Kari Liukkunen

CHANGE PROCESS TOWARDS ICT SUPPORTED TEACHING AND LEARNING
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LEARNING

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Abstract

Technological advancement in the field of information-and-communication technologies (ICT) was rapid during the first decade of the new millennium. Universities started to use the new information-and-communication technologies more in their core processes, which speeded up their transformation from the traditional campus mode toward virtual universities. Research done in this thesis first investigates the traditional campus university’s change process toward the virtual university model. During the implementation process a geographically distributed e-learning concept was also developed for university use. This concept was transferred and researched in the small and medium enterprise (SME) context in the last part of this research.

In large and complex organizations such as universities, it is difficult to find out how the change really was implemented. The literature on change management is voluminous but is dominated by descriptions of single projects. To overcome the limitations of such case studies, this research applies a longer and wider perspective to the change process and, by the introduction of an overarching method that categorizes the investments, shows more clearly the trends, stages of, and the barriers to the development. This long-term study is based on 116 development projects during a ten-year period in a decentralized and networked development environment.

In the company setting, conventional training is being replaced more and more by e-learning. To scaffold SMEs in their e-learning adaptation, the concept of e-learning was transferred to the SME environment. The company cases’ part of the thesis presents how the transferability of geographically distributed e-learning concept was developed and tested in the SME environment.

As a result, the principles that guided ICT strategy implementation and how the strategies were implemented during a ten-year period are presented. The concept for geographically distributed e-learning environments and its development are also introduced. Finally, the process and results from the concept implementation to the SME environment are presented.

This thesis presents university management with an understanding of how larger long-term trends give us the possibility to better understand today’s fast-paced changes. It also gives company managers an example of how models developed in the university environment can be transferred to the company environment.

Keywords: e-learning, geographically distributed environment, ICT strategy, SME, strategy implementation
Liukkunen, Kari, Muutosprosessi kohti ICT tuettua opetusta ja oppimista
Oulun yliopisto, Luonnontieteellinen tiedekunta, Tietojenkäsittelytieteiden laitos, PL 3000, 90014 Oulun yliopisto
Oulu

Tiivistelmä
Tietotekniikan kehitys on ollut nopeaa vuosituhanne vaihteen jälkeen monilla aloilla. Yliopistoiissa sitä on alettu käyttää yhä enemmän osana perustoimintoja, mikä on edistänyt niiden kehitystä traditionaalisista kampusyliopistoista kohti virtuaaliyliopistoja. Tämän tutkimuksen ensimmäisessä osassa on tarkasteltu perinteisen kaupunkiyliopiston muutosprosessia kohti aktiivisesti uutta teknologiaa hyödyntävää yliopistoa ja toisessa osassa muutosten yhtenä tuloksena syntynyttä konsepti siirrettiin yritysympäristöön.


Yritysympäristössä perinteinen koulutus on korvattu yhä useammin teknologiaa hyödyntävillä koulutuksen muodoilla. Pienillä ja keskisuurilla yrityksillä on kuitenkin varsin rajoitetut resurssit koulutuksesta käytettävien teknologioiden käyttöön. Tämän tutkimuksen toisessa osassa yrityksen maantieteellisesti hajautetun oppimisympäristön käyttöönottoa pyrittiin tukemaan tarjoamalla sen käyttöön valmis yliopistoympäristössä kehitetty konsepti. Tämän konseptin siirrettävyyttä ja käyttöönottoa tutkittiin tutkimuksen toisessa osassa.


Tämä väitöskirja esittelee yliopiston johdolle ja toimijoille, kuinka pitkäkestoisten trendien tunteminen auttaa ymmärtämään nykyhetkeä ja sen nopeita muutoksia. Yritysjohdolle väitöskirja tarjoaa esimerkin, kuinka yliopistoympäristön kehitettä voidaan siirtää yritysympäristöön.

Asiasant: e-oppiminen, ICT strategia, maantieteellisesti hajautettu ympäristö, SME, strategian toimeenpano
Preface

Writing this thesis brought me back to good memories of my working career at the University of Oulu. The real starting point for me was early in 2001, when the Department of Information Processing Science received funding for the first regional master program in digital media. This was followed by three other new regional master programs. I published several conference articles about these master programs, and during one of the conference trips, the decision to write this thesis took root. I thank Development Manager Kari Pankkonen for the role he played in this decision.

These regional programs demanded large-scale digital material production and educational technology support activities. For this reason, DiVision, the production unit for digital materials in the Department of Information Processing Science at the University of Oulu, was initiated in May 2001. I was privileged to work in this production unit as a team leader for a group of very talented young professionals. The practices and production models we created have played a very important role in this thesis. I am grateful for this experience and for the six great years we worked together.

I was lucky to meet four great, enthusiastic individuals who shared my vision of the virtual campus: Professor Sanna Järvelä, Director of University Libraries Päivi Kytömäki, and Project Managers Heikki Riikonen and Mika Paakkanen. Together, we founded the VirtuaaliKampus project. I firmly believe that this project changed the University of Oulu more than is commonly understood. Many of the project’s ideas are discussed in this thesis. I am grateful for the great times and friendships I developed working on the project.

Another important event leading to this thesis was the invitation I received from Campus Futurus to work as a Development Manager and after that to be a part of Campus Futurus Management Group. From these experts from all parts of the university, I learned how this special university environment works. I wish to specifically thank Development Manager Juha Pohjonen, who introduced me to the virtual university phenomenon and strategies. As a friend, he has always made time to comment on and support my thesis writing process.

Recent work at the CreaLearn project has given me the opportunity to research the needs and difficulties of firms when they use ICT in distributed working and learning environments. It has been rewarding to observe how experiences from the university environment have been utilized in corporate environments. From the CreaLearn project, I wish to thank Professor Ari
Heiskanen and Project Managers Anna-Mari Kynsijärvi and Kai Lindberg for their great cooperation.

I have enjoyed my work in the Department of Information Science. The most important reason for this is the people that make up the department. I am grateful to them all. Today, I am honored to be a part of MGroup research group. MGroup offers an inspiring working environment and I thank all MGroup members for their support and inspiring discussions. I also thank all the co-authors of the original articles in this thesis who are not otherwise mentioned: Janne Sariola, Terence Karran, Jarkko Aro, Pasi Karppinen, Eva-Maria Hakola, Piia Tolonen, Jari Laru, and Jarkko Hyysalo.

I reserve special thanks for my great supervisors, Professor Markku Oivo, for asking the difficult questions that honed and refined this thesis, and Dr. Jouni Markkula, for good advice and especially for the great conversations that helped me to better understand the research and thesis writing process.

I respectfully thank the pre-examiners of this thesis, Professor Günther Ruhe and Professor Filippo Lanubile, for their thorough and encouraging reviews of this work.

Finally, I thank my parents, Unto and Martta Liukkunan, who have supported me throughout this period. Finally, I thank my dear wife Pia; this thesis would not have been possible without her love, support, and encouragement.
### Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>GSD</td>
<td>Global Software Development</td>
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<tr>
<td>CSCL</td>
<td>Computer Supported Collaborative Learning</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<td>GQM</td>
<td>Goal/Question/Metric method</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<td>GDSP</td>
<td>Geographically Distributed Software Project</td>
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<td>GSDP</td>
<td>Global Software Development Project</td>
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<td>FVY</td>
<td>Finnish Virtual University</td>
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<tr>
<td>MRT</td>
<td>Media Richness Theory</td>
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<td>IRT</td>
<td>Information Richness Theory</td>
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<td>MST</td>
<td>Media Synchronicity theory</td>
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<td>FVY</td>
<td>Finnish Virtual University</td>
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<tr>
<td>BSC</td>
<td>Balanced Scorecard</td>
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<td>TTF</td>
<td>Task Technology Fit Framework</td>
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<td>BOL</td>
<td>Blended Online Learning</td>
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<td>SME</td>
<td>Small and Medium Enterprises</td>
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1 Introduction

Technological advancement in the field of information and communication technologies (ICT) was rapid during the first decade of the new millennium. Universities started to use the new ICT more in their core processes, which speeded up their transformation from the traditional campus mode to the networked mode and toward virtual universities. New technologies changed the operational methods, working models, and structures of universities. However, cultural change within the teaching staff was often at a slower pace than technological development and its adaptation. The challenge with the use of new technologies is to move beyond their early adoption by technology enthusiasts and scale up to widespread use (Nurmela 2006, Schreurs 2009, Hall 2010).

Strategic thinking, planning, and management are crucial elements in the successful adoption of new technologies by all organizations, including universities. In Finnish universities, strategic planning and management have played an increasingly important role in management systems. So, one important action needed to implement the change toward virtual universities was for universities to prepare ICT strategies (Aarrevaara et al. 2007).

Too often, the process of preparing a strategy is not followed by systematic implementation. Instead, there remains a gap between planning and realization (Sariola & Söderlund 2004). To avoid this gap, the guiding principles for the strategy implementation have to be planned in the strategy process (Aaltonen et al. 2001). Barriers identified in the strategic process need to be well connected to the implementation actions (Bryson 1988). Such connections enable the implementation process to remove the main barriers to the integration of new technology. The best crafted strategy is of negligible value if it does not become a reality and form a part of the way in which the members of organizations think and carry out their daily tasks. “Implementation at the level of talk is not only a way of legitimatizing operations without needing to change them, but also a way of strengthening the rational model per se” (Brunsson & Olsen 1993).

The strategy implementation process is difficult to understand or evaluate if the guiding principles behind that process are not understood. Strategy work results take a long time, and it is not possible to clearly meter them, or possible to compare directly to operative results (Malkki 1999). Though, it is important to understand what has happened during the long-term strategy implementation process. By understanding long-term trends and phenomena, it is possible to better understand today’s development trends and those of the future. To reveal
long-term trends and phenomena, this research follows a ten-year period of strategy implementation process in the university context.

While much research has been undertaken on e-learning implementation issues (Xu & Wang 2006, Newton & Ellis 2005), there has been less research undertaken on e-learning combining both the workplace and higher-education environments in the same research (Daneshgar et al. 2008). Although, the learning processes are very much alike in knowledge-intensive work and in formal education situations. In both of these settings, collaborative learning demands that individuals engage in various structured and intentional activities to produce an outcome considering their work (Kleismann & Valkenburg 2005). When individuals engage in workplace activities, their knowledge is changed in some way by their work practices, or, in other words, they learn (Billet 2004). Because of the similarities in learning processes between workplaces and formal learning situations, studies conducted from the perspective of the learning sciences can enrich our understanding of how new knowledge is constructed in company settings (Sawyer 2006). Technical development, pedagogical change, curriculum change, and close cooperation with companies have led the environments at universities and are very close to environments of working methods used in companies.

In company settings, conventional training is being replaced more and more by e-learning, especially in large companies. In knowledge-based economies, investments in training and the update of skills are key elements of growth. Small and medium-sized companies (SMEs) should exploit e-learning in order to ensure their growth and survival. Many SMEs remain reluctant to use e-learning because of the barriers to adaptation or because they do not know where to begin. (Roy 2010). One of the main ideas behind this research is that organizations that are just starting to use e-learning benefit from ready concepts or models. Ready concepts can act as roadmaps for new users and help them avoid making unnecessary investments or doing unnecessary work. This is especially important for organizations where resources are limited.

1.1 Background and Research Context

New technologies have changed the operational methods, working models, and structures of universities (Garrison & Anderson 2003, Pohjonen 2004). In Finnish universities, this change process was started and funded by the Ministry of Education during the years from 2000–2009. Also, Finnish Virtual University
(FVU) was founded to support universities’ cooperation. The main goal of this change process was to implement e-learning in Finnish universities. E-learning term is a difficult term to define, as it is used in many contexts. In this thesis, all learning that takes place with computer-mediated communication (CMC) is called e-learning. CMC can be defined as a system for information flow that enables learning participants to communicate and interact with one another over time (Leinonen 2007).

According to Pohjonen (Pohjonen 2004), work done to adapt to new technology in the University of Oulu and other Finnish universities can be divided into following developmental stages:

- The “Iron Age,” which lasted from 1995–1999. The focus was on developing the infrastructure for the use of information technology. During this period universities invested in new equipment and software.
- The “Age of Know-how,” which lasted from 2000–2001. During this time university staff, especially teachers, was trained in the use of ICT for teaching and learning.
- The “Strategic Age,” lasting from 2002–2003. During this stage, the Ministry of Education’s information strategy for education and research for 2000–2004 proposed that every educational institution should prepare a strategy on how to promote the use of ICT in the organization. The aim was that these strategies should be prepared by the year 2002.
- The next five-year period from 2005–2009, which Pohjonen predicted as the “Age of Networks.”

Research work done in this thesis has been divided in three phases: the strategic steering principles in the University of Oulu, the implementation of the ICT strategies in teaching and learning, and small and medium enterprise (SME) company’s e-learning implementation.

The first research phase of this thesis concentrates on the strategic steering principles in the University of Oulu. These strategies were the results of the Ministry of Education’s demand that every educational institution should prepare a strategy on how to promote the use of ICT in the organization (Ristimäki et al. 2006). In 2004 the Finnish Virtual University (FVU) and some of the universities themselves began to update their ICT strategies. The universities’ joint ICT Strategy Service also prepared a survey of university ICT strategies and developed the ProAktori model and web tool for supporting the management of
strategy processes in universities. The author was member of the FVU’s ICT Strategy Service team, which developed and piloted ProAktori model.

At the University of Oulu, the strategy implementation process differed from that found in most Finnish universities. Most Finnish universities have chosen a centralized working model for their virtual university work (Aarrevaara et al. 2007). At the University of Oulu, work based on the networking model and the Campus Futurus organization coordinated the network’s work. This was why the University of Oulu had some special guiding principles for the strategy implementation.

The second research phase of this thesis examines the implementation of the ICT strategies in teaching and learning. Successful implementation of ICT in teaching and learning prefers support and commitment of the university management (Bates 2001). This was done in the University of Oulu through the Campus Futurus organization, which was founded in the year 2000. The management delegated the coordination and support responsibilities to the Campus Futurus organization, to prepare and implement the university’s ICT strategy for teaching and learning. Campus Futurus was the university’s internal network organization, whose task was to support and promote the using of ICT in teaching, research, development, training, and all the services associated with these functions. It also coordinated Finnish Virtual University activities at the University of Oulu.

The university chose to organize its implementation of the strategy by means of a network model. The center of this network was Campus Futurus. During the time period this research covers, there were three discrete strategic periods: the first between 2002 and 2005, the second between 2005 and 2007, and the third between 2008 and 2009. To implement these strategies, Campus Futurus used the Ministry of Education’s national virtual university funding. By contrast, in many Finnish universities, the majority of these funds were to run educational technology support centers (Kylämä 2005). In the University of Oulu, however, funding was channeled through the Campus Futurus organization to support faculty and departmental development projects. Funding decisions were made by the Campus Futurus Management Group, which drew its membership from staff chosen from every faculty and supporting unit (e.g., the University Library and IT Center) on the basis of their professional seniority. The author was manager of Campus Futurus for a three-year period. After that, the author continued in the Campus Futurus Management Group. This gave the author exceptional possibility to research the changing process in the University of Oulu.
In time, many of the outcomes of the funded projects became mainstream elements of the university’s basic services. In January 2010, the University Board decided that virtual university activities had been integrated within the university’s day-to-day operations and hence that Campus Futurus had fulfilled its mission.

