains. The collective predominant attitudes create fewer opportunities to differentiate and create market value, and possibly reduce the potential for efficiency gains. Typically low labor costs, red tape, bureaucratic organizational structures, explicit and implicit protectionism, political patronage, few career opportunities and advancement opportunities, and low experience and capital availability, weigh heavily against productivity, efficient larger scale organizations, and international and innovation orientation. Policies that would minimize costs and maximize perception of benefits would drive adoption decisions.

Government policy from the EM must clearly **encourage Latvian business to maximize the benefits of ICT** as a GPT. Research from the OECD and other international organizations show that **ICT drives innovation, economic expansion and growth**. Policies could include funding to tighten cooperation between the ICT industry and other businesses. This could be advanced by funding industry groups such as the LV Chamber of Commerce and the Latvian IT Cluster to create work groups to ensure that the potential of ICT as GPT is being consciously pursued. The potential that ICTs hold as a GPT seems far from exhausted and must therefore be of primary importance for Latvia's development strategies. Emerging economies have the opportunity to develop their own innovative uses, which are undoubtedly going to be different from those in developed economies. The problems and opportunities ICTs will address will evolve from a different angle in countries like Latvia in ways that are nearly impossible to predict. As a GPT however, the expectation should be that ICTs adoption and use is unavoidable and will transform society whatever its character, just like electrification did a century ago. The research reviewed and the model itself suggests that the policy leverage points used should focus not on diffusion itself but on the adoption decisions made at firm level.

The model strongly shows that managerial decision making regarding not only what ICT to adopt but how to adopt and the cultural determinants of success are very important. EM and LIAA policy must be to direct or **prioritize ESF training funds** to firms for trainings for executive management that would use case and case analysis to learn to identify the competitive threats clearly, so they can make good decisions. An example of the previous is the importance of accessing the EU as a policy and strategy measure. Higher perceived competition threats and opportunities stimulate adoption and uses of ICTs. The research clearly indicates that the entrance in the EU has created new sources of competition that drive adoption of more ICTs and uses. The model shows that perception of competition and threats can lead to decisions to adopt.

Policy tools such as **tax credits, ESF funding and others should reward adoption decisions**. This would recognize what the model suggests, that policy should not necessarily focus on economy wide diffusion, but on influencing the adoption decision itself. In comparison, a lower use of ICTs compared to other firms in the market favors investing more in ICTs not so much in more sophisticated applications but more so in investing in adopting ICTs (availability of the technologies). This means that local incentives to adopt technologies can have a ripple effect to stimulate further investments and offers a clear opportunity for stimulating policies.

Tax credits or accelerated depreciation should not be limited to first level or first time adoption, but extend to more adoption by making credits and accelerated depreciation available for more ICT adoptions. From the perspective of the model, this would decrease perceived expenses and obstacles. The results of estimating the relationship between adoption of ICT technologies and their uses indicate that ICT intensity and ICT uses seem to interact; the direction of causality yields statistically significant results however only from ICT intensity to ICT uses, and not from uses leading to more ICT intensity. This finding suggests that familiarity with technology breeds ideas for their application, which suggests in turn that ICTs adoption is favourable regardless of use as a necessary formation ground for potential future uses. This further gives grounds for a proactive stimulus from policies to adopt ICTs and extend their diffusion within adopting firms.

EM and LIAA must provide **regular conferences and seminars** to bring together ICT innovators together with businesses so to share knowledge and foment innovation. They should also create databases of innovation ideas and opportunities that are being funded or available for funding. Perceived innovation opportunities positively influence the adoption and uses of ICTs. For example, the formal use of more sources of information on technology improvements and opportunities favors adoption and use of ICTs.

EM, LIAA and those involved in business education must regularly fund or support the kind of **research** done in the Latvian Benchmarking study. While conceptually it is easy to cast a general message of technology as some sort of panacea based on random examples, in practice, the very simple indexes used internationally to compare relative development, showed to lack any power to compare the qualitative impact of the use of ICTs, in a way that would allow drawing realistic and meaningful policy recommendations.

EM, government in general and ministries responsible for specific sectors (Agriculture Ministry, Transport Ministry) must regularly consult with their respective sector to understand the industry **barriers to ICT implementation** so that policy can be informed and targeted. The obstacles to implement ICTs in a broad and sustainable way in Latvian companies are very considerable because the country, despite a sufficient ICT infrastructure, offers little market opportunity to invest in ICTs. Latvia’s small scale, predominance of very small companies and low orientation towards global business contribute to reducing perceived market advantages.

CONCLUSIONS AND RECOMMENDATIONS

The most important conclusion coming from the author's work is that the postulated model is valid. The validated model creates a link between understandings of the importance of ICT to firms and the economy as a whole that was elaborated in the first two chapters and the individual adoption decisions made at firm level. Previous work has focused on what are primarily diffusion related issues such as barriers to e-business. These are perceptions about the environment at large (macro) while the validated model is a micro/firm level approach to understanding adoption. The understanding of the forces associated with adoption leads to the ability of managers to understand where their firm is strong or weak and take realistic decisions on where improvement is needed that will more likely assure successful adoption decisions.

The model, further, allows separate consideration of those actions that could promote adoption or intensity of use. For example, while perception of implementation costs as high is associated with decreased use, it is not associated with adoption decisions. This suggests that managers should understand that if they are most interested in improving or intensifying use of ICT that they would help subordinates change their perception of the costs. They could help subordinates understand the concomitant benefits associated with the costs and so decrease the perception of those costs.

Given the validity of the model the following **main conclusions** can be offered:

1. The validated model combined with the literature regarding innovation (Chapter I) and adoption and diffusion (Chapter 2) demonstrated that the measures of perceived net benefits in sales, costs and general efficiency are valid and is associated with adoption decisions. Higher perceived benefits drive adoption and uses of ICTs. The empirical model confirms that the lack of the perception of immediate opportunities (e.g. of improving existing processes, or selling to a market) prevents firms from deciding to adopt ICTs, especially for uses that truly improve productivity (e.g. transactional processes, collaboration processes, supply chain integration).
2. The possibility to increase sales and market value that was included in the model was suggested by the literature reviewed in Chapter 2 was validated as related to adoption decisions and promotes more uses (intra-firm diffusion) of ICTs but does not influence the adoption of ICTs. Sales and market improvement factors are more important to larger firms and consequently the goals in this area will drive uses that are more sophisticated: business processes performed online (supply chain, marketing and

collaboration related), and online systems for process management and planning (people processes, production, and inventory management).

3. Perception of possibilities to improve market share, number of clients in new and existing markets, as well as the possibility to improve competitiveness relative to others in the market strongly drive the decision to use ICTs in ways that are more sophisticated. This is consistent with and validates the research reviewed in Chapter 2. These factors again are more important to large companies and do not explain adoption of ICT technologies per se.
4. Anticipated cost and efficiency benefits, i.e. goals to reduce costs and improve efficiency, were hypothesized and tested for the model as a result of the literature reviewed in Chapter 2 and are strong reasons to adopt ICTs for all firms, but even more so for smaller companies. Improved communications with suppliers and employees is a major perceived way to increase efficiency achievable through ICTs. Similarly, ICTs allow focusing on core and higher value added activities and integrating the services of suppliers to deal with lesser importance tasks. As suggested by Clemons (1992) this may be the result of firms pursuing ICT investments that lower the cost of market transactions. The use of ICTs allows even the smallest firms to participate in international supply chains and decreases the transaction and coordination costs associated with being either/both supplier and customer.
5. Higher perceived obstacles as an element of the model was suggested by the literature reviewed in Chapter 2 and are shown to reduce adoption and uses of ICTs. For example when implementation costs are perceived to be too high, maintenance costs too large, or time required is perceived as a constraint, these factors obstruct adoption especially in regard to more sophisticated applications. The same occurs when there is insufficient compatibility with existing ICT and organization of work and the company must perform major integration and transformation efforts. This also reflects back on the importance of absorption capacity. Given that firms with strong absorptive capacity (human) have the ability to reasonably predict the success of an adoption decision, it seems that they would also be better able to weigh the relative obstacles of the expense and maintenance of sophisticated applications.
6. The importance of the ability companies have to absorb knowledge as an element for/of the model was suggested by the literature review in Chapters 1 and 2 and is shown to be important for all firms and reflects the relevance of the human capital as a key determinant of adoption possibilities. For example, the lack of knowledge of the

technologies and personnel objections obstructs the will to invest in solutions that are more complex.

7. The capacity to absorb knowledge does not significantly affect the decision to adopt particular technologies (investment in tools) but poses a major obstacle in implementing uses that are more sophisticated. This is consistent with the literature regarding adoption and intra-firm diffusion [64], which suggests that, while adoption is related to intra-firm diffusion, they are processes with different dynamics. Low reliability and unclear benefits; negative attitudes of personnel towards change; people's attitude to learn; and a negative attitude of the Company towards change, all contribute to create a high barrier to the implementation of ICTs that significantly alter organization and business processes.
8. Larger firms are more likely to adopt and have more uses of ICTs. This fits with the fact that the general problems for which ICTs have been developed and applied relate strongly to scale of operations. Hence the predominant type of small companies in Latvia (>90%) contribute strongly to explain the overall low level of adoption of ICTs. However, the overall weight of firm size is only of modest importance compared to the other factors.
9. The proof that companies are more likely to adopt and use ICTs if the industry where they operate shares this practice is inconclusive. However, there is a higher probability of adoption (in financial services for example) that reflects an industry wide perception of the technological opportunities that pertain to the industry sector. In many ways the services provided by the financial services industry are transactions, and anything that decreases the cost and friction of transactions will be perceived positively.
10. Measurement of adoption cost and impact value of ICTs for individual companies is notoriously difficult, but the general benefits of productivity and innovation increases on an economy wide level from the collective adoption levels of ICTs have been very considerable for the years between the early 1990's and the present day. The main increase in productivity can be traced to methods to enable large and disperse organizations operate their structures and run their processes increasingly across borders in order to achieve their goals.
11. The model shows that the likelihood of ICT adoption can be affected by firm level concentration changing perceptions in a number of ways/places that managers can cause. Managers can develop strategies, tactics and related work processes that:

increase perceived net benefits, reduce anticipated cost and increase efficiency benefits, increase technology absorption capacity.

In a similar fashion to models such as Porter's model of generic competitive forces, the model offers a tool or framework from which business, government or business associations can understand how they can intervene to increase the likelihood of firms making the adoption and use decisions that are strongly associated with creating international value chains and would promote Latvia as a strong player in electronic markets. The validated model stands in distinction with the general pronouncements of much research regarding the importance of diffusion in Latvia (and Europe in general) because it addresses not the diffusion related issues but the adoption issues.

Based on the use of the validated model, the research and the main findings, the author makes the following **recommendations** to promote ICT adoption and use within Latvian enterprises and increase their competitiveness. Author divided recommendations for management of Latvian companies and government of Latvia.

Main recommendations for management of Latvian companies:

1. Management must implement systems to increase teamwork decentralize decision-making and flatten hierarchical structures. This would help to increase perceived benefits.
2. Management must require that all ICT implementations are seen as a significant organizational change initiative by requiring a benefits realization plan, detailing the source of the benefits, responsibilities for making changes and timescale for achievement. Management (at board and executive level) should ensure that costs and benefits are explicitly recognized and acknowledged so that adoption decisions are made rationally and with full information.
3. Management must use evaluation and training planning as opportunities to increase the company's technology absorption capacity. Management could facilitate the exchange of experiences at all levels of the organization by creating and contracting for training that would increase technical knowledge and give employees the opportunity to share their explicit and tacit knowledge of the benefits available from other firms and institutions, information spillovers between firms, experience with earlier vintages of technology and (local and international) competitive pressure.

4. Managers should take actions that encourage or facilitate "first round" adoption decisions. This can be done if management explicitly rewards employees for making adoption decisions and innovation using ICT-enabled opportunities. Such decisions can lead to more positive adoption decisions and experiences. Employees analyzing data, collecting competitive intelligence, and using Web 2.0 technologies can be important sources of new business process innovations. This should lead to rewarding employees for innovation and implementation of internal business processes through employee ICT recommendations.
5. Strategic level managers must ensure that training is a part of all implementation projects. The training should be as "real world" as possible; using business cases and simulations that will allow employees to clearly see the benefits of making their own adoption decision. Latvian companies need to identify users, schedule trainers, determine location and conduct training as part of the project plan. Training should use real data and actual business scenarios and coincide with users' ability to put training into practice upon returning to their jobs. Training should also be followed by evaluation for both process effectiveness and depth of diffusion to those trained. The effectiveness of training will later manifest in more positive attitudes toward more adoption decisions.
6. Managers must include explicit value measurements (monetary, market and other) as a direct part of any ICT implementation project. Measuring the value from ICTs is a way for managers to demonstrate for themselves, internal and external audiences the value of the adoption decision that they make and make future decisions easier.
7. Managers must insist that any ICT implementation project has a complete, well thought implementation plan. Such a plan should include both soft (human resource, training and publicity) and hard (actual technical issues).

and main recommendations for management of government of Latvia:

8. The Ministry of Economics (EM), Latvian Investment and Development Agency (LIAA) must use ESF training funds to create executive level trainings to sensitize managers at upper levels to the long term benefits of adoption decisions. These trainings should support government policy that sees facilitating firm level adoption decisions as paramount. Policies that would minimize costs and maximize perception of benefits would drive adoption decisions.

9. Government policy from the EM must clearly encourage Latvian business to maximize the benefits of ICT as a GPT. Research from the OECD and other international organizations show that ICT drives innovation, economic expansion and growth. Policies should include funding to tighten cooperation between the ICT industry and other businesses. This should be advanced by funding industry groups such as the LV Chamber of Commerce and the Latvian IT Cluster to create work groups to ensure that the potential of ICT as GPT is being consciously pursued. The potential that ICTs hold as a GPT seems far from exhausted and must therefore be of primary importance for Latvia's development strategies.
10. EM and LIAA policy must be to direct or prioritize ESF training funds to firms for trainings for executive management that would use case and case analysis to learn to identify the competitive threats clearly, so they can make good decisions. An example of the previous is the importance of accessing the EU as a policy and strategy measure. Higher perceived competition threats and opportunities stimulate adoption and uses of ICTs.
11. Policy tools such as tax credits, ESF funding and others should reward adoption decisions. Incentives to adopt technologies can have a ripple effect to stimulate further investments and offers a clear opportunity for stimulating policies.
12. Tax credits or accelerated depreciation should not be limited to first level or first time adoption, but extend to more adoption by making credits and accelerated depreciation available for more ICT adoptions. This would decrease perceived expenses and obstacles. This further gives grounds for a proactive stimulus from policies to adopt ICTs and extend their diffusion within adopting firms.
13. EM and LIAA must provide regular conferences and seminars to bring together ICT innovators together with businesses so to share knowledge and foment innovation. They should also create databases of innovation ideas and opportunities that are being funded or available for funding. Perceived innovation opportunities positively influence the adoption and uses of ICTs.
14. EM, LIAA and those involved in business education must regularly fund or support the kind of research done in the Latvian Benchmarking study. While conceptually it is easy to cast a general message of technology as some sort of panacea based on random examples, in practice, the very simple indexes used internationally to compare relative development, showed to lack any power to compare the qualitative impact of the use of ICTs, in a way that would allow drawing realistic and meaningful policy recommendations.

15. EM, government in general and ministries responsible for specific sectors (Agriculture Ministry, Transport Ministry) must regularly consult with their respective sector to understand the industry barriers to ICT implementation so that policy can be informed and targeted. The obstacles to implement ICTs in a broad and sustainable way in Latvian companies are very considerable because the country, despite a sufficient ICT infrastructure, offers little market opportunity to invest in ICTs.

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APPENDIX

Table A.1: Technical information of the survey

SURVEY	Survey of entrepreneurs of Latvia ”Usage of information technologies in the enterprises of Latvia” Performed by the March – April, 2007
SURVEY PROVIDER	Research centre SKDS
GENERAL POPULATION	All the economically active companies of Latvia
PLANNED SAMPLE	500 respondents Micro companies (1 – 9 employees): 125 Small companies (10 – 49 employees): 125 Medium companies (50 – 249 employees): 125 Large companies (250 or more employees): 125
ACHIEVED SAMPLE	505 respondents Micro companies (1 – 9 employees): 128 Small companies (10 – 49 employees): 126 Medium companies (50 – 249 employees): 126 Large companies (250 or more employees): 125
SAMPLING METHOD	Random stratified sampling from the data base of economically active companies of Central Statistics Bureau with increased number of respondents in the group of large companies
METHOD OF SURVEY	Telephone interviews
GEOGRAPHIC COVERAGE	All Latvia

Table A.2: Overview of interviews not performed

Number of interviewers	17	Average length of an interview	16 minutes
Total number of contact attempts	2665	The longest interview	125 minutes
Number of completed interviews	505	The shortest interview	3 minutes
Number of not performed interviews	2160		

Non-response because:	Total
Do not want to participate in survey	518
Do not have time	350
Interrupted interview (the respondent interrupted interview and refused to continue)	275
Non-reached because:	
Cannot be reached/ does not answer the phone	317
The company does not exist	17
The company does not correspond to the target group	336
Wrong telephone number (telephone number has been changed/ telephone number of private person/ non-existent telephone number)	234
Fax or automated answer machine	113
Total	2160

Table A.3.a: Dependents, construct descriptive statistics (standardized values)

Constructs/Variables	*N*	Mean	Std. Deviation	Missing		No. of Extremes(a,b)	
				Count	Percent	Low	High
Dependent Variables							
ICTINTENSE_working	505	2.988	2.860	0	.0	0	31
ICTINTENSE	505	1.095	.745	0	.0	.	.
ICTUSES_working	505	3.954	4.469	0	.0	0	21
ICTUSES	505	1.347	1.022	0	.0	0	0
ICTUSES_REDUCED	505	1.242	.738	0	.0	0	0
SALES_ONLINE	72	1.778	.953	433	85.7	0	7
EMAIL_USE_working	355	2.056	1.252	150	29.7	0	0
ICTUSES By Class (Aggregated In ICTUSES)							
ONL_COLLAB	447	.109	1.283	58	11.5	42	37
ONL_MKTNG	447	.024	1.022	58	11.5	0	49
ONL_BIDD	447	.097	1.174	58	11.5	110	86
ONL_RESEA	447	.089	1.148	58	11.5	49	68
ONL_INVO	447	.056	1.061	58	11.5	1	8
ONL_MKTGINFO	447	-.700	.976	58	11.5	0	0
ONL_ORDCYCLE	447	-.393	.795	58	11.5	0	31
ONL_CLISTATUS	447	-.077	.755	58	11.5	46	70
ONL_POSTSALES	447	-.247	.681	58	11.5	48	95
USE_IN_NOCOLLABSYST	91	-.136	1.318	414	82.0	7	0
USE_IN_NOCOLLABPROC	91	-.081	1.237	414	82.0	6	0
USE_IN_CLERICAL	91	.054	.958	414	82.0	1	15
USE_IN_TIMEPLAN	91	-.045	.911	414	82.0	0	7
USE_IN_COLLAB	91	.097	1.046	414	82.0	0	0

a) Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR)

b) Indicates that the inter-quartile range (IQR) is zero.

Table A.3.b: Independent variables, basic model, construct descriptive statistics (standardized values)

Constructs/Variables	N	Mean	Std. Deviation	Missing		No. of Extremes (a,b)	
				Count	Percent	Low	High
Independent Variables (Basic Model)							
COST_KNOW	313	.109	1.759	192	38.0	1	30
COST_RED	447	.000	1.000	58	11.5	50	16
COST_IMP_MAINT	447	-.026	.999	58	11.5	11	9
INPUT_INTEGRATEDP	447	.000	1.000	58	11.5	30	63
INPUT_QUAL_PREC	447	.000	1.000	58	11.5	3	48
INPUT_VALUEADDED	447	.000	1.000	58	11.5	10	13
INPUT_PROC_STD	447	.000	1.000	58	11.5	0	4
MKT_CLUST_COMP	447	.050	1.090	58	11.5	.	.
MKT_SHARE	447	.010	.990	58	11.5	28	85
MKT_BIZVALUE	447	.042	1.101	58	11.5	.	.
MKT_RECOGN	447	.036	1.132	58	11.5	.	.
MKT_ALL_FACTORS	447	.138	2.468	58	11.5	0	43
TECH_COMPAT	447	-.088	.856	58	11.5	85	85
TECH_NO_CLI_ACCES	447	-.003	.812	58	11.5	0	30
TECH_LACK_TECH	447	-.021	.947	58	11.5	36	35
ABSORB_ITCCAPAB	447	.315	.465	58	11.5	0	0
ABSORB_MGMTKNOW	447	.396	.490	58	11.5	0	0
ABSORB_EMPL_KNO	313	-.069	.935	192	38.0	2	9
ABSORB_SOLUTIONS	313	.262	.440	192	38.0	0	0
INDUSTRY	505	5.026	2.043	0	.0	0	0
SIZE_employees	505	2.487	1.122	0	.0	0	0
CONTROL_AGE	459	13.96	18.677	46	9.1	0	48
NOUSE_ENVIR_CLI	256	-.050	.698	249	49.3	41	55
NOUSE_PROD	256	.567	1.087	249	49.3	0	0
NOUSE_BENEF	256	-.034	.659	249	49.3	4	32
NOUSE_ENVIR_SUPP	256	-.226	.505	249	49.3	40	22
NOUSE_NOTCONSID	256	.125	.733	249	49.3	45	41

Table A.3.c: Independents, expanded model, construct descriptive statistics (standardized values)

Constructs/Variables	N	Mean	Std. Deviation	Missing		No. of Extremes (a,b)	
				Count	Percent	Low	High
Independent Variables (Expanded Model)							
INNOVAT_NEWPROD_improved	505	.493	.992	0	.0	.	.
INNOVAT_NEWPROD_new	505	.422	.936	0	.0	.	.
INNOVAT_CLI_COLLAB	278	.903	.896	227	45.0	0	0
INNOVAT_SUPP_COLLAB	273	.806	.880	232	45.9	0	0
ENVIRON_INFLUENCE_ALL	313	.094	1.051	192	38.0	0	0
CLUST_ICTUSE	313	.499	1.851	192	38.0	7	2
WORKPLACE_SUPERV	459	1.911	1.418	46	9.1	0	0
WORKPLACE_SELFORG	481	.279	.449	24	4.8	0	0
ATT_FIRM_TOICTS	473	.159	.366	32	6.3	.	.
ATT_EMP_TOICTS	481	.761	.451	24	4.8	.	.
ATT_FIRM_TOCHANGE	484	.093	.291	21	4.2	.	.
ATT_TIMECONSUM	447	-.078	.644	58	11.5	3	26
ATT_SUPP_NOTLIKE	447	-.119	.669	58	11.5	11	38
ATT_EMP_NOTLIKE	447	-.007	.847	58	11.5	.	.
ATT_CLI_NOTLIKE	447	-.100	.731	58	11.5	.	.
ATT_CHANGE_BIZPLAN_k08	436	1.358	.480	69	13.7	0	0
ATT_CHANGE_ICTPLAN_k09	456	2.559	.715	49	9.7	0	0
ATT_EMP_MGMT	313	.154	2.586	192	38.0	6	25
INFO_ASSOC	505	-.119	.595	0	.0	11	27
INFO_CLI_SUPP	505	-.242	.835	0	.0	1	25
INFO_CHAMBER	505	-.165	.698	0	.0	0	9
INFO_EMPL	505	-.134	.927	0	.0	0	0
INFO_ALL_FACTORS	505	-.660	1.447	0	.0	0	31

a) Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR)

b) Indicates that the inter-quartile range (IQR) is zero.