The third research phase of this dissertation considers small and medium enterprise (SME) company’s e-learning implementation. According to Daneshgar et al. (Daneshgar et al. 2008), the differences in the individual level between workplace and higher education are in their learning approaches. In general, students at higher education rely on superficial learning, while employees in a workplace favor action learning or reflective learning. However, it is observed that postgraduate students exhibit similar characteristics to employees in that they adopt similar learning approaches. At the organization level, it appears that both the workplace and higher education are in need of appropriate top-level management to develop e-learning strategies (Bates 2001). It also appears that corporations are more interested in measuring e-learning success in terms of return on investment (ROI) (Ley et al. 2005), whereas higher education often looks at ways to improve students’ learning experience through e-learning. This notable difference is the largely ignored financial impact of e-learning in the models relating to e-learning in higher education.

In the company setting, conventional training is being replaced more and more by e-learning, especially in large companies. In knowledge-based economies, investment in training and the update of skills are key elements of growth. Small- and medium-sized companies (SMEs) should exploit e-learning in order to ensure their growth and survival. Many SMEs still remain reluctant about the use of e-learning because of the barriers to adoption, or because they do not know where to begin. (Roy 2010)

In the third research phase the e-learning concept developed in the university environment was transferred to the SME context. The introduced concept was based on the development done in the university context. Both concepts are results of the authors research and development work.

1.2 Research Goals and Questions

The research goals and research questions of this thesis are divided into three parts, divided in the same way as the research process. The ICT strategy process is first addressed, and after that, the implementation process in the university
context and its results are presented. In the third part, the transferability of the experiences and the e-learning concept are tested in the company environment.

With ICT becoming an ever more important factor in university activities, universities have prepared strategies on ICT. The main stages of the strategy process are the preparation and implementation of the strategy. Too often, the process of preparing a strategy is not followed by systematic implementation (Sariola & Söderlund 2004). Instead, there remains a gap between planning and realization. To avoid this gap, the guiding principles for the strategy implementation should be planned in the strategy process. For that reason the Proaktori model was created and piloted during the research process. During the research process the implementation principles in the University of Oulu were also developed. The strategy implementation process is difficult to understand or evaluate if the guiding principles behind the implementation process are not understood. This is why the first objects of research in this thesis are the principles that guided the ICT strategy process in teaching and learning and its implementation at the University of Oulu during the years 2000–2009. This research does not examine how or why these principles were generated.

During the company cases, the Goal/Question/Metric method (GQM) (van Solingen & Berghout 1999, Basili et al. 1994) was applied as a framework for the company interviews. It was also applied to formally specify the research goals. It was not applied in a traditional way as used for defining product and process metrics in industrial software development.

The first research goal was defined according to GQM syntax as: to analyze the e-learning strategy process for the purpose of understanding, with respect to the guiding principles, from the viewpoint of the university management in the context of the University of Oulu. From this goal the first research question was specified:

Research Question 1: What was the process and control mechanism behind the ICT strategies in learning and teaching in the University of Oulu during the first decade of this century?

The best crafted strategy is of negligible value, if it does not become a reality and form a part of the way in which the members of organizations think and carry out their daily tasks. Barriers identified in the strategic process need to be well connected to the implementation actions. Such connections enable the implementation process to remove the main barriers to the integration of new technology so that the use of these technologies increases, which leads to their
more effective use and a consequent increase in the quality of learning. During the first decade of this century this was done in the University of Oulu through the Campus Futurus organization. This research actively followed and analyzed Campus Futurus organization’s ICT strategy implementation process through a ten-year period. During the research process the implementation practices were also developed. This implementation process and its results are the second object of study in this thesis. Also, the strengths and weaknesses of the process are discussed.

To understand the strategy implementation process at the University of Oulu, the second research goal is to analyze the e-learning strategy implementation for the purpose of understanding with the respect to recourse allocation and results from the viewpoint of the university management in the context of the University of Oulu. From this goal, the second research question was specified:

**Research Question 2: How were the ICT strategies in learning and teaching implemented at the University of Oulu during the first decade of this century?**

In the research question’s area, there is one special interest area. During the research process, a model for geographically distributed e-learning course production was developed as a part of the strategy implementation process in the University of Oulu. This model was used to develop the geographically distributed e-learning concept for the company cases. This special interest area’s research goal is to analyze the geographically distributed e-learning concept’s development process for the purpose of understanding with the respect to the developed concept from the viewpoint of university management in the University of Oulu. From this goal, the following sub question was identified:

**Research Question 2.1: How the geographically distributed e-learning concept was developed in the development projects during the implementation period?**

The third research phase goal aims to find out whether the experiences and models from the university environment can be transferred and used in the company environment. During the implementation process, an e-learning concept for the university was developed. Part of the developed university’s e-learning concept was a concept for geographically distributed e-learning developed in this research process.

The third object of the study is the transferability of the geographically distributed e-learning concepts developed for the university environments. For
that purpose, the third research goal was formulated: To analyze the e-learning concept implementation for the purpose of evaluation with the respect to transferability from the viewpoint of SMEs in the context of a case company and its customers. From this goal, the third research question was identified:

Research Question 3: How could the geographically distributed e-learning concept developed in the university environment be transferred and used in the company environment?

To scaffold SMEs in their e-learning adaptation, the CreaLearn project was launched in 2008. In this project, the research and development work continued in the company environment. The concept of geographically distributed e-learning was transferred to the SME environment.

1.3 Structure of the Thesis

This thesis is based on eight published research articles. Relationship between the articles and research process is presented in Fig.3. The summary part of the thesis is structured as following: Chapter 1 introduces the background and research environment of the study, scope, research process, and questions. Chapter 2 presents the context and theories used. Chapter 3 describes the research methods and empirical work done during the research process. Chapter 4 lists the main research results categorized by the research questions. Chapter 5 presents summary of the original articles. Chapter 6 concludes with a summary of the results and describes the limitations and possibilities for future research.
2 Background of the Study

This chapter gives readers information about the context and theories used in this study to provide a background for the settings and research done in this thesis. The first and second parts of this study are closely bound to both the phenomenon of the virtual university and the university as an organizational issue. These issues are introduced, and the ideology underpinning the work is presented.

Blended Online Learning (BOL), Computer Supported Collaborative Learning (CSCL), online learning environments, and media choice theories offer backgrounds for the choices and uses of communication technologies. Collaborative learning and distributed teamwork issues are more closely connected to company environments and the company cases researched in this study. Lastly, some issues of e-learning implementation barriers are presented.

2.1 The Virtual University Phenomenon

The changes in universities have been described as a “paradigm shift”, as new information and communication technologies questions the basic functions of the university (Edwards & O'Mahony 1997, Pulkkinen 2007). A common response to the demands of these pressures at both institutional and national levels has been the development of “virtual universities”. According to Van Dusen (Van Dusen 1997), the virtual university is a metaphor for the electronic, teaching, learning, and research environments created by the convergence of several relatively new technologies including, but not restricted to, the Internet, the World Wide Web, and computer mediated communication. The term “virtual campus” is used often as a synonym for virtual university. In this dissertation, the term virtual campus is used to describe activities within a university or faculty, and the term virtual university is used to describe the phenomenon in a larger context.

Harry and Perraton (Harry & Perraton 1999) identified three factors that have encouraged the shift away from the singlet mode of universities to the virtual campus via dual mode provision. First, teaching both on and off campus offers educational and economic benefits from the inter-play between the two modes. The second factor concerns the need to maximize the returns on new technology—clearly, if an institution invests heavily in computer-based teaching material, it is likely to look for potential users both on and off campus. The final factor is the pressure to meet the demands of new client groups—part-time
students, up-dating professionals and in-house company trainees. These virtual university developments have varied considerably in size and scope.

In some countries (such as Spain and Germany), the lead was taken by the national open universities, which already had considerable experience in distance education through the use of video and audio technologies. In other nations, individual prestigious wealthy universities (such as Cambridge and MIT), although using face-to-face tuition on campus, made cross-national alliances to build on existing research links and teaching expertise to try and create synergistic virtual universities. Perhaps the most common form of virtual university structure is that of the consortia, organized either cross-nationally or within different nation states, such as in the UK and Finland (Schreurs 2009).

The Finnish Virtual University (FVU) was established in 2001. The timing and initial goals of the university were not uncommon in Europe. The Finnish initiative is, however, unique in some ways. The FVU is not a new distance education university but a collaboration network established by all 21 Finnish universities. The initiative supports and develops collaboration among the universities in the use of information and communication technologies in teaching and studying. As a consortium, it has developed an information network-based training and educational service for the shared use of its member universities. The FVU was designed to operate as an enabling network, rather than as an online or distance education provider and hence did not provide university courses or award degrees. (Ristimäki et al. 2006, Kylämä 2005, Kess 2004)

In Finland, virtual university activities were fast tracked. At the turn of the century, this was governed by a strong belief in technology’s possibilities to radically and quickly reshape teaching, education, and support activities. In the background was a view of the capabilities of universities to change their operational structure. The execution of virtual university activity was based on the ideology of university autonomy. Universities themselves could specify content and its application. The Ministry of Education funded these activities with approximately 4,5 million euro p.a. The total funding for universities from the Ministry of Education was, at the time, approximately 1,2 billion euro p.a. (Aarrevaara et al. 2007, Neittaanmäki et al. 2010).

The successful implementation of ICT in teaching and learning needs the support and commitment of the university management (Bates 2001). In the University of Oulu, the management delegated the coordination and support responsibilities to the Campus Futurus organization, which was founded in 2000 to prepare and implement the university’s ICT strategy for teaching and learning.
The University of Oulu chose to organize implementation of the strategy by means of a network model. The center of this network was Campus Futurus, and its main goal was to coordinate and promote the development of educational technology and virtual university work. Preparations for the first ICT strategy for teaching and learning began in 2001. This research covers three discrete strategic periods: The first is between 2002 and 2005, the second between 2005 and 2007, and the third between 2008 and 2009. To implement these strategies, Campus Futurus used the Ministry of Education’s national virtual university funding. In contrast, in many Finnish universities, the majority of these funds were granted to run educational technology support centers (Kyläma, 2007). In the University of Oulu, however, funding was channeled through the Campus Futurus organization to support faculty and departmental development projects. Funding decisions were made by the Campus Futurus Management Group, which drew its membership from staff chosen from every faculty and supporting unit (e.g., the University Library and IT Center) based on their professional seniority. In time, many of the outcomes of the funded projects became mainstream elements of the university’s basic services. In January 2010, the University Board decided that virtual university activities had been integrated within the university’s day-to-day operations and hence that Campus Futurus had fulfilled its mission.

Beginning in 2010 after this paper’s research period, Finnish universities and their legal situations changed radically. These changes are not presented here because the objective of this chapter is to give readers a picture of the university environment during the research period.

2.2 Background of the Strategy Work

Balanced Scorecard and its Finnish application, Balanced Success Strategy, were used by the universities’ joint ICT Strategy Service as a basis for the materials, tools and consulting work that guided many of the Finnish universities’ strategy work (Sariola & Söderlund 2004, Liukkunen et al. 2005). The University of Oulu ICT strategies in teaching and learning during the years 2001–2009 were also based on this theoretical framework.

The Balanced Scorecard (BSC) was developed as a strategic control tool by David Norton and Robert Kaplan in the early 1990s. Further development of the BSC has shifted its focus towards a strategic management tool. It has been used to improve organizational performance and to ensure that a strategy functions well, is objective-oriented, and that progress with it is measurable. In the basic model, a
strategy is examined from a number of perspectives: financial, customer, internal process, innovation and learning. These perspectives, for which a set of success factors and metrics important to the vision and strategy are chosen, can vary from one organization to the next according to the strategic emphases and operating policies. The perspectives reflect those areas of the activities to which special attention is given. Later, Norton and Kaplan presented the concept of strategic mapping, whereby the relationships between strategic and operational factors are described with the aid of a strategy map. This provides a brief description of how a strategy is implemented. Strategy maps and the BSC together constitute a measurement technique and a strategic management tool (Kaplan & Norton 1996, Kaplan et al. 2002).

A public-sector application of the BSC has been developed in Finland and is known as the Balanced Success Strategy (Määttä & Ojala 1999). The development of this application was considered necessary because it was felt that there is a clear difference between the private and public sectors. In state non-profit organizations, such as universities, the main metric is not financial but the efficiency with which the organization discharges its functions. The criteria for success in a company are profitability and return on capital. In the public sector, however, success can be evaluated according to performance, impact, financial efficiency and productivity. A non-profit operating environment brings a number of value-based viewpoints to the strategy process and the related decision-making. As with the BSC, the Balanced Success Strategy has four strategic perspectives: political decision-makers and citizens, resource management, organizational performance capability and functioning, and work community and employees. The framework for the Balanced Success Strategy is constructed on the basis of an organization’s mission and vision. The critical success factors determine what is required for achievement of the mission and vision from the different perspectives. The critical success factors should be both strategically important and the kind of factors that the organization can influence through its actions. Evaluation criteria describing the extent to which the critical success factors are realized are, in turn, defined for each of these factors. Short-term objectives are set for the criteria, and these can be either quantitative or qualitative (Määttä & Ojala 1999, Määttä 2000).

One way of describing these organizational changes, in terms of internal institutional development, is through either top-down or bottom-up development. Top-down approaches are characterized by policy and strategy development instigated by members of upper management and then propagated throughout the
organization. Alternatively, bottom-up approaches are characterized by pilot and individually funded projects often instigated by innovative practitioners in a rather more uncoordinated way. Both approaches can be criticized. The top-down approach is not consultative and inclusive enough, and the bottom-up approach creates pockets of excellence and areas of inactivity. These approaches also fail to describe the complexities of organizational shape and reflect a regressive hierarchical model of organizations that is increasingly challenged in practice. Instead, most organizations would benefit from a combined approach to e-learning development, mixing top-down and bottom-up policies, strategy and activities, and interacting and informing one another. (de Freitas & Oliver 2005).

2.3 University as an Organization

Universities are peculiar organizations, so it is difficult to place them into only one typical category. Mintzberg (Mintzberg 1993) classifies organizations into five basic categories:

- Simple Structure (based on direct supervision)
- Machine Bureaucracy (based on standardization of work processes)
- Professional Bureaucracy (based on standardization of skills)
- Divisionalized Form (based on standardization of outputs)
- Adhocracy (based on mutual adjustment)

According to Mintzberg (Mintzberg 1993), universities fall best into the professional bureaucracy category. The main features of a professional bureaucracy are the stability and complexity of the operational work. Professional employees work independently and the organization coordinates its activities through the standardization of skills. Often, professional work is so specialized that managers and planners cannot standardize processes or tasks. Another category that suits universities is the divisionalized form, which can be described as a group of functionally and financially half-independent units conducted through a centralized administration. Administration delegates its authority only partly to the operational units; otherwise, it loses its existence. The third category that may apply to universities is adhocracy. Features in this category exist in research and development projects. Project organization should avoid the tight distribution of work, isolation of the units, standardized behavior and control systems. Reasons for this are to avoid preventing innovation. In project
organization, managers do not lead organizations in the traditional manner, but they use their time in negotiations, coordination and expert tasks.