Table A.4: Questions pertaining to each construct

(A.4.a) Item Statistics, dependent variable ITCINTENSE	Mean	Std. Deviation	N
Vai Jūsu uzņēmums izmanto kaut ko no sekojošā? - Pieeju internetam	.89	.319	505
Savu interneta mājas lapu	.53	.500	505
Iekšējo E-pastu (īmeilu) (t.i. lai kontaktēties ar citiem darbiniekiem uzņēmuma iekšienē)	.46	.499	505
Ārējo E-pastu (īmeilu) (t.i. lai kontaktēties ar citiem cilvēkiem ārpus uzņēmuma)	.73	.442	505
Uzņēmuma iekšējo datu pārraides tīklu (LAN/tīkls, kurš savieno datorus vienas ēkas vai vietas ietvaros)	.32	.468	505
Uzņēmuma ārējo datu pārraides tīklu WAN (vienotā tīklā ir savienoti datori, kas atrodas ģeogrāfiski dažādās vietās)	.19	.391	505
Intranetu (uzņēmuma iekšējo mājaslapu)	.18	.385	505
Ekstranetu	.09	.285	505
Interaktīvo (automatizēto) telefonu sistēmu	.06	.237	505
EDI	.01	.077	505
Video konferences	.02	.152	505
Attālinātos vai mobilos datu terminālus (eg PDA, Laptopus, WAP-telefonus)	.09	.282	505
Attālinātos datu terminālus, kas tiek sinhronizēti ar Jūsu galveno tīklu	.05	.217	505
Uzņēmuma bezvadu iekšējo datu pārraides tīklu /Wireless LANS (802-11a\b\g hiperplan)	.10	.299	505
Uzņēmuma bezvadu ārējo datu pārraides tīklu Wireless WANs (3G\imode, satellite)	.06	.237	505
Datorizētu procesu kontroli	.10	.302	505
Neko no iepriekšminētā	.11	.319	505

(A.4.b) Item Statistics, Business processes performed online (web)

	Mean	Std. Deviation	N
Vai Jūsu uzņēmums izmanto tiešsaistes (onlaina) tehnoloģijas kā daļu kādai no sekojošām aktivitātēm (darbībām)? - Marketings (piemēram sūtot klientiem e-pastus par produktiem vai pakalpojumiem)	.29	.454	447
Piedāvājumu konkursos (e.g. solīšanai/izvērtēšanai)	.16	.366	447
Rēķinu nosūtīšanai	.25	.434	447
Izpētei	.11	.310	447
Ražošanā	.09	.283	447
Pēcpārdošanas apkalpošanā (e.g. pieprasījumu meklēšanas iespējas, atgriezeniskā saite ar klientiem tiešsaistē)	.04	.202	447
Darbinieku meklēšana/vervēšana (eg. reklamē vakances/saņem pieteikumus internetā)	.14	.346	447
Inventarizācija	.04	.202	447
Finansu operāciju /investīciju veikšana tiešsaistē	.11	.318	447
Kopīgs darbs ar klientiem pie projektu izstrādes un attīstīšanas	.06	.230	447
Kopīgs darbs ar piegādātājiem pie projektu izstrādes un attīstīšanas	.05	.212	447
Kopīgs darbs ar piegādātājiem pie pieprasījumu plānošanas un prognozēšanas	.03	.168	447
Cits	.01	.105	447

(A.4.c) Item Statistics, Online systems for admin and info planning tasks (web)

	Mean	Std. Deviation	N
Vai uzņēmuma iekšienē Jums tiešsaistes (onlain) režīmā ir pieejama informācija par … - Uzņēmuma darbiniekiem (piemēram, telefonu saraksts)	.42	.495	268
Vakantajiem amatiem	.29	.457	268
Uzņēmuma darbības plāniem un to izpildi	.21	.410	268
Izmaiņām tehnoloģijās	.15	.361	268
Izmaiņām uzņēmumā	.19	.390	268
Īpaša informācija, kas saistīta ar projektu vai darba grupu	.09	.291	268
Kādas uzņēmuma rīcībā esošās datu bāzes (e.g. informācija par klientiem)	.10	.306	268
Cita vieda informācija	.06	.230	268
Augstākminētās sistēmas mums nav pieejamas	.06	.237	268
Mums nav pieejamas nekādas sistēmas	.34	.476	268
Nezin/NA	.07	.263	268

(A.4.d) Item Statistics, Use of intranets	Mean	Std. Deviation	N
Vai Jūs izmantojat Intranetu: - Laika uzskaites grafiku sastādīšanai	.20	.401	91
Izdevumu kas saistīti ar darbu reģistrēšanu	.19	.392	91
Dažādām rezervācijām, kuras saistītas ar atvaļinājumiem (brīvdienām)	.13	.340	91
Personīgām dienasgrāmatām	.12	.328	91
Atestācijām/darbinieku novērtējumiem/darbinieku darba rezultātu kontrolei	.10	.300	91
Apmācībai	.25	.437	91
Dažādu ar darbu saistītu pamatlīdzekļu un mazsvarīgā inventāra pasūtījumu veikšanai	.11	.314	91
Iekšējai kancelejas preču pasūtīšanai	.12	.328	91
Uzņēmuma palīdzības dienesta darbā	.10	.300	91
Lai kopīgi ar citiem kolēģiem strādātu pie projektiem	.18	.383	91
Lai dalītos ar zināšanām	.18	.383	91
Mums nav augstākminēto sistēmu lai tās izliktu intranetā	.07	.250	91
Mums vispār intranetā nav nekādu koplietošanas sistēmu	.08	.268	91

(A.4.e) Item Statistics, Objectives to implement ITCS	Mean	Std. Deviation	N
To pieprasīja klienti	.03	.174	447
To pieprasīja piegādātāji	.01	.115	447
To pieprasīja vadība/centrālais birojs	.03	.174	447
Tas ir neatņemami šādam uzņēmējdarbības veidam	.03	.180	447
Zināšanu par IT pieaugumu	.02	.148	447
Mūsu produktu/pakalpojumu zināmības (atpazīstamības) /tirgus apjoma pieaugums	.01	.115	447
Kādi bija galvenie iemesli, kāpēc Jūs ieviesāt tiešsaistes (onlaina) tehnoloģijas? - Lai samazinātu izmaksas \palielinātu efektivitāti \peļņu (piemēram, darba veikšanas ātrumu /personāla izmaksas)	.37	.484	447
Lai standartizētu /vienkāršotu procesus (piemēram, viena standarta adrešu grāmata)	.35	.477	447
Lai integrētu procesus (piemēram, finanses ar personāla vadību)	.14	.344	447
Lai samazinātu papīra patēriņu	.15	.355	447
Lai palielinātu apgrozījumu	.11	.316	447
Lai palielinātu akciju cenu	.01	.115	447
Lai palielinātu klientu skaitu /tirgus daļu esošajos tirgos	.13	.334	447
Lai palielinātu klientu skaitu /tirgus daļu jaunos tirgos	.07	.258	447
Lai palielinātu piekļuves ātrumu informācijai	.09	.283	447
Lai palielinātu produktu/pakalpojumu klāstu	.02	.141	447
Lai uzlabotu komunikāciju ar klientiem /uzlabotu attiecības	.06	.230	447
Lai uzlabotu komunikāciju ar personālu	.04	.186	447
Lai uzlabotu komunikāciju ar piegādātājiem	.04	.197	447
Lai uzlabotu produktu/pakalpojumu kvalitāti/precizitāti	.02	.155	447
Lai uzlabotu drošumu	.04	.202	447
Lai uzlabotu \saīsinātu piegāžu laikus	.03	.162	447
Lai turētu līdzi konkurentiem/konkurentu spiediena rezultātā	.03	.174	447
Lai neatpaliktu no progresa	.12	.326	447
To pieprasīja darbinieki (piemēram, tie, kuri strādāja mājās)	.02	.124	447

(A.4.f) Item Statistics, Market	Mean	Std. Deviation	N
Vai ir kādi citi uzņēmumi, par kuriem varētu teikt, ka Jūsu uzņēmumam ar tiem ir stratēģiska sadarbība (t.i. alianse)? Ar stratēģisku sadarbību šeit tiek domāta ilgtermiņa sadarbība, kur sadarbības partneris nav izvēlēts pēc zemākās cenas principa...	8.91	26.09	505
Kā Jūs kopumā novērtētu uzņēmējdarbības vidi Latvija Jūsu sektorā. Vai Jūs varētu teikt, ka līdz šim kopumā Jūsu sektorā ...	12.50	30.58	505
Kā Jūs novērtētu, cik viegli prognozējama ir Jūsu sektora attīstība tuvāko gadu laikā. Vai tā ir…	13.10	31.28	505
Vai iestāšanās Eiropas Savienībā rezultātā konkurence Jūsu biznesa sektorā ir …	8.97	24.22	505
Kā Jūs novērtētu, vai ar citiem līdzīgiem uzņēmumiem Latvijā Jūsu konkurētspēja ir …	12.78	30.78	505

(A.4.g) Item Statistics, Technology absorption	Mean	Std. Deviation	N
Kā kopumā Jūsu darbinieki attiecas pret jaunām tehnoloģijām, kuras viņiem ir paredzēts lietot?	5.59	17.869	313
Vai pašreizējās Jūsu darbinieku ar informācijas tehnoloģijām saistītās (ICT) prasmes apmierina uzņēmējdarbības vajadzības?	2.52	.621	313
Kā Jūsu uzņēmums parasti risina problēmas, kas saistītas ar šo (ICT) prasmju trūkumiem?	2.77	7.646	313
Kā vadības prasmes nodrošina informācijas tehnoloģiju optimālu izmantošanu Jūsu uzņēmumā? Vai tās to nodrošina…	9.37	25.291	313

(A.4.h) Item Statistics, Difficulties encounters/obstacles when implementing on ITCS	Mean	Std. Deviation	N
Vai Jūs varētu man pateikt ar kādiem šķēršļiem (grūtībām) Jūs saskārāties veicot tehnoloģiju pārmaiņas? - Ieviešanas izmaksas	.28	.450	447
Uzturēšanas izmaksas	.17	.378	447
Laika/resursu trūkums	.15	.357	447
Vāja (zema) uzticamība	.02	.148	447
Tehnoloģiju trūkums	.06	.247	447
Klientiem nav tiešsaistes režīma pieejas	.01	.082	447
Piegādātāju/klientu prasmju trūkums	.01	.105	447
Personāla prasmju trūkums	.10	.304	447
Personāla pretošanās	.03	.168	447
Tas nav būtiski uzņēmumam	.01	.105	447
Nepietiekama vadība un ieteikumi no valdības puses	.00	.047	447
Grūtības, kas saistītas ar procesu pārveidi/izmaiņām	.03	.174	447
Grūtības, kas saistītas ar IT sistēmu integrāciju	.02	.148	447
Zināšanu trakums	.06	.238	447

(A.4.i)Item Statistics, negative Consequences of implementing	Mean	Std. Deviation	N
Ar kādām negatīvām sekām kas saistītas ar tiešsaistes (onlaina) tehnoloģiju ieviešanu Jūs esat saskāries iepriekš? - Apkalpošanas (servisa) pārtraukumi \sistēmas „nobrukšana”	.19	.395	447
Klientiem nepatika jauna sistēma	.02	.141	447
Piegādātajiem nepatika jaunā sistēma	.01	.082	447
Personālam nepatika jaunā sistēma	.04	.197	447
Pārak augstas izmaksas	.09	.279	447
(pareiza) Ieviešana prasīja pārak daudz laika	.02	.133	447

Table A.5: Factor analysis

Table A.5.a: Factor Loadings for ITCS (KMO=.845)				
	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
Attālinātos datu terminālus, kas tiek sinhronizēti ar Jūsu galveno tīklu	.773			
Attālinātos vai mobilos datu terminālus (eg PDA, Laptopus, WAP-telefonus)	.761			
Uzņēmuma bezvadu ārējo datu pārraides tiklu Wireless WANs (3G\imode, satellite)	.739			
Video konferences	.630			
Uzņēmuma ārējo datu pārraides tiklu WAN (vienota tiklā ir savienoti datori, kas atrodas ģeogrāfiski dažādās vietās)	.503			
Uzņēmuma iekšējo datu pārraides tiklu (LAN/tīkls, kurš savieno datorus vienas ēkas vai vietas ietvaros)	.503	.550	.412	
Uzņēmuma bezvadu iekšējo datu pārraides tiklu /Wireless LANS (802-11a\b\g hiperplan)	.442			
Iekšējo E-pastu (īmeilu) (t.i. lai kontaktētos ar citiem darbiniekiem uzņēmuma iekšienē)	.402	.409		.402
Pieeju internetam		.833		
Ārējo E-pastu (īmeilu) (t.i. lai kontaktētos ar citiem cilvēkiem ārpus uzņēmuma)		.831		
Savu interneta mājaslapu		.612		
Intranetu (uzņēmuma iekšējo mājaslapu)			.817	
Ekstranetu			.811	
EDI				.809
Interaktīvo (automatizēto) telefonu sistēmu				.579
Number of observations				505
Kaiser's overall measure of sampling adequacy (MSA)				.845
Variance accounted for by the first 4 factors				58%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				2342 (*)
Variance accounted for by each factor	33.63	11.73	7.11	6.81
Characterization of the 4 factors: (1) Wan, Lan, wireless,Terminals, Mobile (ICT_REMOTE) (2) Email, Internet and webpage (ICT_WEB) (3) Intranet, Extranet (ICT_INTRANET) (4) EDI, PBX (ICT_EDI) (The table shows only factor loadings of 0.4 and higher.)				

Table A.5.b: Factor Loadings for ITCs use for client webservices (KMO=.851)

Vai Jūs nodrošināt savus klientus tiešsaistes (online) režīmā ar sekojošu informāciju? –
Vai Jūsu klienti var veikt tiešsaistes režīmā (t.i. onlainā) kaut ko no sekojošā? -

	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
(par) Produktiem vai pakalpojumiem	.854			
(preču un pakalpojumu) Pieejamība	.709			
Cenām, piegāžu laikiem un nosacījumiem	.763			
Produktu/pakalpojumu attīstību	.599			
Veikt maksājumus		.788		
Pasūtīt preces vai pakalpojumus		.777		
Izsekot pasūtījuma apstrādei		.671	.435	
Pieprast papildus informāciju (par precēm un pakalpojumiem)		.622		
Klienta statusa jeb konta stāvokli			.784	
Pēcpārdošanas servisu			.712	
Piegāžu grafikiem			.585	
Biznesa procesiem (kâ notiek preču ražošana/pakalpojumu sniegšana)			.465	
Citu informāciju				.947
Number of observations				
Kaiser's overall measure of sampling adequacy (MSA)				.851
Variance accounted for by the first 4 factors				63%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				1852 (*)
Variance accounted for by each factor	36.22	10.88	8.30	7.88

Characterization of the 4 factors:
(1) Product and service information (WEB_SALES_INFO)
(2) Order, Pay, track (WEB_ORDER_CYCLE)
(3) Account status and post sales (WEB_CLI_SERV)
(4) Other sales and service info (WEB_OTHERI)
(The table shows only factor loadings of 0.4 and higher.)

Table A.5.c: Factor Loadings for ITCs use for BIZ PROCESSES (KMO=.807)

	Rotated Factor Pattern (Varimax)				
	Factors				
	1	2	3	4	5
Identificē (jeb piemeklē) piegādātājus	.782				
Ievāc informāciju par precēm un pakalpojumiem	.655				
Pārbauda izejvielu un materiālu pieejamību	.772				
Pasūta izejvielas un materiālus	.594	.537			
Seko pasūtījumu izpildes gaitai	.514				
Izmanto e-tirgus/biržas, lai pasūtītu preces un pakalpojumus		.734			
Finansu operāciju /investīciju veikšana tiešsaistē		.618			
Marketings (piemēram, sūtot klientiem e-pastus par produktiem vai pakalpojumiem)		.607			
Piedāvājumu konkursos (e.g. solīšanai		.596			
Veic maksājumus		.546			
Izpētei			.722		
Darbinieku meklēšana/vervēšana (eg. reklamē vakances/saņem pieteikumus internetā)			.607		
Pēcpārdošanas apkalpošanā (e.g. pieprasījumi, meklēšanas iespējas,...)			.591		
Ražošanā			.570		
Inventarizācija			.522		
Rēķinu nosūtīšanai			.503		
Kopīgs darbs ar piegādātājiem pie projektu izstrādes un attīstīšanas				.897	
Kopīgs darbs ar piegādātājiem pie pieprasījumu plānošanas un prognozēšanas				.809	
Kopīgs darbs ar klientiem pie projektu izstrādes un attīstīšanas				.772	
Izmanto pēcpārdošanas atbalsta pakalpojumus (t.s.. tehniskais atbalsts)					.825
Number of observations					505
Kaiser's overall measure of sampling adequacy (MSA)					.807
Variance accounted for by the first 5 factors					55%
Bartlett's Test of Sphericity (approx Chi Square) (Significance in brackets * =1% **=5%)					2442(*)
Variance accounted for by each factor	24.4	9.8	8.2	7.7	5.2

Characterization of the 5 factors:
(1) Supply management, order follow up (ONL_BIZ_SUPPLIES)
(2) Online banking, e-markets (ONL_E_SERVICES)
(3) Online research, stocks, production (ONL_BIZ_OPS)
(4) Online collaboration (ONL_BIZ_COLLAB)
(5) Techs support (ONL_TECHSUPP)
(The table shows only factor loadings of 0.4 and higher.)

Table A.5.d: Factor Loadings for RESOURCES PLANNING APPS (KMO=.786)				
	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	
Izmaiņām uzņēmumā	.812			
Uzņēmuma darbības plāniem un to izpildi	.780			
Izmaiņām tehnoloģijās	.775			
Vakantajiem amatiem	.680			
Uzņēmuma darbiniekiem (piemēram, telefonu saraksts)	.560		.550	
Kādas uzņēmuma rīcībā esošas datu bāzes (e.g. informācija par klientiem)		.755		
Īpaša informācija, kas saistīta ar projektu vai darba grupu		.690		
Cita vieda informācija		.687		
Augstākminētās sistēmas mums nav pieejamas			-.848	
Number of observations			268	
Kaiser's overall measure of sampling adequacy (MSA)			.786	
Variance accounted for by the first 4 factors			63%	
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)			670 (*)	
Variance accounted for by each factor	38.71	12.92	11.14	

Characterization of the 3 factors:

(1) Online info on plans, needs (PLAN_BIZNEEDS)

(2) Online client databases and projects (PLAN_CLIENTS)

(3) No client, planning, needs systems (PLAN_NOSYST)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.e: Factor Loadings for MARKET IMPROVEMENT OBJECTIVES for IC
(KMO=.726)

	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
Produktu/pakalpojumu zināmības (atpazīstamības) /tirgus apjoma pieaugums	.723			
Lai uzlabotu produktu/pakalpojumu kvalitāti/precizitāti	.630			
Lai uzlabotu komunikāciju ar klientiem /uzlabotu	.609			
Lai uzlabotu \saīsinātu piegāžu laikus	.504			
Lai palielinātu produktu/pakalpojumu klāstu	.495			
Lai palielinātu klientu skaitu /tirgus dalu esošajos tirgos		.859		
Lai palielinātu klientu skaitu /tirgus Danu jaunos tirgos		.845		
Lai turētu līdzi konkurentiem/ spiediena rezultātā			.840	
Lai neatpaliktu no progresa			.728	
Lai palielinātu akciju cenu				.838
Lai palielinātu apgrozījumu				.628
Number of observations				447
Kaiser's overall measure of sampling adequacy (MSA)				.726
Variance accounted for by the first 4 factors				59%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				757 (*)
Variance accounted for by each factor	26.06	12.11	11.86	8.90

Characterization of the 4 factors:

(1) Increase market/brand recognition/market size, effectiveness (MKT_EFFICIENT)

(2) Improve market share, number of clients in new and existing markets (MKT_SHARE)

(3) Improve competitiveness relative to market (MKT_COMPETE)

(4) Increase sales and market value (MKT_BIZVALUE)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.f: Factor Loadings for COST AND INPUT EFFICIENCY OBJECTIVES f
adoption (KMO=.662)