Universities, however, cannot be categorized clearly into any one of Mintzberg’s categories, but they have features of all the described categories. The way a university is organized and its stability, for example, makes it a professional bureaucracy. Its guidance and evaluation systems make it a divisionalized form; and when we emphasize work content and the character of a university, it is a resample adhocracy. Maybe this is why (Malkki 1999) notes that, “in the real life, managing the university at the department level, faculty level, and central administration level is a constant balance between different and partly controversy elements.”

2.4 Blended Online Learning

Learning and teaching environments are no longer divided into two polarized classes of face-to-face and online environments. Today, these two are combined in different ways, and the result of this combination is known as blended learning (Sela 2010). Terms like “hybrid learning” and “mixed mode learning” are also sometimes used. Power (2008) argues that, with the development and growth of web-based synchronous communication tools, that a campus-based definition of blended learning needs to be expanded to “blended online learning” to describe the simultaneous and complimentary integration and implementation of an asynchronous mode learning environment (e.g., a course management system) and a synchronous desktop conferencing environment (Power 2008).
Fig. 1. Relative position of blended online learning environment (Power 2008).

The roots of campus-based environments are in traditional higher education systems where classes have been delivered by faculty in synchronous lecture settings. Initially, blended learning was used to complement these synchronous lectures through the use of asynchronous discussion forums and learning management systems such as Optima, Blackboard and Web CT. With the development of synchronous tools, such as Adobe Connect, opportunities have been created to provide students at a distance with both synchronous and asynchronous communication possibilities. (Power 2008)

2.5 Computer Supported Collaborative Learning

Computer Supported Collaborative Learning (CSCL) is an approach based on the idea to integrate collaborative learning with educational technology. According to Lipponen (Lipponen 2002), CSCL is focused on how collaborative learning supported by technology can enhance peer interaction and work in groups, and how collaboration and technology can facilitate sharing and distribution of knowledge and expertise among community members.

CSCL arose in the 1990s in reaction to software that forced students to learn as isolated individuals (Stahl et al. 2006). The benefit of technology for collaboration and knowledge building comes from the advantage of effective thinking tools (Bereiter & Scardmalia 1989) and shared knowledge resources
such as computer databases. The knowledge building environment can support the building, articulating, exploring, and structuring of knowledge. The collaborating partners can use the environment for writing notes, creating charts, and reading and commenting on each other’s productions in a communal database (Hakkarainen et al. 2002). The new potential that technology gives teaching and learning is based, in part, on the unique characteristics and capabilities of the technology. However, technology is only a facilitator; more important is how technology is used in the educational setting, that is, its pedagogical implementation (Roschelle & Patton 2002). It is not just a matter of implementing and putting new technology into use, but in many cases, also simultaneously applying new practices (Lipponen 2002).

2.6 Collaborative Learning and Distributed Teamwork in Company Environments

The increasing globalization of markets and production has increased pressure to distribute business projects globally. Moreover, in research organizations, research projects are evolving towards big, globally distributed projects. International connections and online courses are becoming commonplace in education organizations. All this development leads to a situation in which most knowledge workers, at some stage in their working career, will have to be a member of virtual team. Learning processes in knowledge-intensive work and in formal education situations are much alike. In both settings, collaborative learning demands that individuals engage in various structured and intentional activities to produce an outcome (Kleismann & Valkenburg 2005). When individuals engage in workplace activities, their knowledge is changed in some way by their work practices, or in other words, they learn (Billet 2004). Because of the similarities in the learning processes between workplaces and formal learning situations, studies conducted from the perspective of the learning sciences can also enrich our understanding of how new knowledge is constructed in teamwork settings (Sawyer 2006). Furthermore, studies conducted from a teamwork perspective can enrich our understanding of distributed student groups’ work.

Virtual teams provide an effective structural mechanism for handling the increased travel, time, coordination, and costs associated with bringing together geographically, temporally, and functionally dispersed members to work on a common task. However, virtual teams face challenges that may be absent in traditional co-located teams. Often, many participants have never met, and they
may have different levels of experience and may have motivations that conflict with the common goals. Such factors make it increasingly difficult to coordinate across teams, manage evolution, and monitor progress (Herbsleb & Moitra 2001, Mockus & Herbsleb 2001). These challenges indicate the importance of enhancing distributed teamwork.

Teams can choose from a broad array of technologies to supplement or replace face-to-face interaction. The technologies differ in their extent of media richness as communication channels (Daft et al. 1987) and in the extent to which they enable synchronous collaboration (Riopelle et al. 2003). Thus, whereas desktop videoconferencing is relatively high in media richness and synchronicity, e-mail is lower on both dimensions. Other technologies commonly used to support the functioning of virtual teams include telephones, web sites, instant messaging, file- and application-sharing, electronic bulletin boards, group decision support systems, wikis, and real-time calendar/scheduling systems. The extent to which a team uses these technologies affects its extent of virtualness (Bell & Kozlowski 2002, Griffith et al. 2003).

2.7 Media Choice Theories

Organizations usually have several ways of delivering the same message. Media choice theories try to explain the reasons that certain tools should be used for certain tasks or activities (Niinimäki et al. 2010). Three theories are usually connected with communication and communication tools/media choice: social presence theory (SPT), media richness theory (MRT), or information richness theory (IRT), and media synchronicity theory (MST).

Social presence theory was introduced in 1976 by Short et al. It suggests that the social effects of a medium are based on the medium’s ability to provide awareness of the presence of an interaction partner. The more effectively the communication tool provides awareness of presence, the more people feel they are socially present in the communication situation. Media low in social presence (e.g., memos) are good for providing information, while media high in social presence (e.g., face-to-face communication) are better for negotiations. (Short et al. 1976)

Daft and Lengel (Daft & Lengel 1986) proposed a theory based primarily on social presence theory and the presumption that increased media richness is linked to increased social presence (Dennis & Valacich 1999, Robert & Dennis 2005). This became one of the most widely applied theories of media use and was
originally called information richness theory, later becoming media richness theory. According to this theory, a medium is considered richer the more communication channels and feedback it provides, the more targeted the message is, and the more the language conveys shared meanings and is more easily understood by all communicating parties. Face-to-face communication represents the richest medium and paper-based written media the leanest medium. Media richness theory suggests that different professional tasks are completed more efficiently when task properties and media richness match. Tasks with high equivocality and uncertainty should be channelled through richer media. Tasks with unequivocality and high certainty can be channelled better through a leaner medium. (Daft et al. 1987, Niinimäki et al. 2010, Kock 2005)

Dennis and Valacich (1999) analysed the capabilities of different media, and based on that analysis, criticized Daft & Lengel’s media richness theory for three reasons:

- No media could have the highest values in all dimensions, so none could be labeled “the richest”.
- No media is monolithic. It is possible for one medium to possess different levels of communication capability depending how it is configured and used.
- Ranking media in absolute terms is not practical.

Based on these criticisms, Dennis and Valacich (1999) introduced media synchronicity theory, which suggests that effective media use requires a match between media capabilities and the fundamental communication processes needed to perform the task. The theory focuses on two main communication processes: the exchange of information (conveyance) and the development of shared meaning (convergence). Choosing a single medium for any task may prove less effective than choosing media or set of media that the group uses at different times in performing a task, depending on the current communication process. Multiple communication media should be used when performing a task, which involves both exchanging information and developing shared meaning for the information. (Dennis & Valacich 1999).

Common to these theories is the task technology fit (TTF) framework, which proposes that matching ICT characteristics with task characteristics is more likely to lead to the effective use of communication tools (Goodhue & Thompson 1995, Zigurs & Bucklan 1998, Zigurs & Khazanchi 2008). As these theories are commonly used for media selection, ICT adaptation and use, ICT-mediated communications, and communication media design, it is important to understand
that new media (e.g., instant messaging) may have difficulties fitting into these classifications, which will result in the need for a revision of these theories ((Kock 2005, Eric T.K. Lim 2008).

2.8 E-learning implementation barriers

Barriers to the implementing of new learning technologies in organizations normally occur between the decision to implement a new e-learning system and the impact on the organization (Ali & Magalhaes 2008). The general e-learning implementation model and where the barriers are presented in Fig. 2.

Fig. 2. Model of e-learning implementation (based on Ali & Magalhaes, 2008).

Numerous empirical studies and conceptual articles have focused on the barriers to the integration of technology integration, and different categories (e.g., pedagogic) of barriers have been identified and used by different researchers. A common categorical distinction is between extrinsic and intrinsic barriers. However, the terms used to describe this divide differ. For example, Ertmer (Ertmer 1999) uses the terms first-order barriers (access, time, support, recourses, and training) and second-order barriers (attitudes, beliefs, practices, and resistance). In contrast, Becta (BECTA, British Educational Communications and Technology Agency 2004) divides barriers between institutional and individual, while Su (Su 2009) uses the general terms external and internal barriers.

According to Roy (2010), before e-learning can be implemented in an organization, some pre-requisites should be addressed. The first pre-requisite is the need to develop an e-learning culture within the organization, where managers and employees are truly motivated and committed to using e-learning. A second
pre-requisite is the need to lower the present barriers to the efficient and effective use of e-learning. According to Roy (2010), the main barriers are the following:

- Lack of access to computers or the internet
- Lack of training and support
- Lack of knowledge on the courses and content
- The level of interaction
- The cost of purchases and development

Two recent meta-analyses of the literature on barriers to implementing new technologies in education (Bingimlas 2009; Su 2010) conclude that many researchers have quite similar opinions about the main barriers:

- Lack of access to resources and technologies
- Lack of competence and training
- Lack of confidence and vision or rationale for technology

Identification of these barriers should be well connected to the implementation actions. Such connections enable the implementation process to remove the main barriers to the integration of new technology, so that the use of these technologies increases, which leads to more effective use, and consequently, to an increase in the quality of learning. Ertmer’s (2005) work demonstrates the need to address both the “hard” (technological) and “soft” (staff development) aspects of any such strategic developments with respect to ICT in order to secure success.
3 Research Process

In this chapter, the research methods are described first. The work done during this research period then is described in three phases (Fig. 3). The research initially focussed on the organization’s strategy and its guidance principles for strategy implementation. In the second phase, the scope changed to the implementation process and development projects. Development projects described in the second phase were the main tools of the ICT strategy in teaching and learning implementation. In the second phase, a method also was developed to categorize the investments and to show the trends, stages, and barriers of the development work done in the projects. In the third phase, the geographically distributed e-learning concept, developed during the research period, was transferred and tested in a company environment.

Fig. 3. Research process and relationships between the original articles 1–8.

The data collected in this study is both quantitative and qualitative. A combination of qualitative and quantitative data often provides better understanding of the studied phenomenon. This research approach is called mixed methods. The
research presented in this thesis is as a whole mixed methods research. (Runeson & Höst 2009).

### 3.1 Research Methods

In the first phase, a constructive research approach was used. The constructive research approach builds an innovation (e.g., construct, model or method) based on existing knowledge and/or new technical advancements (Järvinen 2001). The constructive research approach was also used in the second research phase when projects developing distributed e-learning course concepts are discussed.

The theory-creating research approach is used in the second phase, which addresses the university’s execution of its strategic plans, which include the implementation of the virtual university e-learning concept SME communication tools that are used in the geographically distributed work. The theory-creating research approach aims at creating new theories that aim to explain and describe reality. Theory creating research is best suited to situations in which there is no prior knowledge of a phenomenon or part of reality. (Järvinen 2001)

In the second part of the third research phase, the theory-testing research approach was used. In an empirical study, the theory-testing research approach is used to confirm or falsify a theory. In this case, the hypothesis that the geographically distributed e-learning concept could be transferred to a company environment was tested. The theory-testing research approach usually includes controlled experiments, longitudinal field studies, and theory testing case research. (Järvinen 2001)

Most of the research work done during the research period of this thesis was done in single or multiple case studies (Table 1). The case study approach was selected as the research approach because it suits situations where control over behavior and research data can be collected through observations in unmodified settings.

According to Yin (2009), a case study is an empirical inquiry that investigates a contemporary phenomenon in depth and in a real-life context, particularly when the boundaries between phenomenon and context are not clearly evident. For example, case studies do not generate the same results for causal relationships as controlled experiments, but they provide deeper understanding of the phenomena that are studied (Runeson & Höst 2009).

Case studies are used for many purposes, such as to provide a description, to test a theory or to generate a theory. They can consist of one (single case study) or
several cases (multiple-case study) and they can be based on qualitative or quantitative data collection. The case study method also provides the possibility of using many sources of evidence (data triangulation), and many data collection methods (methodological triangulation). Multiple sources of evidence and multiple methods provide a better validity for the findings. (Yin 2009)

Table 1. Research approaches utilized.

<table>
<thead>
<tr>
<th>Research case</th>
<th>Research approach</th>
<th>Research method</th>
<th>Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProActori tool development and university’s strategy process</td>
<td>Constructive</td>
<td>Case study</td>
<td>1</td>
</tr>
<tr>
<td>University execution of its strategic plans and implementation of the virtual university e-learning concept</td>
<td>Theory-creating</td>
<td>Multiple-case study</td>
<td>2, 6</td>
</tr>
<tr>
<td>Development projects developing distributed e-learning course concept</td>
<td>Constructive</td>
<td>Case studies</td>
<td>2–6</td>
</tr>
<tr>
<td>SMEs’ communication tools use in the geographically distributed work</td>
<td>Theory-creating</td>
<td>Multiple-case study and GQM</td>
<td>7</td>
</tr>
<tr>
<td>Transferring the geographically distributed e-learning concept, developed in the university environment, to the SME context</td>
<td>Theory-testing</td>
<td>Action research and GQM</td>
<td>8</td>
</tr>
</tbody>
</table>

As the purpose in the original article 8 was to change and improve the use of e-learning tools and practices in SMEs, action research was chosen as the approach to be used with the case company. Action research is a qualitative research approach that aims to improve practices through the collaborative work of researchers and practitioners (Avison 2002). A case study is purely observational, while action research is focused on and involved in the change process (Runeson & Höst 2009). Kurt Lewin’s (Lewin 1948) classic action research model was used and adopted for the case. Lewin (1948) specifies the planned change of social conduct towards a higher level as a three-step process consisting of unfreezing (including planning and initial fact-finding), moving (including execution of the plan), and freezing (including evaluation of the plan).