	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
Lai uzlabotu komunikāciju ar personālu	.889			
Lai uzlabotu komunikāciju ar piegādātājiem	.855			
Lai uzlabotu drošumu	.538		.515	
Lai samazinātu izmaksas \palielinātu efektivitāti \peļņu (piemēram, darba veikšanas ātrumu /personāla izmaksas)		.794		
Lai samazinātu papīra patēriņu		.708		
Nebija iemeslu (neviens)		-.65		
Darbinieki veic vairāk darbu ar augstu pievienoto vērtību			.802	
Lielāks uzsvars uz pamatdarbību (core activities)			.789	
Zināšanu par IT pieaugums				.771
Tas ir neatņemami šādam uzņēmējdarbības veidam				.654
Number of observations				447
Kaiser's overall measure of sampling adequacy (MSA)				.662
Variance accounted for by the first 4 factors				64%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				770 (*)
Variance accounted for by each factor	26.2	15.2	12.0	10.9

Characterization of the 4 factors:

(1) Improve communications with suppliers and employees (INPUT_SUPP_CLI_COMMS)

(2) Reduce costs and improve efficiency (COST_RED)

(3) Focus on core and higher value added (INPUT_VALUEADDED)

(4) General IT knowledge for this type of business (INPUT_GEN)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.g: Factor Loadings for TECHNOLOGY OBSTACLES to ICT adoption (KMO=.513)

	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
Ieviešanas izmaksas	.884			
Uzturēšanas izmaksas	.883			
Grūtības, kas saistītas ar IT sistēmu integrāciju		.789		
Nepietiekama vadība un ieteikumi no valdības puses		.791		
Personāla prasmju trūkums			.705	
Personāla pretošanās			.680	
Zināšanu trūkums			.638	
Nav redzams labums				.814
Vāja (zema) uzticamība				.805
Number of observations				447
Kaiser's overall measure of sampling adequacy (MSA)				.513
Variance accounted for by the first 4 factors				63%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				351 (*)
Variance accounted for by each factor	17.8	16.9	14.6	13.5

Characterization of the 4 factors:

(1) Implement and maintain costs (IMP_OBST_COST)

(2) System integration (IMP_OBST_TECHN_SYSTINTG)

(3) Lack of knowledge and personnel objections (IMP_OBST_TECHN_KNOWHOW)

(4) Low reliability and low benefits (IMP_OBST_TECHN_RELIAB)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.h: Factor Loadings for TECHNOLOGY ABSORPTION (KMO=.564)

	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
Kas no sekojošā vislabāk raksturo Jūsu uzņēmuma attieksmi pret tehnoloģijām, kuras ir pieminētas šajā aptaujā?	.746			
Situācijās, kad Jūs ieviešat ar IT tehnoloģijām saistītus projektus, vai Jūs pamata izmantojat...	.685			
Kā kopumā Jūsu darbinieki attiecas pret jaunām tehnoloģijām, kuras viņiem ir paredzēts lietot?	.595			
Kā vadības prasmes nodrošina informācijas tehnoloģiju optimālu izmantošanu Jūsu uzņēmumā? Vai tās to nodrošina…	.489	.578		
Kā Jūsu uzņēmums parasti risina problēmas, kas saistītas ar šo (ICT) prasmju trūkumiem?		.833		
Kurš no sekojošajiem izteikumiem visprecīzāk raksturo veidu kā Jūsu uzņēmums reaģē uz pārmaiņām?			.960	
Vai pašreizējās Jūsu darbinieku ar informācijas tehnoloģijām saistītās (ICT) prasmes apmierina uzņēmējdarbības vajadzības?				.991
Number of observations				313
Kaiser’s overall measure of sampling adequacy (MSA)				.564
Variance accounted for by the first 4 factors				69%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				126 (*)
Variance accounted for by each factor	24.64	16.49	15.18	13.01

Characterization of the 3 factors:

(1) Firm, management and personnel attitudes towards ICTs (ABSORB_ATT)

(2) Management capabilities and option to deal with ICT impl needs (ABSORB_CAP)

(3) Firm attitude to change (ABSORB_FIRM_ATTITUDE)

(4) Employee level of knowledge (ABSORB_EMPL_KNOW)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.i: Factor Loadings for COMPETITIVENESS factors (KMO=.625)				
	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	4
Kā Jūs kopumā novērtētu uzņēmējdarbības vidi Latvijā Jūsu sektorā. Vai Jūs varētu teikt, ka līdz šim kopumā Jūsu sektorā ...	.858			
Kā Jūs novērtētu, cik viegli prognozējama ir Jūsu sektora attīstība tuvāko gadu laikā. Vai tā ir…	.829			
Vai salīdzinot savu ar citiem līdzīgiem Jūsu nozares uzņēmumiem citās Eiropas valstīs Jūs varētu apgalvot, ka dažādas informācijas un komunikāciju tehnoloģijas Jūs izmantojat…		.874		
Vai salīdzinot savu ar citiem apgrozījuma ziņā līdzīgiem Jūsu nozares uzņēmumiem Latvijā Jūs varētu apgalvot, ka dažādas informācijas un komunikāciju tehnoloģijas Jūs izmantojat…		.819		
Kā Jūs novērtētu, vai ar citiem līdzīgiem uzņēmumiem Latvijā Jūsu konkurētspēja ir …			.968	
Vai iestāšanās Eiropas Savienībā rezultātā konkurence Jūsu biznesa sektorā ir …				.963
Number of observations				505
Kaiser's overall measure of sampling adequacy (MSA)				.625
Variance accounted for by the first 4 factors				83%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				396 (*)
Variance accounted for by each factor	34.11	22.04	14.71	11.88
Characterization of the 4 factors: (1) Prognosticability of competitive environment (COMP_CONDITIONS) (2) Comparable use of ICTS (COMP_ICTUSES) (3) Local level of competitiveness (COMP_LEVEL_LOC) (4) EU effects on competition level (COMP_EU) (The table shows only factor loadings of 0.4 and higher.)				

Table A.5.j: Factor Loadings for Cultural and Environmental factors (KMO=.623)

Vai Jūs nodrošināt savus klientus tiešsaistes (online) režīmā ar sekojošu informāciju? –

Vai Jūsu klienti var veikt tiešsaistes režīmā (t.i. onlainâ) kaut ko no sekojošā? -

	Rotated Factor Pattern (Varimax)			
	Factors			
	1	2	3	
Dod priekšroku kārtot darījumus klātienē vai pa telefonu	.827			
Dod priekšroku kārtot darījumus klātienē vai pa telefonu	.773			
Tiešsaistē pieejami pārāk maz piegādātāju	.695			
Klienti dod priekšroku tiešam (face to face) kontaktam pa telefonu	.446		.532	
Pārāk maz tiešsaistes (onlaina) klientu		.923		
Tiešaistē pieejami pārāk maz piegādātāju			.901	
Number of observations			165	
Kaiser’s overall measure of sampling adequacy (MSA)			.623	
Variance accounted for by the first 4 factors			70%	
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)				
Variance accounted for by each factor	34.89	17.88	17.09	

Characterization of the 3 factors:

(1) Prefer face to face clients/suppliers (ENVIR_FACE2FACE)

(2) Few online client (ENVIR_FEW_ONLINE_CLI)

(3) Few online suppliers (ENVIR_FEW_ONLINE_SUPP)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.k: Factor Loadings for Innovativeness (KMO=.550)

	Rotated Factor Pattern (Varimax) Factors 1	2
Domājot par pēdējo 3 gadu laikā ieviestiem jauniem produktiem un pakalpojumiem	.944	
Domājot par pēdējo 3 gadu laika ieviestiem jauniem produktiem un pakalpojumiem	.943	
Cik % Jūsu uzņēmuma apgrozījuma aizvadītā gada laika veido tādi produkti un pakalpojumi, kuri ir tikuši ieviesti pēdējo 3 gadu laika, ieskaitot jau esošo produktu/pakalpojumu modifikācijas?		.873
Cik procentus Jūsu uzņēmuma apgrozījuma aizvadītā gada laika veido tādi produkti un pakalpojumi, kuri ir tikuši saražoti ar pēdējo 3 gadu laika ieviestu, jaunu procesu palīdzību?		.872
Number of observations		363
Kaiser's overall measure of sampling adequacy (MSA)		.550
Variance accounted for by the first 2 factors		83%
Bartlett's Test of Sphericity (approx Chi Square) (significance in brackets * =1% **=5%)		501 (*)
Variance accounted for by each factor	50.417	32.946

Characterization of the five factors:

(1) Proportion of new products done in collaboration (INNOV_COLLAB)

(2) Percentage of sales from new products (INNOV_NEWPROD)

(The table shows only factor loadings of 0.4 and higher.)

Table A.5.l: Factor Loadings for Innovation info (KMO=.780)

Vai Jūs dalāties ar zināšanām par tehnoloģijām ar kādu no sekojošajiem avotiem, vai varbūt no šiem avotiem Jūs šīs zināšanas iegūstat?

	Rotated Factor Pattern (Varimax)				
	Factors				
	1	2	3	4	5
Tirdzniecības un rūpniecības palāta	.823				
Valdības pārziņā esošās uzņēmējdarbību sekmējošas organizācijas (LIAA utml.)	.818				
Nozaru asociācijas	.749				
Masu mediji, žurnāli un grāmatas		.706			
Konsultanti		.671			
Personāls			.885		
Draugi un ģimenes locekļi			.436		
Nedalos/neiegūstu			-.880		
Klienti				.831	
Piegādātāji				.785	
Citi uzņēmumi		.551		.332	
cits avots					.845
E-kopienas (vēstkopas) (E-communities)		.482			.553
Number of observations					505
Kaiser’s overall measure of sampling adequacy (MSA)					.780
Variance accounted for by the first 5 factors					65%
Bartlett's Test of Sphericity (approx Chi Square) (Significance in brackets * =1% **=5%)					85(*)
Variance accounted for by each factor	27.75	14.27	8.61	7.50	6.80

Characterization of the 5 factors:

(1) Associations (INFO_ASSOC)

(2) Consultants and own research (INFO_CONSULT)

(3) Employees, other, NONE (INFO_SOME_NONE)

(4) Clients and suppliers (INFO_CLI_SUPP)

(5) Other, e-communities (INFO_E_COMMUNS)

(The table shows only factor loadings of 0.4 and higher.)

Table A.6: Model detailed results, Case summaries ICTINTENSE, Link function: Logit[17]

		N	Marginal Percentage
ICTINTENSE	0 tech	96	19.0%
	1-4 tech	287	56.8%
	5-9 tech	100	19.8%
	10-15 tech	22	4.4%
Cik darbinieku strādā Jūsu uzņēmumā Latvijā neieskaitot īpašniekus?	1-9	129	25.5%
	10-49	126	25.0%
	50-249	125	24.8%
	250 un vairāk	125	24.8%
Kurā no sekojošām nozarēm ietilpst Jūsu uzņēmums?	Lauksaimniecība, mežsaimniecība, zvejniecība un derīgo izrakumu	15	3.0%
	Celtniecība	48	9.5%
	Transports un sakari	30	5.9%
	Ražošana	67	13.3%
	Mazum vai vairumtirdzniecība	104	20.6%
	Pakalpojumi	209	41.4%
	Valsts sektors	12	2.4%
	Finanšu starpniecība	20	4.0%
Valid		505	100.0%
Missing		0	
Total		505	

[17] The link function is a transformation of the cumulative probabilities that allows estimation of the model. The link used in the model is the Logit function, in the form: log(x / (1−x)) suited for evenly distributed categories.

A.6.a Variable: ICTINTENSE – case 1: all variables selected, industry and size – Parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTINTENSE = 0]	-4.404	.532	68.447	1	.000	-5.448	-3.361
	[ICTINTENSE = 1]	-.511	.487	1.101	1	.294	-1.466	.444
	[ICTINTENSE = 2]	2.019	.509	15.717	1	.000	1.021	3.017
Location	COST_RED	.138	.104	1.735	1	.188	-.067	.342
	MKT_EFFICIENT	.824	.161	26.038	1	.000	.507	1.140
	IMP_OBST_RELIAB	.046	.103	.196	1	.658	-.156	.247
	INPUT_SUPP_CLI_COMMS	-.155	.122	1.608	1	.205	-.395	.085
	INPUT_VALUEADDED	-.218	.105	4.283	1	.038	-.424	-.012
	IMP_OBST_ABSORB	-.019	.114	.028	1	.868	-.243	.205
	ABSORB_ATT	-.565	.131	18.766	1	.000	-.821	-.310
	ABSORB_CAP	-.515	.140	13.469	1	.000	-.790	-.240
	ABSORB_FIRM_ATTITUDE	-.146	.122	1.431	1	.232	-.386	.094
	ENVIR_FACE2FACE	-.358	.134	7.153	1	.007	-.620	-.096
	ENVIR_FEW_ONLINE_CLI	-.432	.142	9.276	1	.002	-.710	-.154
	ENVIR_FEW_ONLINE_SUPP	.187	.090	4.328	1	.037	.011	.363
	INFOFUT	.197	.049	16.399	1	.000	.102	.292
	COMP_CONDITIONS	.294	.108	7.332	1	.007	.081	.506
	COMP_ICTUSES	-.252	.103	5.945	1	.015	-.455	-.049
	COMP_LEVEL_LOC	.348	.104	11.294	1	.001	.145	.551
	COMP_EU	.141	.100	2.012	1	.156	-.054	.336
	[SIZE_qt_b02=1]	-2.987	.342	76.480	1	.000	-3.656	-2.317
	[SIZE_qt_b02=2]	-1.749	.303	33.402	1	.000	-2.343	-1.156
	[SIZE_qt_b02=3]	-.898	.276	10.571	1	.001	-1.440	-.357
	[SIZE_qt_b02=4]	0(a)	.	.	0	.	.	.
	[INDUSTRY=1]	-2.425	.742	10.676	1	.001	-3.880	-.970
	[INDUSTRY=2]	-.734	.557	1.733	1	.188	-1.826	.359
	[INDUSTRY=3]	.083	.597	.019	1	.890	-1.087	1.252
	[INDUSTRY=4]	-.860	.532	2.616	1	.106	-1.903	.182
	[INDUSTRY=5]	-.819	.518	2.499	1	.114	-1.835	.197
	[INDUSTRY=6]	-.821	.488	2.831	1	.092	-1.778	.135
	[INDUSTRY=7]	-.276	.769	.129	1	.720	-1.784	1.232
	[INDUSTRY=8]	0(a)	.	.	0	.	.	.

Link function: Logit.

a This parameter is set to zero because it is redundant.

Test of Parallel Lines(c)

A.6.b Variable: ICTINTENSE – case 2: all variables selected and size, parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTINTENSE = 0]	-3.617	.271	178.342	1	.000	-4.148	-3.086
	[ICTINTENSE = 1]	.173	.194	.792	1	.373	-.208	.553
	[ICTINTENSE = 2]	2.652	.274	93.782	1	.000	2.115	3.189
Location	COST_RED	.131	.102	1.637	1	.201	-.070	.332
	MKT_EFFICIENT	.789	.159	24.453	1	.000	.476	1.101
	IMP_OBST_RELIAB	.063	.103	.378	1	.539	-.138	.265
	INPUT_SUPP_CLI_COMMS	-.145	.121	1.431	1	.232	-.383	.093
	INPUT_VALUEADDED	-.198	.103	3.655	1	.056	-.401	.005
	IMP_OBST_ABSORB	-.068	.112	.369	1	.543	-.288	.151
	ABSORB_ATT	-.537	.128	17.623	1	.000	-.788	-.286
	ABSORB_CAP	-.505	.139	13.184	1	.000	-.777	-.232
	ABSORB_FIRM_ATTITUDE	-.141	.119	1.392	1	.238	-.375	.093
	ENVIR_FACE2FACE	-.348	.132	6.939	1	.008	-.607	-.089
	ENVIR_FEW_ONLINE_CLI	-.408	.139	8.577	1	.003	-.681	-.135
	ENVIR_FEW_ONLINE_SUPP	.193	.089	4.658	1	.031	.018	.368
	INFOFUT	.196	.048	16.638	1	.000	.102	.290
	COMP_CONDITIONS	.290	.106	7.475	1	.006	.082	.497
	COMP_ICTUSES	-.281	.101	7.724	1	.005	-.480	-.083
	COMP_LEVEL_LOC	.347	.102	11.679	1	.001	.148	.546
	COMP_EU	.110	.098	1.242	1	.265	-.083	.302
	[SIZE_qt_b02=1]	-2.983	.332	80.949	1	.000	-3.633	-2.333
	[SIZE_qt_b02=2]	-1.846	.298	38.414	1	.000	-2.429	-1.262
	[SIZE_qt_b02=3]	-.933	.273	11.695	1	.001	-1.468	-.398
	[SIZE_qt_b02=4]	0(a)	.	.	0	.	.	.

Link function: Logit.

a This parameter is set to zero because it is redundant.

A.6.c Variable: ICTINTENSE – case 3: all variables selected and industry parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTINTENSE = 0]	-2.887	.469	37.952	1	.000	-3.805	-1.968
	[ICTINTENSE = 1]	.449	.451	.991	1	.320	-.435	1.333
	[ICTINTENSE = 2]	2.764	.486	32.287	1	.000	1.810	3.717
Location	COST_RED	.292	.100	8.602	1	.003	.097	.488
	MKT_EFFICIENT	.426	.150	8.031	1	.005	.131	.721
	INPUT_SUPP_CLI_COMMS	.019	.118	.026	1	.873	-.213	.251
	INPUT_VALUEADDED	-.182	.106	2.965	1	.085	-.390	.025
	IMP_OBST_ABSORB	.090	.109	.688	1	.407	-.123	.303
	ABSORB_ATT	-.697	.136	26.421	1	.000	-.963	-.431
	ABSORB_CAP	-.472	.136	12.118	1	.000	-.738	-.206
	ABSORB_FIRM_ATTITUDE	-.189	.121	2.449	1	.118	-.425	.048
	ENVIR_FACE2FACE	-.328	.129	6.489	1	.011	-.580	-.076
	ENVIR_FEW_ONLINE_CLI	-.030	.125	.057	1	.811	-.275	.215
	ENVIR_FEW_ONLINE_SUPP	.117	.087	1.812	1	.178	-.053	.287
	INFOFUT	.226	.047	23.039	1	.000	.134	.319
	COMP_CONDITIONS	.284	.105	7.367	1	.007	.079	.489
	COMP_ICTUSES	-.328	.100	10.714	1	.001	-.524	-.131
	COMP_LEVEL_LOC	.331	.101	10.739	1	.001	.133	.530
	COMP_EU	.275	.096	8.182	1	.004	.087	.464
	[INDUSTRY=1]	-2.496	.711	12.325	1	.000	-3.889	-1.103
	[INDUSTRY=2]	-.546	.534	1.046	1	.306	-1.592	.500
	[INDUSTRY=3]	-.036	.575	.004	1	.950	-1.163	1.091
	[INDUSTRY=4]	-.725	.514	1.991	1	.158	-1.732	.282
	[INDUSTRY=5]	-1.290	.500	6.665	1	.010	-2.269	-.311
	[INDUSTRY=6]	-1.021	.471	4.693	1	.030	-1.945	-.097
	[INDUSTRY=7]	.027	.744	.001	1	.971	-1.432	1.486
	[INDUSTRY=8]	0(a)	.	.	0	.	.	.

Link function: Logit.

a This parameter is set to zero because it is redundant.

A.6.d Variable: ICTINTENSE – case 4: all variables selected and no dummies for industry or size, parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTINTENSE = 0]	-1.916	.137	195.704	1	.000	-2.185	-1.648
	[ICTINTENSE = 1]	1.294	.119	118.457	1	.000	1.061	1.527
	[ICTINTENSE = 2]	3.555	.244	212.293	1	.000	3.077	4.033
Location	COST_RED	.298	.098	9.286	1	.002	.106	.489
	MKT_EFFICIENT	.353	.149	5.657	1	.017	.062	.645
	INPUT_SUPP_CLI_COMMS	.027	.117	.052	1	.819	-.203	.256
	INPUT_VALUEADDED	-.152	.105	2.079	1	.149	-.357	.054
	IMP_OBST_ABSORB	.041	.107	.148	1	.700	-.168	.251
	ABSORB_ATT	-.694	.133	27.345	1	.000	-.954	-.434
	ABSORB_CAP	-.456	.130	12.228	1	.000	-.712	-.200
	ABSORB_FIRM_ATTITUDE	-.158	.117	1.828	1	.176	-.387	.071
	ENVIR_FACE2FACE	-.324	.127	6.499	1	.011	-.572	-.075
	ENVIR_FEW_ONLINE_CLI	.031	.123	.064	1	.800	-.210	.273
	ENVIR_FEW_ONLINE_SUPP	.116	.086	1.831	1	.176	-.052	.284
	INFOFUT	.237	.047	25.638	1	.000	.145	.328
	COMP_CONDITIONS	.305	.102	8.872	1	.003	.104	.506
	COMP_ICTUSES	-.374	.098	14.481	1	.000	-.567	-.181
	COMP_LEVEL_LOC	.371	.099	14.048	1	.000	.177	.564
	COMP_EU	.253	.095	7.065	1	.008	.066	.439

Table A.7: Model detailed results, Case summaries ICTUSE,
Link function: Logit[18]