For empirical data collection in the original seventh and eighth articles, the Goal/Question/Metric (GQM) based approach was applied as a framework for the interviews. The GQM abstract sheet was used in the interviews for collecting data. The GQM method was not applied for metrics. GQM is originated in software
engineering, which was adapted for study’s purposes in the designing of the interviews. The GQM paradigm is a practical approach for defining metrics and evaluating sets of operational goals using measurement. It provides a systematic approach to define measurement programs for organizations and projects based on their specific needs. (van Solingen & Berghout 1999, Basili et al. 1994).

Table 2. Data collection.

<table>
<thead>
<tr>
<th>Article</th>
<th>Data collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ProAktori: A Management Tool for ICT Strategy Processes in Universities</td>
<td>2 pilots, (16 participants in University of Oulu and 11 participants in University of Helsinki), Observations and interviews in both pilots.</td>
</tr>
<tr>
<td>2. The Long Term Implementation Process of ICT Strategy in Teaching and Learning</td>
<td>70 Campus Futurus management group’s meeting memos analyzed</td>
</tr>
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<td></td>
<td>116 project applications analyzed</td>
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<td></td>
<td>116 project reports analyzed</td>
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<td></td>
<td>3 expert interviews</td>
</tr>
<tr>
<td>3. The Production Model of Digital Video Course at the University of Oulu</td>
<td>One year observation period</td>
</tr>
<tr>
<td></td>
<td>Two workshops (8+9 participants)</td>
</tr>
<tr>
<td></td>
<td>8 expert interviews</td>
</tr>
<tr>
<td>4. DoPro Online Course Production Model for Finnish Universities – the Producer's Perspective</td>
<td>Modeling and analyze of two production groups work</td>
</tr>
<tr>
<td></td>
<td>Workshop (54 experts from 22 universities or polytechnics), video recording and working papers analyzed</td>
</tr>
<tr>
<td></td>
<td>6 transcribed expert interviews</td>
</tr>
<tr>
<td></td>
<td>Pilot course production</td>
</tr>
<tr>
<td>5. Developing new mobile services for the Universities – University students' conceptions of their needs for mobile tools for scaffolding learning activities</td>
<td>2 web questionnaires (n = 715 and n = 147)</td>
</tr>
<tr>
<td>6. Journey from Material Distribution to Virtual Working Environments</td>
<td>Conclusion paper, data from papers 3–5</td>
</tr>
<tr>
<td>7. Supporting collaboration in the geographically distributed work with communication tools in the remote district SMEs</td>
<td>Web questionnaire (96 answers)</td>
</tr>
<tr>
<td></td>
<td>30 transcribed interviews in 13 companies</td>
</tr>
<tr>
<td>8. Transferring an University E-Learning Concept to SME Context</td>
<td>8 observation sessions</td>
</tr>
<tr>
<td></td>
<td>3 online observation sessions</td>
</tr>
<tr>
<td></td>
<td>10 transcribed user interviews</td>
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<tr>
<td></td>
<td>3 transcribed company personnel interviews</td>
</tr>
</tbody>
</table>
3.2 Strategy Process and Tool Development

The first research phase concentrates on the university’s strategy work and the ICT Strategy Service’s Proaktori model. First, strategy work at Finnish universities is described and then the development of the Proaktori model development is presented (original paper 1).

3.2.1 ICT strategy work in teaching and learning


Upon request, in 2004 the Finnish Virtual University (FVU) set up an ICT Strategy Service consisting of articles, models and tools on the FVU portal to help universities in their strategy development. In 2004, the FVU and some of the universities began to update their ICT strategies. The universities’ joint ICT Strategy Service also prepared a survey of university ICT strategies. The survey revealed that the strategies were somewhat weak, especially with regard to implementation and monitoring (Sariola & Söderlund 2004). In response to this problem, the ICT Strategy Service started to develop the ProAktori model and database web tool for supporting the management of strategy processes in universities.

The development work was based on the experiences from the first strategy processes, ICT Strategy Service’s survey of university ICT strategies, the Balanced Scorecard (BSC) (Kaplan & Norton 1996, Kaplan et al. 2002), and a public-sector application of the BSC known as the Balanced Success Strategy (Määttä & Ojala 1999). The ICT Strategy Service consisted of six experts from four universities, including the author. At the beginning of 2004, internal workshops were used to create the ProAktori model. The ProAktori web tool development started right after the principles of the model were ready. At the same time, work began on producing support materials for both users and consultation. The architecture, user logic and user interface design were all based on the model’s idea of how the strategy process should be performed. By the end of 2004, after internal testing, the tools and the model were ready for publication.
At the same time, the ProAktori method was piloted at the University of Helsinki and the University of Oulu.

In the first pilot study, the Virtual University steering group at the University of Helsinki used the model to evaluate the existing university’s virtual university strategy 2003–2006. In the second pilot, the Campus Futurus’s management group used the method to prepare new ICT in learning and teaching strategies for the years 2005–2007. Writers of article 1 participated in both of the pilot groups’ meetings and observed the model’s use. After the pilot studies, the ProAktori web tool was published as a part of FVU portal, and it was offered free to all Finnish universities. It was used until 2010 when the FVU portal was closed.

### 3.3 University Case

The research performed in this phase is mainly described in articles 2–6. In the first part of this phase, the University of Oulu’s execution of its strategic plans and implementation of the virtual university e-learning concept is presented (article 2). The timeline of this work is presented in Fig. 4. Next, some projects that participated in the development of the distributed e-learning course concept are introduced (articles 3–6). These projects are examples of the development work performed in the main development areas from 2001 to 2009. Knowledge gained from these projects was later used and tested in the company environment described in the third phase section and in papers 7 and 8.

![Fig. 4. Timeline of the strategy periods.](image)

The reader should notice that official years in the names of the strategy periods sometimes differ from actual years. The following list explains:
Virtual university funding started in the year 2000, and in the first years, it was used to found Campus Futurus and to build networks in the University of Oulu.

Strategy 2002–2005 was already completed during the year 2001, and funding decisions in the year 2001 were made according its principles.

The Board of the university was not able to approve the strategy proposal earlier than at the beginning of the year 2002 for bureaucratic reasons.

The Board of Campus Futurus found that the goals of the strategy 2002–2005 were already fulfilled during the year 2004. It decided to shorten the strategy period 2002–2005 by one year and begin the strategy process for the new strategy period, 2005–2007.


3.3.1 ICT strategy in teaching and learning implementation in the University of Oulu

The University of Oulu chose to organize its implementation of the strategy by means of a network model. The center of this network was Campus Futurus, and its main goal was to coordinate and promote educational technology development and virtual university work. To implement ICT strategies in learning and teaching, Campus Futurus used the Ministry of Education’s national virtual university funding. In contrast, in many Finnish universities, the majority of these funds were used to run educational technology support centers (Kylämä 2005). In the University of Oulu, however, funding was channeled through the Campus Futurus organization to support faculty and departmental development projects. The projects were the main instrument for the implementation of the strategy. Campus Futurus organization’s own resources were very limited, so it concentrated only on coordinating development work and organizing seminars and workshops. Funding decisions were made by the Campus Futurus Management Group.

The various documents created and compiled by the workings of the Campus Futurus Management Group from 2000 to 2009 formed the basis for the data collection. In the Campus Futurus meetings, progress was reviewed, project applications were discussed, and funding decisions were made. During the years from 2000 to 2009, there were 70 meetings and over 300 project funding proposals. During the ten year time period, 116 positive funding decisions were made. These decisions were based on the strategies.
To present this development process and to show the trends, stages and the barriers of the development, a method for categorizing project funding was developed. Although this method simplifies the real life phenomena, it enables a clearer picture of the development stages and trends.

All 116 project applications were categorized in accordance with the main goals of the projects. The final reports from the projects were also checked to ensure that the actual work done during the projects was in the right category. In some cases, some of the funding was transferred to another category. If there were difficulties categorizing a project, the project personnel were contacted and a categorization decision was made based on these interviews. In the first phase of the data analysis, there were 13 different categories. However, after closer analysis of their contents, the decision was taken to reduce the number of categories to five. Funding decisions were presented graphically during the strategy periods to illustrate how funding decisions guided development work in this large and scattered environment. Three expert interviews were also done in order to verify results and historical facts.

### 3.3.2 Development projects developing distributed e-learning course concept

A reason that development work on distributed e-learning solutions began so quickly and on such a large scale was that a consortium of Finnish universities established the Finnish Virtual University in January 2001 (Kylämä 2005). This added to the interest in and funding possibilities for online educational solutions. As a part of this development trend and increasing demand for ICT professionals, from 2001 to 2007 regional master programs were organized at the Department of Information Processing Science (TOL) and the Department of Electrical and Information Engineering at the University of Oulu (Mikkonen 2005). The main purpose was to deliver material to students in northern Finland and to enable their learning. At the same time, the University of Oulu was implementing its ICT strategy in teaching and learning. The main development area of this strategy was course development. This gave development projects support from the university level, and the same time they fulfilled the university’s goal to launch development projects on faculty and department levels.
Efficient distribution of materials and rapid material production processes

The first of the three development projects described in this thesis concentrated on efficient distribution of materials and rapid material production processes (article 3). This issue was important for an organization to launch large-scale geographically distributed educational programs with limited personnel and time resources. For this purpose, DiVision, the production unit for digital materials at the Department of Information Processing Science at the University of Oulu, was initiated in May 2001. The DiVision production team consisted of eight members and the author as a team leader.

Testing and development work with the production team’s processes began in 2002. Experiences and a theoretical referential basis for the production models of online course materials were sought in the methods of software production, as course applications based on multimedia techniques can be thought of as small-scale data systems. These methods alone were not enough. Similar to the making of any product, the manufacture of learning materials needs to take into account the user, the special nature of the materials, and their purpose. It was observed that the course productions could not be implemented using the readily available basic models, and a proprietary model suitable for course production had to be created by combining them. The starting point for the model emerged from the incremental model of production.

Development work first concentrated on improving the efficiency of the production because of the quickly growing demand of the course productions. Later, during the Virtual Campus project focus moved to different distribution channels and better service possibilities available to the students. This kind of development work was a new phenomenon in Finnish universities, and it was presented at many national (ITK 2003, ITK 2004, LeTTET 2005, ITK 2006) and international conferences (EDEN 2003, EDEN 2004, ED-Media 2005, E-Learn 2009).

DoPro production model for Finnish universities

The idea of the second development project was to improve the quality of the course materials and services by increasing collaboration between teachers and the production unit staff (original article 4). This was done together with the University of Art and Design and the FVU. The goal of this project was to develop a common digital course production model for all Finnish universities.
This DoPro model was based on the DiVision team’s production model and the University of Art and Design’s Virtual University team’s work. At that time, these were two of the biggest production units at Finnish universities.

At first, team leaders from both production units described and analysed the good practices and difficulties of both teams. After that, the model was elaborated on a workshop organized by the FVU on March 2005. Fifty-four experts from 22 universities or polytechnic institutes attended the workshop. The workshop was videotaped and the working papers of groups were collected for analysis. The workshop results were used to enrich the developed model. Six experts from three production units were also interviewed. The purpose of these interviews was to get a more detailed picture of the working habits in different organizations and new ideas in these groups. All the interviews were recorded and transcribed. DoPro model piloting started in May 2006. The DiVision team at the University of Oulu and the University of Art and Design’s Virtual University team started to change their working habits regarding the DoPro model. During the autumn of 2006, the first pilot courses were produced. At first, experiences were very promising, but the development work had to be stopped in the spring of 2007 because the funding for the regional master programs stopped, and at the same time, virtual university funding was reallocated. Both production teams were first heavily cut and then closed down during 2007. The DoPro concept could be proven in the pilot productions, but the large-scale implementation was aborted and follow-up studies could not be launched.

**Scaffolding student work with mobile services**

The third project’s basic idea was that mobile technologies and devices could be a solution for the university’s place-dependant teaching. One of the starting points of this development work in scaffolding student work with mobile services (article 5) was the VirtualCampus project (2003–2005). As a result of multidisciplinary co-operation (Department of Information Processing Science, Department of Electrical and Information Engineering, Learning and Educational Technology Research Unit, and University Library), the VirtualCampus project was launched to promote applications of wireless technology in university studies and work. The project was coordinated by the Department of Information Processing Science; the author acted as a leader of this project. The development activities were divided into three sub-projects according to the following
questions, which provided the basis for the activities of the Virtual Campus (Liukkunen et al. 2004):

- What are the technological prerequisites (such as the network architecture) that provide the framework for a virtual campus?
- What kind of mobile applications or services can be justifiably developed to support the work of the university?
- What kind of pedagogical models can be designed and the efficient utilization of current applications and services?

In addition to these projects, the new Learning Centre of the Faculty of Science and Technology, where wireless networking was already a consideration in the planning stages, functions as the test laboratory for the first stage of the project.

In this dissertation, the development work is presented through the survey on how to scaffold students’ work with mobile devices and some applications based on the survey results. After mobile services, the development focus moved to the use of social media and the implementation of collaborative tools at the university level. This development is briefly described in paper 6.

**3.3.3 Geographically distributed e-learning concept**

The first version of the geographically distributed e-learning model was originally developed for university use. Development started when the DiVision production unit developed a course production model for a distributed e-learning environment. It was further developed by the DoPro project. In addition, the model was influenced by the Virtual Campus project’s work on how to scaffold mobile work as presented in Fig. 5.

![Fig. 5. Background of the first version of geographically distributed e-learning concept.](image-url)
Development of the first version of the concept consisted mainly of collecting and reshaping the ideas and proven best practices from earlier development work to the transferable concept. The first version of the concept consisted of how to produce a course and execute it in a geographically distributed environment.

When the concept’s use in the company case was planned, it became clear that the production and distribution models were not sufficient. The concept had also to be implemented in new environments, so it would need instructions for the implementation process. For that reason, the simplified version of the University of Oulu’s implementation process was developed and added to the concept.

The results of this work and the geographically distributed e-learning concept are more closely presented in Chapter 4.2.2.

3.4 Company Cases

The research performed in this phase is described in the original articles 7 and 8. This phase of the work is done mainly in the CreaLearn project (6/2008–11/2011). The project’s main objects were to study how to support the distributed project’s work, shared knowledge creation, and geographically distributed workplace learning. In this thesis, the results of company interviews and geographically distributed e-learning concept transfer to SME environments are presented. The timeline of this phase is presented in Fig. 6.

First, data on the collaboration and communication challenges from the point of view of SMEs was collected in the company interviews (n = 30). The implementation of the geographically distributed e-learning then was tested with one of the companies that were interviewed between 2009 and 2011.
3.4.1 Company interviews

From the CreaLearn project’s research of geographically distributed project work, 11 organizations in Kainuu area were selected for interviewing. These represented almost all the software companies that, according to project’s exploration, have geographically distributed projects in this region. In addition, two international organizations operating outside the Kainuu district were selected for interviewing in order to detect possible differences. Of the organizations interviewed in CreaLearn, 10 were SMEs and three were larger, international organizations. The interview results on how to support collaboration in distributed project work with communication tools are based on the interviews done during the period from 5/2009 to 12/2009. The interview data consisted of 30 transcribed interviews with 13 companies.