A.7.a Variable: ICTUSE – case 1: all variables selected, industry and size, parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTUSES = .00]	-1.307	.290	20.370	1	.000	-1.874	-.739
	[ICTUSES = 1.00]	.114	.287	.158	1	.691	-.448	.676
	[ICTUSES = 2.00]	1.172	.294	15.878	1	.000	.595	1.748
Location	COST_RED	.198	.061	10.467	1	.001	.078	.319
	INPUT_SUPP_CLI_COMMS	.167	.074	5.056	1	.025	.021	.312
	INPUT_VALUEADDED	-.098	.065	2.308	1	.129	-.225	.028
	ENVIR_FACE2FACE	-.350	.086	16.694	1	.000	-.518	-.182
	ENVIR_FEW_ONLINE_CLI	.090	.085	1.123	1	.289	-.076	.256
	ENVIR_FEW_ONLINE_SUPP	.180	.068	7.085	1	.008	.047	.312
	MKT_EFFICIENT	.169	.093	3.283	1	.070	-.014	.352
	MKT_COMPETE	-.173	.066	6.828	1	.009	-.303	-.043
	MKT_BIZVALUE	.094	.062	2.320	1	.128	-.027	.216
	IMP_OBST_COST	-.067	.060	1.238	1	.266	-.184	.051
	IMP_OBST_RELIAB	.037	.059	.391	1	.532	-.079	.153
	IMP_OBST_SYSTINTG	-.105	.071	2.171	1	.141	-.245	.035
	IMP_OBST_ABSORB	-.105	.069	2.307	1	.129	-.240	.030
	ABSORB_ATT	-.232	.080	8.452	1	.004	-.388	-.075
	ABSORB_CAP	-.528	.109	23.401	1	.000	-.742	-.314
	ABSORB_FIRM_ATTITUDE	-.018	.076	.059	1	.808	-.167	.131
	INNOV_COLLAB	-.067	.057	1.354	1	.245	-.179	.046
	INNOV_NEWPROD	-.156	.064	5.927	1	.015	-.282	-.030
	INFOFUT	.139	.028	24.239	1	.000	.084	.195
	COMP_LEVEL_LOC	.188	.063	9.012	1	.003	.065	.311
	COMP_EU	.171	.060	8.132	1	.004	.054	.289
	COMP_CONDITIONS	.018	.067	.071	1	.790	-.113	.149
	COMP_ICTUSES	-.101	.061	2.758	1	.097	-.219	.018
	[SIZE_qt_b02=1]	-.572	.182	9.911	1	.002	-.929	-.216
	[SIZE_qt_b02=2]	-.272	.166	2.688	1	.101	-.598	.053
	[SIZE_qt_b02=3]	.016	.158	.010	1	.919	-.294	.326
	[SIZE_qt_b02=4]	0(a)	.	.	0	.	.	.
	[INDUSTRY=1]	-.999	.457	4.772	1	.029	-1.896	-.103
	[INDUSTRY=2]	-.589	.326	3.275	1	.070	-1.227	.049
	[INDUSTRY=3]	-.525	.352	2.220	1	.136	-1.216	.166

[18] The link function is a transformation of the cumulative probabilities that allows estimation of the model. The link used in the model is the Logit function, in the form:
log(x / (1−x)) suited for evenly distributed categories.

[INDUSTRY=4]	-.444	.313	2.010	1	.156	-1.057	.170
[INDUSTRY=5]	-.552	.306	3.253	1	.071	-1.153	.048
[INDUSTRY=6]	-.369	.287	1.660	1	.198	-.931	.192
[INDUSTRY=7]	-.058	.454	.016	1	.898	-.947	.831
[INDUSTRY=8]	0(a)	.	.	0	.	.	.

A.7.b Variable: ICTUSE – case 2: all variables selected, size – parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTUSES = .00]	-2.039	.208	95.815	1	.000	-2.447	-1.631
	[ICTUSES = 1.00]	.094	.186	.255	1	.614	-.271	.459
	[ICTUSES = 2.00]	1.463	.201	53.212	1	.000	1.070	1.856
Location	COST_RED	.325	.097	11.238	1	.001	.135	.514
	INPUT_SUPP_CLI_COMMS	.263	.121	4.691	1	.030	.025	.500
	INPUT_VALUEADDED	-.226	.111	4.151	1	.042	-.443	-.009
	ENVIR_FACE2FACE	-.460	.128	12.833	1	.000	-.712	-.208
	ENVIR_FEW_ONLINE_CLI	.074	.129	.332	1	.565	-.179	.328
	ENVIR_FEW_ONLINE_SUPP	.548	.118	21.397	1	.000	.316	.780
	MKT_EFFICIENT	.231	.153	2.281	1	.131	-.069	.530
	MKT_COMPETE	-.284	.103	7.636	1	.006	-.486	-.083
	MKT_BIZVALUE	.150	.100	2.236	1	.135	-.047	.347
	IMP_OBST_COST	-.127	.094	1.805	1	.179	-.312	.058
	IMP_OBST_RELIAB	.065	.090	.525	1	.469	-.111	.241
	IMP_OBST_SYSTINTG	-.364	.118	9.473	1	.002	-.597	-.132
	IMP_OBST_ABSORB	-.307	.108	8.112	1	.004	-.518	-.096
	ABSORB_ATT	-.338	.120	7.997	1	.005	-.573	-.104
	ABSORB_CAP	-.680	.153	19.857	1	.000	-.979	-.381
	ABSORB_FIRM_ATTITUDE	-.065	.113	.334	1	.563	-.286	.156
	INNOV_COLLAB	-.139	.089	2.465	1	.116	-.313	.035
	INNOV_NEWPROD	-.212	.095	5.017	1	.025	-.398	-.027
	INFOFUT	.245	.048	25.790	1	.000	.150	.339
	COMP_LEVEL_LOC	.385	.096	16.187	1	.000	.197	.572
	COMP_EU	.181	.095	3.665	1	.056	-.004	.367
	COMP_CONDITIONS	.082	.102	.645	1	.422	-.118	.282
	COMP_ICTUSES	-.094	.094	.999	1	.318	-.277	.090
	[SIZE_qt_b02=1]	-.923	.275	11.238	1	.001	-1.463	-.383
	[SIZE_qt_b02=2]	-.568	.258	4.840	1	.028	-1.074	-.062
	[SIZE_qt_b02=3]	-.147	.252	.338	1	.561	-.641	.348
	[SIZE_qt_b02=4]	0(a)	.	.	0	.	.	.

Link function: Logit.

a This parameter is set to zero because it is redundant.

A.7.c Variable: ICTUSE – case 3: all variables selected and industry, parameter estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTUSES = .00]	-2.561	.476	28.945	1	.000	-3.494	-1.628
	[ICTUSES = 1.00]	-.426	.466	.835	1	.361	-1.338	.487
	[ICTUSES = 2.00]	.955	.467	4.177	1	.041	.039	1.870
Location	COST_RED	.388	.097	16.135	1	.000	.199	.577
	INPUT_SUPP_CLI_COMMS	.305	.121	6.351	1	.012	.068	.542
	INPUT_VALUEADDED	-.244	.111	4.839	1	.028	-.461	-.027
	ENVIR_FACE2FACE	-.451	.129	12.211	1	.000	-.704	-.198
	ENVIR_FEW_ONLINE_CLI	.177	.125	2.001	1	.157	-.068	.423
	ENVIR_FEW_ONLINE_SUPP	.500	.118	18.108	1	.000	.270	.731
	MKT_EFFICIENT	.152	.154	.976	1	.323	-.149	.453
	MKT_COMPETE	-.292	.106	7.607	1	.006	-.500	-.085
	MKT_BIZVALUE	.120	.102	1.378	1	.240	-.080	.319
	IMP_OBST_COST	-.097	.095	1.043	1	.307	-.283	.089
	IMP_OBST_RELIAB	.059	.091	.430	1	.512	-.118	.237
	IMP_OBST_SYSTINTG	-.336	.118	8.083	1	.004	-.568	-.104
	IMP_OBST_ABSORB	-.228	.106	4.667	1	.031	-.435	-.021
	ABSORB_ATT	-.412	.120	11.703	1	.001	-.648	-.176
	ABSORB_CAP	-.691	.151	20.938	1	.000	-.987	-.395
	ABSORB_FIRM_ATTITUDE	-.107	.115	.870	1	.351	-.332	.118
	INNOV_COLLAB	-.119	.090	1.775	1	.183	-.295	.056
	INNOV_NEWPROD	-.214	.096	4.997	1	.025	-.402	-.026
	INFOFUT	.258	.049	28.078	1	.000	.163	.354
	COMP_LEVEL_LOC	.365	.097	14.233	1	.000	.175	.555
	COMP_EU	.252	.094	7.217	1	.007	.068	.436
	COMP_CONDITIONS	.073	.103	.512	1	.474	-.128	.275
	COMP_ICTUSES	-.119	.094	1.596	1	.207	-.304	.066
	[INDUSTRY=1]	-1.823	.698	6.830	1	.009	-3.190	-.456
	[INDUSTRY=2]	-.800	.536	2.226	1	.136	-1.851	.251
	[INDUSTRY=3]	-.873	.578	2.284	1	.131	-2.006	.259
	[INDUSTRY=4]	-.846	.520	2.643	1	.104	-1.865	.174
	[INDUSTRY=5]	-1.168	.507	5.307	1	.021	-2.161	-.174
	[INDUSTRY=6]	-.874	.480	3.309	1	.069	-1.815	.068
	[INDUSTRY=7]	-.214	.729	.086	1	.770	-1.643	1.216
	[INDUSTRY=8]	0(a)	.	.	0	.	.	.

A.7.d Variable: ICTUSE – case 4: all variables selected and no dummies for industry or size

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTUSES = .00]	-1.638	.126	167.778	1	.000	-1.886	-1.390
	[ICTUSES = 1.00]	.459	.104	19.589	1	.000	.255	.662
	[ICTUSES = 2.00]	1.832	.135	184.774	1	.000	1.568	2.097
Location	COST_RED	.392	.095	17.040	1	.000	.206	.578
	INPUT_SUPP_CLI_COMMS	.302	.120	6.325	1	.012	.067	.537
	INPUT_VALUEADDED	-.217	.112	3.770	1	.052	-.436	.002
	ENVIR_FACE2FACE	-.464	.128	13.085	1	.000	-.715	-.213
	ENVIR_FEW_ONLINE_CLI	.189	.123	2.341	1	.126	-.053	.430
	ENVIR_FEW_ONLINE_SUPP	.505	.116	18.870	1	.000	.277	.733
	MKT_EFFICIENT	.131	.151	.743	1	.389	-.166	.427
	MKT_COMPETE	-.266	.103	6.703	1	.010	-.467	-.065
	MKT_BIZVALUE	.138	.100	1.910	1	.167	-.058	.334
	IMP_OBST_COST	-.082	.093	.769	1	.380	-.264	.101
	IMP_OBST_RELIAB	.069	.089	.598	1	.439	-.106	.244
	IMP_OBST_SYSTINTG	-.340	.117	8.442	1	.004	-.569	-.111
	IMP_OBST_ABSORB	-.255	.105	5.948	1	.015	-.461	-.050
	ABSORB_ATT	-.409	.120	11.678	1	.001	-.643	-.174
	ABSORB_CAP	-.694	.153	20.561	1	.000	-.994	-.394
	ABSORB_FIRM_ATTITUDE	-.084	.112	.564	1	.453	-.303	.135
	INNOV_COLLAB	-.135	.088	2.337	1	.126	-.308	.038
	INNOV_NEWPROD	-.212	.094	5.033	1	.025	-.396	-.027
	INFOFUT	.257	.048	28.915	1	.000	.163	.351
	COMP_LEVEL_LOC	.390	.095	16.696	1	.000	.203	.577
	COMP_EU	.236	.093	6.421	1	.011	.054	.419
	COMP_CONDITIONS	.102	.101	1.019	1	.313	-.096	.300
	COMP_ICTUSES	-.139	.092	2.264	1	.132	-.320	.042

A.7.e Variable: ICTUSE – case 5: all variables selected with no dummies for industry or size + ICTINTENSE