In the CreaLearn project interviews, the Goal/Question/Metric method (GQM) was used. According to this method, the first formal goal should be defined first. In this case, the formal definition was the following: Analyze distributed project team’s working environment for the purpose of understanding with respect to communication from the viewpoint of project team in the context of distributed SW development. Based on this goal and the findings and categories found in the literature review, the above interviews were conducted. A formal GQM abstract sheet was applied for collecting data from the interviews. (van Solingen & Berghout 1999, Basili et al. 1994)

The interviewees represented various roles from entrepreneurs to software developers. They all worked in geographically distributed projects and used communication tools to collaborate with their colleagues or customers. The length of a typical interview was 90 minutes. The interviews were also recorded and transcribed by an external party. The interview results were used to modify the geographically distributed e-learning concept for the use of SMEs.

3.4.2 Geographically distributed e-learning concept transfer to SME environment

Development of the company case began after the company interviews with one of the companies involved in the study. This small company has its own software product for the company administration. The company trained its customers to use the system and consulted on its efficient use. Company consultants had to travel around the country to give training sessions to their customers. They also
had four offices in different cities, and although they had used open source communication tools to communicate between these offices, they had stopped using them because of their unreliability. The company had very limited resources for the e-learning implementation process and tools.

Because the objective was to change and improve the usage of e-learning tools and practices in SMEs, action research was chosen as the approach to the case company. The first planning step was done by collecting information about the company’s initial situation and development needs (expectations) with respect to e-learning. The second execution step was done by conducting actions, which included a proposal for new e-learning tools, training, and so on for the company in order to introduce new means for their work. The third evaluation step was carried out by conducting empirical data collection with company personnel and their customers. Based on this, it was possible to make decisions about the impact of the new tools and methods on the company’s work and whether the concept would be “frozen” in production use, by the company.

For the empirical data collection in the first and third step, The Goal/Question/Metric based approach was utilized. In this case, the following goal was formulated: Analyze the e-learning concept implementation for the purpose of evaluation with the quality focus transferability from the viewpoint of the SMEs in the context of case company and its customers.

In the first step of the concept (“Analyze situation → Identify barriers → Create strategy / plan for implementation- thinking model”), the initial state analyses of the company needs and barriers were done by observations of the training sessions and interviewing company personnel. Based on these results, and taking into account the company’s available resources, a new communication tool environment for e-learning was recommended. The concept was introduced in April 2010. The company accepted the recommendations and started the internal use of the system with instructors’ meetings to motivate personnel and familiarize them with the new tool and its use. The first training sessions started with customers in the autumn of 2010. Most of the instructors had never used e-learning, and they asked us to observe first training sessions and provide comments. In the third step, the impact of the intervention and the effect of the new concept and tools were evaluated by interviews with the company’s customers and instructors (n = 10) about their first experiences with the e-learning sessions at the beginning of 2011. As a result, the company was able to make decisions about whether and how to adopt the new concept in their work.
4 Analysis and Main Results

The research process was divided into three parts (Fig. 3). The process first focused on the organization’s strategy and guidance principles for implementation of the strategy. In the second phase, the focus shifted to the implementation process and development projects. In the third phase, the geographically distributed e-learning concept, developed during the research period, was transferred and tested in a company environment. In addition, the research questions followed this phase, and the main results are presented according to the same division. Fig. 7 presents the relationships between the main results presented in this chapter.

According to Lipponen (Lipponen 2002), one of the major challenges of educational technology is scaling-up, that is, the question of how to expand and implement good practices that researchers and teachers have found and developed. In other words, what is needed for the successful implementation of
technology? In order to answer that question with regard to university and SME environments, the research goals and questions of this thesis were set.

4.1 Research Question 1

This chapter answers research question 1: *What was the process and control mechanism behind the ICT strategies in learning and teaching in the University of Oulu during the first decade of this century?*

At the beginning of this millennium, Finnish universities performed their first ICT strategies in learning and teaching, and in 2004 the Finnish Virtual University and some traditional universities began to update their ICT strategies. The universities’ joint ICT Strategy Service also prepared a survey of university ICT strategies, which revealed that the strategies were rather weak, particularly with regard to implementation and monitoring (Sariola & Söderlund 2004). In response to this problem, the ICT Strategy Service developed the ProAktori model and web tool for supporting the management of strategy processes in universities. These were piloted in the strategy work carried out at the universities of Oulu and Helsinki. At the University of Oulu, the strategy implementation process differed from that found in most Finnish universities. Most Finnish universities have chosen a centralized working mode for their virtual university work (Aarrevaara *et al.* 2007). At the University of Oulu, the networking model was chosen and the Campus Futurus organization coordinated the network’s work, which was why the University of Oulu had some special guiding principles for the strategy implementation.

- The answer to the first research question includes the following:
- The ProAktori model, which was used as a process model for the strategy work done at the University of Oulu.
- The special guiding principles for the strategy implementation at the University of Oulu.

4.1.1 The ProAktori model

The ProAktori concept included the model itself, a web-based tool to support collaborative strategy work, and learning material on how to use the model and tool to support strategy process.
The ProAktori model is based on the Balanced Scorecard (Kaplan & Norton 1996, Kaplan et al. 2002) and its Finnish application, the Balanced Success Strategy (Määttä & Ojala 1999). It can be used as an assistive tool in evaluating the formulation of a strategy and the implementation of a completed strategy. The ProAktori perspectives (e.g., competence) must be derived from the organization’s mission and vision for the ICT strategy. It is recommended that between three and six perspectives are used, and their relationship to each other must be logical, forming a balanced whole. Critical success factors must be chosen in the case of each perspective; these are factors from each perspective that have the greatest influence on the achievement of the vision (e.g., ICT skills). A total of 6–12 success factors are recommended. The objectives and the actions to implement them then should be determined. Finally, metrics are selected for monitoring the activities. These stages are presented in Fig. 8.

![Fig. 8. Stages in the ProAktori model (Liukkunen et al. 2005).](image)

The chosen metrics must be valid, reliable, relevant and practical, and there must not be too many of them. The metrics can be quantitative or qualitative in character and they must have a clear connection with the strategic objectives and practical actions. The metrics can be used to guide and evaluate the realization of the strategy. The set of metrics can be altered if there are changes in the organization’s strategy or its operating environment.

A related web tool was created in 2004 to support the strategy process work. After the pilot period, it was available for the university’s use in the FVU web portal from 2005 to 2010. The tool enables multiple users to work collaboratively on the same strategy document and to divide the work into sub-sections for different groups. It can also be used by a single person to evaluate the existing strategy. The production model is linear, but the interim saves enable flexible work by multiple users.
The stages of the process can be seen in the tabs of the online service. The program itself, also guides the user through the process (Fig. 9). The process is as follows:

- The user enters background information on the strategy document, the organization, and himself or herself.
- The introduction presents the grounds for beginning the strategy process and describes the drivers of change and the operating environment.
- The mission, vision and current status are defined.
- Perspectives and success factors are defined.
- The goals of the strategy and its implementation are detailed, and measures are defined for monitoring the accomplishment of the goals.
- The implementation of the strategy is evaluated and conclusions are drawn for future action.
- The finalized description of the strategy can be saved for use by the organization or for distribution over the web.

A strategy prepared with the aid of the ProAktori model can be incorporated into an annual action plan. The basic ProAktori model was piloted and applied in the strategy processes for ICT use in teaching at the Universities of Helsinki and
The experiences of both universities in using the ProAktori model were encouraging. As an example of the formulation of a new strategy, the use of ProAktori

- helped in understanding the impact of ICT use on the university’s activities as a whole;
- helped to focus on the main success factors;
- directed attention to specific metrics and objectives;
- provided a clear method of presentation that combines strategic goals, their implementation and monitoring in a very concrete way.

As an example of the evaluation of an existing strategy, the use of ProAktori

- helped in understanding strategy implementation as a whole;
- helped in responding to changes in the operating environment and in reorienting the strategy;
- helped in evaluating the necessary number of chosen objectives and metrics and their adequacy for successful implementation.

During the strategy process at both universities, it was found that the most important factor was not the strategy document itself but the process by which the document was produced. The ProAktori model provided the working group members with the tools for communication and for organizing the work.

4.1.2 The guiding principles for the strategy implementation

The University of Oulu chose to organize its implementation of the strategy by means of a network model. The center of this network was Campus Futurus, and its main goal was to coordinate and promote educational technology development and virtual university work. Preparations for the first ICT strategy for teaching and learning started in 2001. During the period this thesis covers, there were three discrete strategic periods: between 2002 and 2005, between 2005 and 2007, and between 2008 and 2009. To implement the strategies, Campus Futurus used the Ministry of Education’s national virtual university funding. In contrast, in many Finnish universities, the majority of these funds were used to run educational technology support centres. In the University of Oulu, however, funding was channelled through the Campus Futurus organization to support faculty and departmental development projects. Funding decisions were made by the Campus Futurus Management Group, which drew its membership from staff chosen from
every faculty and supporting unit. Based on the Campus Futurus meeting memos and analysis of the strategy documents, the main principles that guided the strategy implementation were the following:

- Work is organized in a decentralized networking mode and Campus Futurus will coordinate the work
- Strategy implementation is done through the development projects
- The main part of the work should be done on a faculty or department level
- The university’s day-to-day operations did not get funding
- Three years is the maximum funding period for development projects

The focus was on familiarizing educational staff with new working methods and tools. This was achieved by funding course development across the spectrum from traditional courses, to courses in digital form (or at least using digital material), and to learning environments. Funding elements for the infrastructure category included mainly technical equipment, software and learning environments. In the beginning, infrastructure spending accounted for almost the whole budget because the network and working environments were created almost from scratch. Once the networks were established, the emphasis switched to leveraging changes in working culture, as better trained staff demanded proper learning environments and access to these resources.

### 4.1.3 Conclusion

Chapter 4.1 answered research question 1: *What was the process and control mechanism behind the ICT strategies in learning and teaching in the University of Oulu during the first decade of this century?*

The answer to the first research question comprises two main parts:

- The ProAktori model, which was used as a process model for the strategy work done at the University of Oulu
- The special guiding principles for the strategy implementation at the University of Oulu

Strategy processes in University of Oulu followed the principles of the ProActori model. The ProAktori model is based on the Balanced Scorecard (Kaplan & Norton 1996, Kaplan et al. 2002) and its Finnish application, the Balanced Success Strategy (Määttä & Ojala 1999). The model and its principles were piloted at the University of Helsinki and the University of Oulu.
In the piloting stage, it was found that the most important factor was not the strategy document itself, but the process by which the document was produced. The ProAktori model provided the working group with a clear method of presentation that combined strategic goals and their implementation and monitoring in a very concrete way.

To avoid implementation difficulties (Sariola & Söderlund 2004, Aaltonen et al. 2001), some special guiding principles for the strategy implementation in University of Oulu were defined during the strategy process:

- Work is organized in a decentralized networking mode and Campus Futurus will coordinate the work.
- Strategy implementation is done through the development projects.
- The main part of the work should be done on a faculty or department level.
- The university’s day-to-day operations did not get funding.
- Three years is the maximum funding period for development project.

Because the Campus Futurus Management Group made these strategies together with the manager of Campus Futurus, the values that steered implementation and funding decision making did not differ from the official values in the strategy documents. Strategies are value choices, so it is not possible to rank them. One way to evaluate them is to examine the implementation process and its effect on the organization. This evaluation is done in the following chapter.

### 4.2 Research Question 2

This chapter answers research question 2: How were the ICT strategies in learning and teaching implemented at the University of Oulu during the first decade of this century?

In the area of this research question, one special interest area is emphasized by the following sub-question:

> How the geographically distributed e-learning concept was developed in the development projects during the implementation period?

From 2000 to 2009, Campus Futurus used the Ministry of Education’s national virtual university funding to implement ICT strategies. In contrast, at many Finnish universities, the majority of these funds were used to run educational technology support centers. At the University of Oulu, however, funding was channeled through the Campus Futurus organization to support faculty and
departmental development projects. In the first part of this chapter, this process was reviewed through the Campus Futurus Management Group’s funding decisions.

During the ICT strategy implementation process at the University of Oulu, the projects developed concepts or best practices on how different areas of e-learning in the university environment should be organized. One of the developed concepts concerned geographically distributed e-learning. At the beginning of this century, this area was important due to the inception of regional master programs (Mikkonen 2005) and other regional activities. The geographically distributed e-learning concept is presented in the latter part of this chapter.

4.2.1 The long term trends in ICT in teaching and learning implementation process

Analysis of the funding decisions in addition to that of the development of the strategic goals suggests that the implementation of the virtual university environment progressed in the University of Oulu in the following phases:

- infrastructure building
- resourcing for the new desired working culture
- environments, support services for the new culture and environments

This iterative planning and implementation cycle continued so that when a new working culture or environment was established, it created a ground on which the following new cultures and environments could be built. This process created a demand for new infrastructure and support services. At the University of Oulu, the forces affecting strategic planning were partly the result of strategic decisions and partly because of new technologies like wireless devices and social media. In addition to strategic planning and technology, in an organization like the university, much pressure is exerted from different directions on the development work and the projects’ goals and funding. The main kinds of pressure are presented in Fig 10.
The implementation process of the virtual university environment was researched mainly through the documents produced by the Campus Futurus Management Group from 2000 to 2009. In Campus Futurus meetings, progress was reviewed, project applications were discussed, and funding decisions were made. From 2000 to 2009, there were 70 meetings and over 300 project funding proposals. During the ten year period, 116 positive funding decisions (Table 3.) were made. These decisions were based on the strategies.
Table 3. Virtual university funding decisions for 116 development projects.

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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Social media</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20000</td>
<td>7000</td>
<td>0</td>
<td>14800</td>
<td>37000</td>
<td>12000</td>
<td>0</td>
</tr>
</tbody>
</table>

All 116 project applications were categorized in accordance with the main goals of the projects. The final reports from the projects were also checked to ensure that the actual work done during the projects was in the right category. In the first phase of the data analysis, there were 13 different categories. However, after closer analysis of their contents, the decision was taken to reduce the number of categories to five:

- infrastructure (includes basic infrastructure, equipment, video conference, networking and learning environments)
- support and training services (includes user skills and pedagogical training, learning material production and web portals for training purposes)
- course development (funding for course development projects done in faculties)
mobilility and wireless (piloting projects)
- social media (piloting projects and new working culture development)

The graphic presentation of funding decisions during the strategy periods created a practical tool for considering how funding decisions guided development work in a large and scattered environment.

The virtual university funding levels were relatively stable on a year-to-year basis. However, Finland’s conversion from the Finnish markka to the EU currency in 2002 and the changing inflation rate meant that getting comparable monetary data was problematic. For this reason, it is clearer to represent yearly funding decisions in percentages (Fig. 11) than in euro.

![Diagram](image)

**Fig. 11. The themes behind development projects funded during the period 2000–2009.**

Resourcing decisions (Fig. 11) show that during the research period, there were three bigger development waves: course development, mobility/wireless, and social media. It also demonstrates that support services and infrastructure investments depend closely on the development phases. These phases are discussed in the sections below.
The work in this period commenced in 2000, when Campus Futurus was founded and the first funding decisions were made. The first year’s funding was dedicated mainly to infrastructure building. A major part of building the essential infrastructure involved the establishment of networking both inside the university and nationally. Fast networking was essential, as was cooperating with the early adopters of the new technologies within the university. Preparation work for the first ICT strategy was also done. During this period, the foundations of the national virtual university development were established. The focus was on familiarizing educational staff with new working methods and tools. This was achieved by funding course development across the spectrum from traditional courses, to courses in digital form (or at least using digital material), and to learning environments. Figures show that it took about four years to complete the adaptation and another three years before the use of new technologies was an integral part of mainstream teaching. This strategy directed work and funding decisions from 2001 to 2004. The main development areas derived from the identified main barriers were

- infrastructure and facilities;
- staff training;
- course development;
- networking.

The adoption of new working methods and tools demanded additional staff training and support. However, during the first strategic phase, investments in this area were surprisingly low. There were two reasons for this. During the first years, user engagement with new technologies was low, and courses were at the basic level. After three years, support service funding rose more rapidly because of the fast increase in user engagement, and also because the knowledge level of users improved and became more heterogeneous.

Funding elements for the infrastructure category included mainly technical equipment, software, and learning environments. In the beginning, infrastructure spending accounted for virtually the whole budget, because the network and working environments were created almost from scratch. Once the networks were established, the emphasis switched to leveraging changes in working culture, as better-trained staff demanded proper learning environments and access to these resources. Inability to access resources is one of the main barriers preventing
teachers from integrating new technology into their teaching (Bingimlas 2009). It was found that during this period, typically many of the goals and initiatives came from the university management or from the Campus Futurus Management Group. Hence, this could be described as a “top down” development period.

**Strategic Period 2005–2007**

The big change in the second phase, compared with the previous period, is that when the knowledge and expertise of staff had improved, and the working culture was favorably disposed towards the use of new technologies in teaching, the direction of the new development initiatives changed. The impact of the development of mobile and wireless networks provides a good example of how bottom-up pressure changed top-down decision-making. When the first wlan-networks and mobile devices appeared on the university campus, early adapters among the teaching staff started experiments in using these new technologies. At first, the university management was reluctant to support these experiments, but when user pressure grew and the potential pedagogical and other benefits of mobile learning were recognized, the university campus was quickly provided with a free wlan-network, and broad support was given for the mobility pilot projects by Campus Futurus. Pilot projects broadened both the size of the user population and the level of expertise in using new technologies. The speed with which staff adopted and mainstreamed the use of new technologies in their teaching was much faster than in the former phase. Hence, after three years, the funding for this area could be minimized.

As with the integration of all new technologies, funding for the early use “pioneers” and the technological use enablers is needed. The data gathered for the first two planning phases shows that funding for both the technological infrastructure and the necessary staff development has to be simultaneous if fast results are needed. In essence, the infrastructure has to be ready and network access already granted to pioneer users before large scale use can begin.

Campus Futurus continued to allocate ever-higher levels of funding for support and training services until the end of this strategic period. Various reasons accounted for this. First, as the new technologies became better integrated, the number, expertise and sophistication of users, both staff and students, grew exponentially, which prompted further demands for more technology and training. Second, during this phase the awareness among middle managers at the university, of the impact and potential of these new technologies increased markedly.
Moreover, it was recognized that middle management were particularly important in both making decisions about new technologies and convincing junior staff of the need to embrace these technologies in their teaching. Consequently, special training for the middle management was launched to help them understand new possibilities and maximize their potential.

**Strategic Period 2008–2009**

The distinctive feature of this period is the fast rise of the use of social media. The rise in the use and development of social media in education was very similar to that which occurred with mobile technologies in the previous strategic period. It also started with the experiments of the early adapters, and the university’s role was mainly to help distribute the new media and offer safe tools and infrastructure for their official use. After two years of funding, the use of social media was embedded within all the university’s taught programmes, and it had become part of the university’s normal offering. As students have become familiar with social media, they have adopted their own devices for mobile working, with the result that project funding has shifted from building the basic infrastructure to web services and environments.

**4.2.2 Geographically distributed e-learning concept**

The background of the geographically distributed e-learning concept was originally in a course production model for distributed e-learning that was developed for university use (original articles 3–4). To ensure that the course production part of the geographically distributed e-learning concept was successfully transferred and implemented, an implementation stage was added to the concept (Fig. 12).
Implementation

The implementation part of the concept offers guidelines for the organization when it implements e-learning in its geographically distributed learning or working environment. This part of the concept is called, “Analyze situation → Identify barriers → Create strategy / plan for implementation- thinking model”. As its name implies, it has three main parts. These parts are presented in more detail below (Table 4)

Table 4. Analyze situation → Identify barriers → Create strategy / plan for implementation- thinking model.

<table>
<thead>
<tr>
<th>Models stage</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze situation</td>
<td>Observation, interviews and questionnaires</td>
</tr>
<tr>
<td></td>
<td>Organization’s situation</td>
</tr>
<tr>
<td></td>
<td>Organization’s goals</td>
</tr>
<tr>
<td></td>
<td>Organization’s challenges</td>
</tr>
<tr>
<td></td>
<td>Organization’s resources</td>
</tr>
<tr>
<td>Identify barriers</td>
<td>Mainly based on analyze stage, more enquiries if needed</td>
</tr>
<tr>
<td></td>
<td>List of main barriers to prevent effective e-learning concept</td>
</tr>
<tr>
<td></td>
<td>installation and use</td>
</tr>
<tr>
<td></td>
<td>Technical, organizational and human barriers</td>
</tr>
<tr>
<td>Create strategy / plan for</td>
<td>Strategy / plan consists</td>
</tr>
<tr>
<td>implementation</td>
<td>Practical and realistic goals</td>
</tr>
<tr>
<td></td>
<td>Action list, based on the barrier list</td>
</tr>
<tr>
<td></td>
<td>Recourses</td>
</tr>
<tr>
<td></td>
<td>Timetable</td>
</tr>
</tbody>
</table>
First part of this model analyzes the organization’s situation, goals, challenges and resources. These factors should be concrete and connected to e-learning implementation. In this stage, model barrier identification has an important role. Analysis of the organization provides material for the identification of barriers and for the actions and recourses to overcome them. If the barriers are wrongly identified or some important barriers are not noticed, the actions, which are defined in the implementation plan, are focused on the wrong targets. This error leads to inefficient or partly failed implementation.

Course production

Because course applications based on multimedia techniques can be thought of as small-scale data systems, previous experiences and a theoretical referential basis for the production models of online course materials were sought for the methods of software production,. These methods alone were not enough, however. Similar to the making of any product, the manufacture of learning materials needs to take into account the user, the special nature of the materials, and their purpose. It was observed that the course production could not be implemented using the readily available basic models, and a suitable proprietary model had to be created by combining them. The starting-point for the model emerged from the incremental model of production in which the stages of planning and the technical implementation were crystallized as distinct wholes. Both parts also include aspects typical of working methods used in agile processes. The guiding principles of the developed production model are the following:

- Iterative production
- Modular structure
- Continuous feedback
- Agility
- Tutoring
- Recorded lectures
- Material for long term use
- Web based distribution

Incrementality in course production means that no attempt is made to make the entire course ready at the same time, so it is split into production-wise smaller logical units (modular structure). These units can consist of a single theme in the course, a single lecture, or an animation illustrating a single thing. The size is not
as much a defining factor as a constituent logical whole that can be inspected and published for use by the students. From the production point of view, each partial whole constitutes entire production cycles (Fig. 13) that are repeated until all the materials required by the course are finished.

![Modular course production diagram]

**Fig. 13. Modular course production.**

In a fast publication timetable, an effort is made to acquire user experiences and feedback at as early a phase as possible, so that it is still possible to influence the implementation of the latter part of the course if necessary. This reduces production risks and improves quality through the effectiveness of the feedback that is received.

Agile methods offer only directive principles of action, which are applied by individuals aiming at creative problem solving. Traditional methods often offer binding rules for various situations, and it takes a great deal of time and work to apply them. Agile processes do not involve new process practices, and they emphasize the primary role of people in the success of the project. Planning and development takes place mainly through direct communication between the developers and users, which makes the delivery of information faster and enables quick decisions and changes if necessary. (Highsmith & Cockburn 2001)

Based on the results of the company interviews, some modifications were made to this concept for SME use. These modifications are discussed in chapter 4.3.2.
4.2.3 Conclusion

This chapter answered research question 2: *How were the ICT strategies in learning and teaching implemented at the University of Oulu during the first decade of this century?*

Overall, data on this decade of development demonstrates that the decentralized and networked working model was a good way to use limited resources to generate different development projects. Moreover, the basic decision to target most of the funding to the development work done at the faculty or departmental level helped to create new working practices and cultural change among the teaching staff.

During the research period, there were fast changes in the focus of the funding decisions, which reflected the rapid technical and cultural change during the ten-year period. One important discovery was that during the first four-year period, development initiatives and decisions were made via a top-down process. Subsequently, the organization achieved maturity in its use of new technologies, which was sufficient to enable further pressure for more development, coming from the “bottom up” rather than from the “top down”. During the process of change from the top-down to the bottom-up approach, the same kind of combined mode was formed as de Freitas & Olivier (2005) recommended for organizations. They suggested that most organizations would benefit from a combined approach to e-learning development, mixing top-down and bottom-up policy, strategy and activities that interact and inform one another.

In the area of this research question, one special interest area was represented with a sub-question:

*How the geographically distributed e-learning concept was developed in the development projects during the implementation period?*

In development projects mainly funded by virtual university funding, a model for course production was developed. The second version of this model was the DoPro model. It was developed with FVU for all Finnish universities. Initial experiences in the use of the models were positive, but the ending of the virtual university funding prevented long-term use experiences. However, these production models created a base for the course production part of the geographically distributed e-learning model (Fig. 14).
Fig. 14. Main components of geographically distributed e-learning concept.

The implementation part was added to ensure the concept’s transferability. It was based on the principles of ProAktori models and the University of Oulu’s implementation process experiences. The implementation part of the concept offers guidelines for the organization to implement e-learning in its geographically distributed learning or working environment. It is called “Analyze situation $\rightarrow$ Identify barriers $\rightarrow$ Create strategy / plan for implementation” - thinking model. In a later part of this study, some modifications for SMS use were made to this concept. These modifications are discussed in chapter 4.3.2.

4.3 Research Question 3

This chapter answers research question 3: How could the geographically distributed e-learning concept developed in a university environment be transferred and used in a company environment?

The research process included, as an initial phase, interviews ($n = 30$) with a larger group of companies ($n = 13$). The company interviews concentrated on the communication tools and their use, as communication plays a key role in designing successful e-learning solutions. The results of the interviews provided background information and a starting point for the company case, where the goal was to research implementation of the geographically distributed e-learning concept. In this chapter, results from the company interviews are presented and
then findings from the company case are discussed. Finally, conclusions based on the results are presented.

4.3.1 Company interviews

In the company interviews, the interviewees represented various roles from entrepreneurs to software developers. They all worked in geographically distributed projects and used communication tools to collaborate with their colleagues or customers. The length of a typical interview was 90 minutes. The interviews were also recorded and transcribed by an external party.

Two different researchers listened to the recorded interviews and compared their results with GQM abstract sheets that the interviewer completed during the interviews. The interview data was also collected in the common data sheet, which also made it possible to use some statistical analyses. The findings of the interviews were then compared with the theoretical framework of the literature analysis first executed.

According to company interviews, the use of virtual meeting tools is growing due to high travelling costs and ecological awareness. Companies have also become more aware of lost productivity because of travelling time. However, there was consensus between almost all the interviewees concerning the importance of face-to-face meetings, especially at the beginning of projects. If organizing such meetings was not possible for these organizations, the importance of a communication tool using video became a necessity during the first distributed-project meetings. It was expressed that it is also possible to gain teamness and trust even without face-to-face meetings, but that took much more time. Once these people got to known each other, they needed rich media to support their diminished social interactions.

Interviews results revealed that when using conference tools, the most important feature for the users was the quality of the voice, which, together with document sharing, was enough for most interviewees. Other important features were desktop sharing, ease of use, video picture, and real-time communication.

The most popular communication solution for meetings was online conference tools. Eighty-five percent of interviewed companies used these tools. Videoconferences were not used as commonly as online conference tools; 54 percent of the interviewed companies used videoconferences. The reason seems to be that videoconference equipment is considered expensive and difficult to use. All the interviewees used the telephone, which is so familiar that it was not
recognized as a special communication tool (i.e., on par with videoconferencing). The use of teleconferencing has lost much of its significance, but it still has an important role in situations in which participants are in an environment that is technologically limited or if they travel frequently. Using wikis and blogs has rapidly grown in many areas. Sixty-two percent of the interviewed companies used wikis or blogs in their work; blogs were considered mostly for external communications and wikis for internal communications. Companies using instant messaging (69% of interviewed) were divided into two groups. Some of the companies’ instant messaging tools were used as supplementary tools when, for example, voice connections did not work during online conferences. The other group included companies where instant messaging was the most important tool for internal communication. Instant messaging advantages were real-time communication, knowledge of the user’s state, use culture, and ease of use.

Interviews gave some references that company’s working context. Maturity level also influenced their communication culture and the way companies coordinated their teamwork. The findings suggest that small companies have innovative ways to deal with coordination and communication problems in distributed working environments. The literature yields many more examples of big companies’ solutions than innovative ways to use new tools. The findings suggest that in small companies, the communication practices differ from those used in bigger companies. Reasons for this difference could be both the size of the teams and the size of the staff. A limited number of colleagues enables the use of agile working methods and ad-hoc communication. Coordination was not experienced as difficult in the small companies as in the bigger ones due to the flexible management styles. Communication cultures depended also on the nature of the work assignment. This finding is aligned with the suggestion of media richness theory that different professional tasks are completed more efficiently when task properties and media richness match (Niinimaki et al. 2009).

Most of the interviewees emphasized that companies have to have common communication tools and meeting roles. These roles and tools could vary but the idea was that everybody should be conversant with company policy and follow it. In many companies, there was also a growing tendency to avoid unnecessary meetings.

The company interviews revealed that the main problem in companies was the poor skill level of workers regarding their ability to use communication tools. Small companies could not hire support personnel, and application training was organized only in bigger companies. Personnel did not recognize the value of
such training. Choosing the right communication tools for external communication was another issue. Using many different communication tools led to situations in which none of the tools was used properly. In particular, there were problems with open-source programs. Open-source program manufacturers or distributors did not usually have sufficient support services or help desk services.