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTUSES = .00]	-3.663	.497	54.236	1	.000	-4.637	-2.688
	[ICTUSES = 1.00]	-.768	.462	2.755	1	.097	-1.674	.139
	[ICTUSES = 2.00]	.668	.462	2.091	1	.148	-.237	1.572
Location	COST_RED	.266	.100	7.063	1	.008	.070	.461
	INPUT_SUPP_CLI_COMMS	.299	.127	5.505	1	.019	.049	.548
	INPUT_VALUEADDED	-.160	.116	1.906	1	.167	-.387	.067
	ENVIR_FACE2FACE	-.363	.134	7.394	1	.007	-.625	-.101
	ENVIR_FEW_ONLINE_CLI	-.048	.143	.112	1	.738	-.327	.232
	ENVIR_FEW_ONLINE_SUPP	.386	.118	10.803	1	.001	.156	.617
	MKT_EFFICIENT	.138	.163	.715	1	.398	-.181	.456
	MKT_COMPETE	-.238	.111	4.647	1	.031	-.455	-.022
	MKT_BIZVALUE	.139	.103	1.813	1	.178	-.063	.341
	IMP_OBST_COST	-.094	.098	.930	1	.335	-.286	.097
	IMP_OBST_RELIAB	-.022	.094	.055	1	.815	-.207	.163
	IMP_OBST_SYSTINTG	-.255	.121	4.427	1	.035	-.493	-.017
	IMP_OBST_ABSORB	-.275	.112	6.067	1	.014	-.494	-.056
	ABSORB_ATT	.091	.127	.512	1	.474	-.158	.339
	ABSORB_CAP	-.324	.119	7.393	1	.007	-.558	-.091
	ABSORB_FIRM_ATTITUDE	-.018	.114	.025	1	.875	-.242	.206
	INNOV_COLLAB	-.070	.096	.539	1	.463	-.258	.117
	INNOV_NEWPROD	-.187	.108	3.003	1	.083	-.398	.025
	INFOFUT	.164	.050	10.896	1	.001	.066	.261
	COMP_LEVEL_LOC	.202	.105	3.709	1	.054	-.004	.407
	COMP_EU	.084	.097	.751	1	.386	-.106	.273
	COMP_CONDITIONS	-.090	.112	.644	1	.422	-.310	.130
	COMP_ICTUSES	-.030	.101	.089	1	.765	-.228	.168
	[ICTINTENSE=0]	-5.717	.641	79.498	1	.000	-6.974	-4.460
	[ICTINTENSE=1]	-1.103	.479	5.295	1	.021	-2.043	-.164
	[ICTINTENSE=2]	-.606	.488	1.543	1	.214	-1.562	.350
	[ICTINTENSE=3]	0(a)	.	.	0	.	.	.

Link function: Logit.

a This parameter is set to zero because it is redundant.

Table A.8: Model detailed results, Case summaries by firm size

A.8.a Variable: ICTINTENSE – case 1: Large firms (>50 employees)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTINTENSE = 0]	-5.225	.695	56.588	1	.000	-6.586	-3.864
	[ICTINTENSE = 1]	-.875	.581	2.264	1	.132	-2.014	.265
	[ICTINTENSE = 2]	1.566	.590	7.043	1	.008	.409	2.722
Location	MKT_EFFICIENT	.879	.243	13.058	1	.000	.402	1.355
	COST_RED	.187	.158	1.400	1	.237	-.123	.497
	INPUT_SUPP_CLI_COMMS	-.211	.159	1.748	1	.186	-.523	.102
	INPUT_VALUEADDED	-.321	.190	2.865	1	.091	-.693	.051
	IMP_OBST_COST	-.178	.147	1.453	1	.228	-.467	.111
	IMP_OBST_RELIAB	-.164	.224	.537	1	.464	-.604	.275
	IMP_OBST_SYSTINTG	.170	.150	1.287	1	.257	-.124	.464
	IMP_OBST_ABSORB	.397	.151	6.898	1	.009	.101	.693
	ABSORB_ATT	-.154	.199	.604	1	.437	-.544	.235
	ABSORB_CAP	-.306	.208	2.175	1	.140	-.713	.101
	ABSORB_FIRM_ATTITUDE	.101	.188	.287	1	.592	-.268	.469
	ENVIR_FACE2FACE	-.164	.168	.958	1	.328	-.494	.165
	ENVIR_FEW_ONLINE_CLI	-.389	.182	4.574	1	.032	-.746	-.033
	ENVIR_FEW_ONLINE_SUPP	-.106	.170	.388	1	.533	-.440	.228
	INNOV_COLLAB	-.038	.153	.061	1	.806	-.339	.263
	INNOV_NEWPROD	.161	.157	1.062	1	.303	-.146	.468
	INFOFUT	.115	.070	2.672	1	.102	-.023	.253
	COMP_LEVEL_LOC	.266	.167	2.536	1	.111	-.061	.593
	COMP_EU	.278	.137	4.120	1	.042	.010	.546
	COMP_CONDITIONS	-.064	.177	.131	1	.718	-.412	.284
	COMP_ICTUSES	-.420	.151	7.776	1	.005	-.716	-.125
	[INDUSTRY=1]	-3.374	1.164	8.401	1	.004	-5.655	-1.092
	[INDUSTRY=2]	-2.251	.707	10.150	1	.001	-3.637	-.866
	[INDUSTRY=3]	-.346	.797	.188	1	.665	-1.909	1.217
	[INDUSTRY=4]	-1.712	.665	6.628	1	.010	-3.015	-.409
	[INDUSTRY=5]	-1.907	.698	7.468	1	.006	-3.274	-.539
	[INDUSTRY=6]	-1.741	.618	7.935	1	.005	-2.953	-.530
	[INDUSTRY=7]	-1.625	.960	2.867	1	.090	-3.507	.256
	[INDUSTRY=8]	0(a)	.	.	0	.	.	.

Link function: Logit., a This parameter is set to zero because it is redundant.

A.8.b Variable: ICTINTENSE – case 2: Large firms (<=50 employees)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Upper Bound	Lower Bound
Threshold	[ICTINTENSE = 0]	-.961	.942	1.041	1	.308	-2.808	.885
	[ICTINTENSE = 1]	2.863	.960	8.890	1	.003	.981	4.745
	[ICTINTENSE = 2]	6.301	1.208	27.204	1	.000	3.933	8.668
Location	MKT_EFFICIENT	.659	.237	7.717	1	.005	.194	1.124
	COST_RED	.331	.153	4.654	1	.031	.030	.632
	INPUT_SUPP_CLI_COMMS	.099	.210	.221	1	.638	-.313	.511
	INPUT_VALUEADDED	-.124	.189	.432	1	.511	-.495	.246
	IMP_OBST_RELIAB	.154	.122	1.605	1	.205	-.084	.393
	ABSORB_ATT	-1.072	.222	23.261	1	.000	-1.507	-.636
	ABSORB_CAP	-.575	.219	6.875	1	.009	-1.005	-.145
	ABSORB_FIRM_ATTITUDE	-.325	.195	2.788	1	.095	-.706	.056
	ENVIR_FACE2FACE	-.942	.239	15.591	1	.000	-1.410	-.474
	ENVIR_FEW_ONLINE_CLI	-.054	.226	.058	1	.810	-.496	.388
	ENVIR_FEW_ONLINE_SUPP	.161	.138	1.366	1	.242	-.109	.431
	INFOFUT	.313	.072	18.781	1	.000	.172	.455
	COMP_LEVEL_LOC	.292	.151	3.765	1	.052	-.003	.588
	COMP_EU	.262	.167	2.484	1	.115	-.064	.589
	COMP_CONDITIONS	.628	.173	13.153	1	.000	.288	.967
	COMP_ICTUSES	.026	.153	.028	1	.867	-.274	.325
	[INDUSTRY=1]	-.824	1.180	.488	1	.485	-3.137	1.488
	[INDUSTRY=2]	2.212	1.081	4.188	1	.041	.094	4.331
	[INDUSTRY=3]	1.514	1.095	1.910	1	.167	-.633	3.661
	[INDUSTRY=4]	.792	1.032	.589	1	.443	-1.231	2.816
	[INDUSTRY=5]	.575	.979	.345	1	.557	-1.343	2.493
	[INDUSTRY=6]	.525	.954	.303	1	.582	-1.345	2.396
	[INDUSTRY=7]	2.496	1.550	2.593	1	.107	-.542	5.533
	[INDUSTRY=8]	0(a)	.	.	0	.	.	.

Link function: Logit.

a This parameter is set to zero because it is redundant.

A.8.c Variable: ICTUSE – case 3: Small firms (<=50 employees)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Threshold	[ICTUSES = .00]	-1.562	.977	2.555	1	.110	-3.477	.353
	[ICTUSES = 1.00]	.197	.972	.041	1	.840	-1.708	2.101
	[ICTUSES = 2.00]	2.021	.980	4.256	1	.039	.101	3.941
Location	MKT_EFFICIENT	.680	.269	6.383	1	.012	.152	1.208
	COST_RED	.607	.145	17.408	1	.000	.322	.892
	INPUT_SUPP_CLI_COMMS	.626	.231	7.310	1	.007	.172	1.079
	INPUT_VALUEADDED	-.398	.224	3.162	1	.075	-.836	.041
	ABSORB_ATT	-.715	.193	13.711	1	.000	-1.093	-.336
	ABSORB_CAP	-1.426	.282	25.590	1	.000	-1.978	-.873
	ABSORB_FIRM_ATTITUDE	-.088	.184	.229	1	.632	-.449	.273
	ENVIR_FACE2FACE	-1.035	.255	16.482	1	.000	-1.534	-.535
	ENVIR_FEW_ONLINE_CLI	-.049	.242	.041	1	.840	-.523	.425
	ENVIR_FEW_ONLINE_SUPP	.458	.181	6.384	1	.012	.103	.813
	COMP_LEVEL_LOC	.338	.143	5.572	1	.018	.057	.618
	COMP_EU	.245	.166	2.159	1	.142	-.082	.571
	COMP_CONDITIONS	.205	.162	1.597	1	.206	-.113	.524
	COMP_ICTUSES	.049	.145	.115	1	.735	-.236	.334
	IMP_OBST_COST	-.197	.145	1.836	1	.175	-.481	.088
	IMP_OBST_RELIAB	.105	.104	1.033	1	.310	-.098	.309
	IMP_OBST_SYSTINTG	-.332	.282	1.393	1	.238	-.884	.219
	IMP_OBST_ABSORB	-.218	.174	1.580	1	.209	-.559	.122
	INNOV_COLLAB	-.167	.132	1.596	1	.207	-.427	.092
	INNOV_NEWPROD	-.129	.148	.759	1	.384	-.419	.161
	INFOFUT	.235	.071	10.886	1	.001	.096	.375
	[INDUSTRY=1]	-1.104	1.197	.851	1	.356	-3.449	1.242
	[INDUSTRY=2]	-.101	1.075	.009	1	.925	-2.208	2.006
	[INDUSTRY=3]	.088	1.098	.006	1	.936	-2.064	2.239
	[INDUSTRY=4]	-.102	1.045	.010	1	.922	-2.150	1.946
	[INDUSTRY=5]	-.213	.999	.045	1	.831	-2.172	1.745
	[INDUSTRY=6]	-.280	.981	.081	1	.776	-2.203	1.644
	[INDUSTRY=7]	1.036	1.577	.431	1	.511	-2.055	4.126
	[INDUSTRY=8]	0(a)	.	.	0	.	.	.