4.3.2 Geographically distributed e-learning concept transfer to SME environment

The geographically distributed e-learning concept was modified and completed for SME use based on the company interviews (Fig. 15). The following three points were added to the concept:

- SMEs have limited resources that must be considered when systems are planned.
- User skill levels vary a great deal, which is one of the main identified barriers.
- Only one tool should be used if possible.

Fig. 15. Background of the company case.
The first part of the concept offers guidelines for the organization when it prepares to implement e-learning in its geographically distributed learning or working environment. It is called, “Analyze situation → Identify barriers → Create strategy / plan for implementation- thinking model”.

Table 5. Actions during the first part of the concept’s suggestions.

<table>
<thead>
<tr>
<th>Concept’s suggestions</th>
<th>Company case actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze of needs and environment</td>
<td>Work assignments’ observation</td>
</tr>
<tr>
<td></td>
<td>Personnel interviews</td>
</tr>
<tr>
<td>Identify barriers</td>
<td>Main barriers were identified and listed</td>
</tr>
<tr>
<td>Create implementation plan / strategy</td>
<td>Based on needs and barriers plan was created</td>
</tr>
<tr>
<td></td>
<td>consisting objectives and actions</td>
</tr>
</tbody>
</table>

The company case was begun by observing the face-to-face training sessions in order to find out the company’s needs for training customers. Results of these observation sessions were formulated as the following needs:

- Personal connection between instructor and client
- Motivation
- Distributing material and core knowledge
- Teaching use of the company’s software and how to create needed documentation
- Personal feedback and tutoring

After the needs analysis, we interviewed three of the company’s employees who were responsible for education and development to determine the company’s situation and their expectations. The following barriers to use were mentioned in the interviews:

- Growing number of tools is a problem
- The use of logic in every tool is different
- Many customers have low bandwidth
- Only one out of ten meetings succeeds
- No official support for the users
- Ad hoc meeting procedures
- Tried many free communication software but none fulfilled expectations
- Material is hard to find because there is not one official depository
Based on these baseline results and resources, a new communication tool environment for e-learning was planned for implementation, and the concept for use and training was introduced in April 2010. The modified company case concept proposal included the following principles:

- Only one tool should be used. Our interviews and earlier studies indicated that if many software tools are used to support different aspects of complex learning and teaching processes and if they are not interoperating, it restricts their use. In this case, Adobe Connect Pro (ACP) was selected because it had all the most important features that the SMEs preferred in the first phase interviews.
- Learning material should be modular and include practical sections (e.g., videos) for the most difficult tasks.
- Online learning sessions should be shorter than face-to-face sessions.
- Tutoring and helpdesk services should be included to support customers’ learning.
- Learning materials should be stored in the learning environment for future use.

The company accepted the proposal and started the internal use of the system in its instructors’ meetings. This implementation process was studied by observing these internal meetings and interviewing personnel during the implementation process. The first sign that the internal implementation process was going to succeed was the growing number of staff meetings via Adobe Connect Pro web conference tool (ACP). These meetings were one part of the actions that Roy (2010) described in his first pre-requisite as a need to develop e-learning culture within an organization, where managers and employees are truly motivated and committed to use e-learning. In the first meetings, there were problems with participants’ computer audio setups. After this problem was fixed and all the instructors had headset microphones, the fear and resistance faded fast. One of the main motivating reasons for the system was that participants could stay at home during the meetings, and traveling time was saved. The following list presents the most common comments and barriers to use expressed in the personnel interviews:

- At first there was resistance and fear to change
- Problems with tools and communication
- Meeting culture is problematic
- Knowledge distribution got better
Good for teaching but consulting had to be face-to-face
– We can handle more customers this way
– In an open office, the noise disturbs, you have to have a peaceful environment

The first training sessions started with customers in the autumn of 2010. Most of the instructors had never used e-learning, although they all had experience in face-to-face training. They asked us to observe the first training sessions and give comments. Their first experience was that the lectures with the new medium were weaker than the face-to-face lectures. After the comments, they simplified and made their lecture material modular to support short teaching sessions. Before the change, they usually had whole day face-to-face sessions with customers, and these had to be transformed into smaller teaching sessions.

After the first set of training sessions, the customers and instructors were interviewed (n = 10) about their experiences in the e-learning sessions at the beginning of 2011. As Ertmer (Ertmer 2005) proposed, there is a need to address both the “hard” (technological) and “soft” (staff development) aspects. According to that advice, the interviews were divided into two categories: technology and learning sessions. The main results are presented in Tables 6 and 7. Table 6 presents the technology issues and Table 7 concentrates on the learning sessions.

Table 6. Results of the user (n = 10) interviews on technology issues.

<table>
<thead>
<tr>
<th>Technology issues</th>
<th>What are the most important features?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Can hear the voice</td>
</tr>
<tr>
<td></td>
<td>Can see the shared desktop</td>
</tr>
<tr>
<td></td>
<td>Fast start for the meeting</td>
</tr>
<tr>
<td></td>
<td>Get participants to discuss and see the same document</td>
</tr>
<tr>
<td></td>
<td>Video picture helps becoming acquainted with the trainer</td>
</tr>
<tr>
<td>What is the present state?</td>
<td>Most of the users are happy with the technology and concept</td>
</tr>
<tr>
<td></td>
<td>Most of the problems are connected to the sound, usually in the customer’s computer. These problems are especially difficult with multipoint meetings.</td>
</tr>
<tr>
<td></td>
<td>Low bandwidth incurs problems with speech and picture synchronization</td>
</tr>
<tr>
<td></td>
<td>Technical problems take time away from the meetings. This is frustrating.</td>
</tr>
<tr>
<td>How could you develop the present situation?</td>
<td>Better guides for known difficulties</td>
</tr>
<tr>
<td></td>
<td>Prepare one computer for the sessions and use only that computer</td>
</tr>
<tr>
<td></td>
<td>Make time to open and test the connection before the session</td>
</tr>
<tr>
<td></td>
<td>Buy good headset microphones or table microphones for every participant</td>
</tr>
<tr>
<td></td>
<td>Backup plans for technical problems (e.g., Skype or phone for sound problems)</td>
</tr>
</tbody>
</table>

How should the concept be developed? –
The interview results confirm that the same technical features are important to users and company employees. Most of the users were satisfied with the system after their computer setup was checked. It was discovered that the reason for some of the sound problems was that some of the customers did not have loudspeakers on their computers. Another problem was that people changed computers and the setup was again different. After the first problems were solved, no additional issues were raised by the users. As a result, company expectations for the system were fulfilled. The only expectation not met was the use of video clips. Video clips could not be used during the research period because of company resources.

Table 7. Results of the user (n = 10) interviews about learning sessions.

<table>
<thead>
<tr>
<th>Learning sessions</th>
<th>What are the most important features?</th>
<th>What is the present state?</th>
<th>How could you develop the present situation?</th>
<th>How should the concept be developed?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interaction between participants</td>
<td>Effective because distance communication reduces unimportant communication</td>
<td>More flexible timetables for the sessions</td>
<td>Conclusions of the material could be added to the environment</td>
</tr>
<tr>
<td></td>
<td>Possibility of real-time feedback</td>
<td>As effective as face-to-face sessions</td>
<td>Small videos for the difficult parts</td>
<td>Shorter meetings and more often</td>
</tr>
<tr>
<td></td>
<td>Sharing materials and sceneries assure that everyone has the right material</td>
<td>Problems with timetables and acute questions</td>
<td></td>
<td>Ad hoc training sessions for acute problems</td>
</tr>
<tr>
<td></td>
<td>Trainers examples are important</td>
<td>Social interaction is not at the same level as with face-to-face sessions</td>
<td></td>
<td>Good practices for the address request in multipoint meetings</td>
</tr>
</tbody>
</table>

It was also found in the interview data that the important features were similar to those in earlier company interviews, which shows that the baseline assumptions were right when this concept was modified for the SME use. Most of the interviewees were satisfied with the concept’s effectiveness, and the reason for dissatisfaction was that social interaction was experienced to be inadequate. This can be a sign that meeting rules and working habits should be scrutinized. Overall, the feedback was very positive. The interviewees had just started to use this e-
learning concept and, usually, in this phase the user is confronted with numerous problems.

The company’s expectations could be seen as fulfilled because none of the expectations from the baseline interview existed in the user interview’s “should be developed” list. The company could take care of more customers after they started to use the e-learning concept. According to the company’s manager, who was responsible for this e-learning development project, the company could not have been able to go through the implementation process with these recourses without a ready concept from outside the company.

4.3.3 Conclusion

This chapter answered research question 3: How could the geographically distributed e-learning concept developed in the university environment be transferred and used in a company environment?

Five years ago, when the original version of the geographically distributed e-learning concept was developed in DoPro project, the production and distribution of an e-learning course was expensive and the cost was a barrier to most SMEs (Roy 2010) that could not afford to use e-learning in their business.

However, technology has evolved, and relatively cheap conference tools, good quality web cameras, desktop video capture tools and easy web distribution now make it possible for the SMEs to use and produce e-learning materials with limited recourses and technical skills. Technical quality is usually more than adequate, even for commercial use. Concepts that earlier needed large professional production teams can be transferred and downsized to different environments.

The company case proved the importance of the planning phase before the concept’s implementation. The first part of the geographically distributed e-learning concept offered guidelines for the organization when it prepares to implement e-learning in its geographically distributed learning or working environment. It is called, “Analyze situation → Identify barriers → Create strategy / plan for implementation- thinking model”.

In the company interviews and company case analysis, we found that the main barrier in SMEs was the poor skill level of workers in using communication tools. Small companies could not hire support personnel and application training was only organized in bigger companies. Personnel did not recognize the value of this training. One possible solution for this problem is to connect training to the
internal use of the tool to overcome the fear and resistance, as we did in the company case. The first sign that the internal implementation process was going to succeed was the growing number of staff meetings via ACP after the first training meetings. These meetings were one part of the actions that Roy (2010) described as the first pre-requisite for developing an e-learning culture within an organization, where managers and employees are truly motivated and committed to use e-learning.

In this company case, the geographically distributed e-learning concept was successfully transferred to the SME environment. Furthermore, this case has shown that organizations that are just starting to use e-learning benefit from ready concepts or models. As Roy (2010) noted, many SMEs are still reluctant to use e-learning because of the barriers in adaption or because they do not know where to begin. Ready concepts can act as roadmaps for new users and help them to avoid making unnecessary investments or doing unnecessary work.
5 Summary of the Original Articles

Yin’s (2009, 164) advice is to compose portions of the case study early, rather than waiting until the end of the data analysis process. In this research, eight scientific articles were published and orally presented at scientific conferences. For all of these articles, the publication forum was selected to fulfill an appropriate scientific review process and to reach the kind of audience that was regarded as important from the viewpoint of appropriate feedback. For instance, the earlier papers were published at educational technology conferences targeted at practitioners of e-learning in the higher education environment, whereas later papers were published at forums for experts in distributed working environments.

This chapter presents a summary of the original articles and results. In the first part, the author’s involvement is presented. Table 7 then summarizes author’s contribution to the articles and the contribution of the original articles to the thesis. In the last section, summaries of the original articles are presented.

5.1 Author’s involvement and Contribution to the Results

This dissertation brings together the results of work done in multiple projects and arenas from 2000 to 2010. The real starting point for the author was at the beginning of 2001 when the Department of Information Processing Science received funding for the first regional master’s program in digital media. This was followed by regional master programs in software production (2002), mobile services (2003), and information security (2005). The author first participated in the planning phase of these programs and later worked as project manager and team leader.

These regional programs demanded large-scale digital material production and educational technology support activities. For this purpose, DiVision, the production unit for digital materials in the Department of Information Processing Science at the University of Oulu, was initiated in May 2001. The DiVision production team consisted of eight members with the author as a team leader. During 2004, 335 students were studying outside of the main campus area around northern Finland in six regional centers, and approximately 400 hours of video materials were produced. At this time, the Department of Information Science was one of the leading providers of regional academic instruction in Finland. This fast development was the starting point for the author to develop and research production and support processes. This phase can be seen in the author’s early
publications, which seek results to problems with fast digital material production and distribution in different media forms. This work was first done at the university level (Articles 3, 5–6) and later at the national level (article 4).

In 2000, the University of Oulu founded the Campus Futurus organization to reform and implement a strategy for the educational use of information and communication technology. It also coordinated development projects related to educational technology. Later, it also began to coordinate virtual university activities and represent the University of Oulu in national and international virtual university projects. At the beginning of 2004, the author became manager of Campus Futurus for a three-year period. After that, the author continued in the Campus Futurus management group. These roles gave the author the opportunity to participate in four university-level strategy processes and the Finnish Virtual University’s (FVU) strategy process. The author was also part of the FVU’s strategy consultant team, which consulted other universities in their strategy processes. Part of this work is described in article 1.

Recent work at the Department of Information Science has given the author the opportunity to research the needs and difficulties of companies (article 7) when they use ICT in distributed working and learning environments. It has been rewarding to see how well experiences from the university environment have been utilized in company environments (article 8).

The author was the first of the original articles 2, 3, 4, 7 and 8, and the only writer of the original article 6 presented in this dissertation. Authors of articles 1 and 5 made equal contributions to these articles. A summary of the articles and the author’s role in the articles is presented in Table 8.

Table 8. Summary of contributions and results in this thesis and author’s role in the original articles.

<table>
<thead>
<tr>
<th>Article</th>
<th>Contribution and author’s role</th>
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<tr>
<td>1</td>
<td>Authors of this article had equal contributions to the article. Author of this thesis was a member of FVU’s strategy service group and main SW architect of the tool design.</td>
</tr>
<tr>
<td>Liukkunen, K.; Pohjonen, J. &amp; Sariola, J. (2005): ProAktori: A Management Tool for ICT Strategy Processes in Universities</td>
<td>Article describes national level context of Finnish Virtual University consortium work and presents core models and processes that guided Finnish universities’ the use of ICT in teaching strategy work and its results. Article describes development work and some design principles used when collaborative tool for the universities’ distributed strategy work was developed. Articles 3–6 present examples of the development projects at the national or at the university level that fulfilled these strategy goals. These results are also described in the article 2.</td>
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<tr>
<td>Article</td>
<td>Contribution and author’s role</td>
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<tr>
<td>2</td>
<td>Author was the first writer of this article and had main responsible for research planning, data collection and analyzes. Article presents how traditional campus university executed its strategic plans and implemented the virtual university model. The guiding principles of these strategic plans were presented in original article 1. To overcome the limitations of single case studies, this paper applies a longer and wider perspective to the institutional ICT strategy process and, by the introduction of an overarching method which categorizes the investments, shows more clearly the trends, stages and the barriers of the development. This long term study is based on 116 development projects during the ten-year period in a decentralized and networked development environment.</td>
</tr>
<tr>
<td>3</td>
<td>Author was the first writer of this article and main contributor to the developed production model. Author was also team leader of the DiVision production team and planned the research and did most of the data collection and analyze. Article seeks solution for the production and distribution barriers that were based on mismatch of delivery speed and requirements of digital learning material. As a result it presents production and distribution model for the digital learning material which is cost effective for the organization. This work was part of the strategy implementation process described in the original articles 1 and 2.</td>
</tr>
<tr>
<td>4</td>
<td>Author was the first writer of this article and main contributor to the developed model. Author was scientific leader of DoPro –project. Based on the results presented in the article 3, a production model for the Finnish Universities was developed. Main development idea was that quality of the material could be improved by taking teachers along to the production process. This gave also teachers possibility to the professional development and committed them to the production process results.</td>
</tr>
<tr>
<td>5</td>
<td>Author was project manager of Virtual Campus –project. Authors of this article this article had equal contributions to the article. Mobile devices were seen as an important distribution media and possibility to scaffold students work. This research was launched to understand these needs and ways to work. Article presents main results of this research and gives same time broader picture of how students want to use technology based services to scaffold their work.</td>
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### Article Contribution and author’s role

<table>
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<th>Contribution and author’s role</th>
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<tr>
<td>6</td>
<td>Author was the only writer of this article.</td>
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<tr>
<td>7</td>
<td>Author was the first writer of this article and had main responsible for interviews and analyzes.</td>
</tr>
<tr>
<td>8</td>
<td>Author was the first writer of this article and had main responsible for interviews and analyzes.</td>
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### 5.2 Summary of Article 1


Strategic planning and management have played an important role in Finnish university management systems. The universities have been proactive in drawing...
up general and sector-specific strategies for use in developing their activities and revising their structures. With ICT becoming an ever more important factor in university activities, the universities have also prepared strategies for ICT. Since 2002, all Finnish universities have prepared and implemented strategies for the use of ICT in teaching as part of the Finnish Virtual University concept. Reports made on these strategies reveal that they were often rather weak on implementation and monitoring. A key problem was bridging the gap between strategic objectives and their implementation. Ensuring that the strategic process is measurable helps to define and communicate more precisely the aims and direction of the strategy, thus enabling a bridge to be built between plans and their implementation. The ProAktori model and database tool were created to address this problem. The model was developed particularly to support the formulation, implementation and evaluation of strategies for the use of ICT in teaching at universities. It was piloted at the Universities of Oulu and Helsinki in 2005 and 2006.

Results and Contribution

This article presents core models and processes, the innovation of the strategies, and examples of their use by two universities. In order to understand the environments of the universities, the article also provides a description of the Finnish Virtual University.

The ProAktori model is based on the Balanced Scorecard (Kaplan & Norton 1996, Kaplan et al. 2002) and its Finnish application, the Balanced Success Strategy (Määttä & Ojala 1999). It can be used as an assistive tool in evaluating the formulation of a strategy and the implementation of a completed strategy. The basic ProAktori model was piloted and applied in the strategy processes for ICT use in teaching at the Universities of Helsinki and Oulu. The experiences of both universities in using the ProAktori model were encouraging.

Article 2 presents how these strategies affected development work at the University of Oulu. Articles 3–6 describe work at the project level performed to fulfill the goals of the strategies.
5.3 Summary of Article 2


Strategic thinking, planning and management are crucial elements in the successful adoption of new technologies by all organizations. Strategic readiness presupposes the ability to see the possibilities, the identification of the true needs for change, the setting of clear visions, the implementation of concrete projects, the securing of sufficient resources, and the active management of change. Successful change generates an organizational ethos in which change is both expected and welcomed. In contrast, drifting into experiments that have no clear goals will lead to failures, increased costs, and increased resistance to change. The allocation of fiscal and other resources over time provides a useful road map when exploring the process of strategic change. Hence, this study describes how the University of Oulu executed its ICT strategy in teaching and learning, where the resources were invested, and the main barriers to implementation.

The literature on change management is voluminous, but it is dominated by descriptions of single projects. To overcome the limitations of such case studies, this paper applies a longer and wider perspective to the institutional ICT strategy process and, by the introduction of an overarching method that categorizes the investments, shows more clearly the trends, stages and the barriers of the development. Hence, the paper is based on 116 development projects during a ten-year period in a decentralized and networked development environment. The scope of this study enables the revelation of long-term trends and developments that are hard to notice in short term research.

Results and Contribution

The university is such a large and complex organization that it is very difficult to determine how these technological and cultural changes were actually implemented within individual departments. In this research, the process of change and development was reviewed by assessing 116 financed development projects undertaken over a ten-year period. To present this development process and to show the trends, stages and the barriers to the development, a method for
categorizing project funding was developed. This method simplifies the real life phenomena, but it produces a clearer picture of the development stages and trends.

Overall, this decade of development demonstrated that the decentralized and networked working model was a way to use limited resources to generate different development projects. The basic decision to target most of the funding to the development work done in the faculty or at department level provided an opportunity to create new working practices and cultural change among teaching staff.

During the research period, there were fast changes in the focus of the funding decisions, which reflected the rapid technical and cultural change during the ten-year period. It was discovered that during the first four years period, development initiatives and decisions were made via a “top down” process. After the organization achieved maturity in its use of new technologies, it enabled further pressure for more development to come from the “bottom up”, rather than the “top down”.

The speed of this change and the fast development of technology forced the funding mechanism to react to the development trends. It was possible to respond quite quickly to the changing demands and possibilities because the strategic process was flexible. Furthermore, the funding decisions were made and reviewed frequently each year, which enabled speedy transfer of funds to problem areas.

5.4 **Summary of Article 3**


The rapid development of educational technology and information networks had enhanced the interest in the production of online courses and the possibilities of new learning materials. In the activities of universities, the added value of the use of online courses could be seen in improved prerequisites for regional activities as well as in possibilities to offer flexible study opportunities to students who cannot participate in normal teaching due to work issues or geographic distance. More and more attention was given to the use of the technology and the content of the material that is conveyed with it. However, the universities did not have any clear common production concept for the wide-scope production and delivery of
learning materials although they had already made strategic decisions with regard to starting master programs outside the main campuses.

The number of content creation units was growing in Finnish universities because of increased demand, and it therefore became more and more requisite to promote the good practices and examples of efficient content creation projects. Like many other fast-growing areas, the production methods were developing along with the activities, and usually they were not systematically developed, let alone modeled or researched. This article’s purpose was to fulfill that gap and present a tested model for fast and efficient digital learning material production and distribution for geographically distributed learner groups.

**Results and Contribution**

In course productions, the starting points are provided by the needs of both the students and the institution. The students require high quality. The organization providing the education requires, in addition to quality, fast and cost-efficient production. In production processes, these starting points have guided the operations in technical production to an incremental production process.

The agile type of working method used in the production model was tested by the production team, and it proved to be a highly functional way to work on course production. This model was used as a basis for the further development described in article 4.

According to student surveys done during the years 2001–2003, slow or missing Internet connections were common barriers for the students outside the main campus area. Before fast Internet connections become common, students were ready to sacrifice interaction in order to get technology that is more reliable. This meant that the main interest during that phase was to develop reliable and scalable solutions for material production and distribution.

**5.5 Summary of Article 4**

When faster Internet connections became common and slow or missing Internet connections were no longer barriers to the students, it became time to think more about the quality of the material. For that reason, the DoPro project was launched in December 2004 to develop a joint production model for Finnish universities, which was supported by The Ministry of Education and the Finnish Virtual University. The development and testing of the model were managed by the Department of Information Processing Science at the University of Oulu and the Virtual University Unit at the University of Art and Design, Helsinki. The units were among the largest university production units in Finland and comprised experts in a variety of fields with varied educational backgrounds.

The main idea was that a high-quality production process ensures a high-quality end product. The technical production model described in the article was a base for this development. The main interest was how to get teaching staff to commit to the production and how to ensure enough communication between teaching staff and production unit. A main idea was also to give teaching staff the opportunity for professional development by including them in the whole production process.

Results and Contribution

The development and introduction of the model clarified the activities of the production groups contributing to the experiment. Central goals were the modeling of the groups’ work and removal of the unnecessary phases of work. Modeling and a more streamlined production process helped all the participants to understand the process and the meaning of the various phases of the work. Familiarization with the production process helped to utilize the possibilities offered by the production groups in the design phase and at the same time avoided forms of implementation that waste resources. Including the teacher more closely in the whole production process is necessary for the flow of information and fast decision-making. At the same time, it meant that teachers benefitted in an important way from the viewpoint of professional development because they became familiar with the production work and the opportunities offered by educational technology. Essential for both the students and the university has been the quality assurance built into the model. Because formal design and inspection practices are built into the process before moving on to the next phase of production or to publication, the chosen quality level can be standardized in the various course productions.
Process models derived from software production were validated in the use of the production teams at the University of Oulu and the University of Art and Design. They proved to offer a good basis for the development of online courses in the institutions that participated in the development. The educational organizations need to adjust the existing models according to their principles and goals. Adjustment is accelerated if the organization has access to proven models of action.

5.6 Summary of Article 5


Mobile devices such as mobile telephones, personal digital assistants and laptops, can be viewed as a cognitive tool for supporting learning. They offer new opportunities to learn anytime and anywhere, enabling a transition from occasional, supplemental use to frequent, integral use. Mobile devices enable people to access Internet resources and run experiments in the field, store and manage information, images and sounds, and communicate and share the material with others. The new potential that mobile technology provides teaching and learning is based, in part, on the unique characteristics and capabilities of the technology. However, technology is only a facilitator; more important is how technology is used in educational setting.

The development of mobile services at the University of Oulu was planned in three parts: 1) creation of the infrastructure; 2) modification of existing network services for mobile use; and 3) creation of the real new mobile services. In this connection, the creation of an infrastructure means the construction of a wireless network and the offering of wireless internet services (access services) to university students and staff. A functional wireless network provides the basis for a gradual generalization of the use of wireless terminal devices. At the same time, the users' skills and experiences—as well as their requirements—reach such a level that it becomes possible to build, introduce, and evaluate mobile services. In the second phase, the goal was to determine the essential network services that could be reasonably modified for application by mobile users. At this stage, it was
also important to accumulate experiences about mobility. The overall objective was to understand the limitations of mobile services and to establish the benefits that may be gained from them. The third stage aimed at determining the contents of mobile services and creating services that were targeted specifically at mobile users. This study was launched to understand the needs and working habits of mobile users. Its overall aim was to understand how to enhance the meaningful use of mobile devices in higher education.

Results and Contribution

Article 5 provides an introduction to the theoretical framework of the pedagogical use of mobile devices in a higher education context. In order to design the mobile tools and services, two studies were conducted to evaluate students’ needs. The first study \((n = 715)\) was conducted to explore university students’ conceptions of their needs for mobile tools for scaffolding their learning activities. That study was used also to determine the essential network services that will be modified into a mobile format. The second study \((n = 147)\) was conducted to explore student conceptions of the kind of features the users of the mobile web based learning environment viewed as useful for scaffolding their learning activities.

Information on how to support effective collaboration is essential when designing mobile tools promoting distributed learning and working. Article 5 confirms that the evaluation studies of larger samples of students can be useful for the design of the future learning environments—at least they can give authentic information about the students’ needs and reflect the current pedagogical culture of universities. Based on the results presented in this article, the MobileOptima project was launched to develop the mobile version of the university’s learning environment.

5.7 Summary of Article 6


Throughout the development period, the basic idea was to support student work and learning with a working environment. The first version of the environment
consisted of a local tutor, e-mail, a learning platform, and a video conferencing system. The first developmental phase added digital video. The first distribution method was via CD/DVD. After the students' opportunities for online access had developed sufficiently, it was time for media servers. Technical development and quantitative growth were important to the university. Soon it was found that there was a need for teaching staff to contribute to planning and content production in the working environment. At the same time, new technical solutions were sought to scaffold students' work. Mobile devices were one promising possibility. Applications such as Skype or Messenger made it possible for teachers to consult small student groups. At the same time, these applications also made distributed work a real option for the students. It was possible for students to work on the same problem without having to gather in the same place. Now applications to scaffold distributed work (e.g., Adobe Connect Pro) as well as wikis or blogs are quite normal tools for student groups.

**Results and Contribution**

The plans for the first master’s program environment were made in 2000, and the main purpose was to deliver material to our students in northern Finland and to support their learning by quite traditional means. Student support services and working environments had to be created very quickly. Development work on these environments continued throughout the duration of these master’s programs. Subsequently, it was possible to identify that the major development steps could be represented in four phases. These phases were also the results of development projects launched to support the development of the working environment. The first phase concentrated on efficient distribution of materials and fast material production processes. This was an important issue in the launching of a large-scale geographically distributed educational program with limited personal and time resources. The second phase investigated the possibilities of scaffolding student work with mobile services. The idea of the third phase was to improve the quality of the course materials and services by increasing collaboration between teachers and the production unit staff. The fourth phase is still in progress and concentrates on the implementation of collaborative tools at the university level and on the opportunities offered by Web 2.0.
5.8 Summary of Article 7

Kari Liukkunen, Kai Lindberg, Jarkko Hyysalo and Jouni Markkula (2010)
Supporting collaboration in the geographically distributed work with communication tools in the remote district SMEs. ICGSE 2010

This article demonstrates that the same communication tools are used to support geographically distributed work in small ICT companies as used in the university environment. With new communication technology, it is possible to offer tools for good communication, even in geographically distributed projects. Communication is the most critical issue in collaboration, and in order to achieve successful results, communication must be arranged properly. This article studies the use of communication tools to support geographically distributed work in small ICT companies located in rural areas. Because of the nature of these companies, the article mainly discusses geographically distributed, inter-organizational work. The conclusions are based on the company interviews carried out from 2006 to 2009.

Results and Contribution

According to company interviews, the use of virtual meeting tools is growing due to high travelling costs and ecological awareness. Companies have also become more aware of lost productivity as a result of travelling time.

The key categories of collaboration challenges were identified from the literature and interviews (n = 30) were conducted in 13 companies. It was found that the models created to meet the needs of large international companies are not directly transferable for use by SMEs. Instead, organizations need to adjust their activities according to their own purposes, principles, and goals. Findings suggest that in small companies, the communication practices differ from the practices of bigger companies. Reasons were both the size of the teams and the size of the staff. The fact that a company is situated in a rural area places higher expectations of know-how and quality on these companies, which affects personnel, working environment, and communication needs.

In the early stage, it is usual that companies have very limited resources and knowledge in choosing the right tools to support the new distributed working environment. The company interviews showed that the main problem in companies was the poor skill level of workers regarding their ability to use
communication tools. Small companies could not hire support personnel, and application training was organized only in bigger companies. Personnel did not recognize the value of such training. Choosing the right communication tools for external communication was another issue. Using many different communication tools led to situations in which none of the tools was used properly.

The results of this article form a part of the basis for the company case presented in article 8.

5.9 Summary of Article 8


The key objectives of this article are to determine the main barriers when an SME decides to implement e-learning and whether the university e-learning implementation process helps remove the main barriers to the integration of e-learning solutions in companies. The results are based on the development work done at the University of Oulu during the first decade of this century, company interviews carried out from 2006 to 2009, and one company case between 2009 and 2011. In this company case, the company’s needs were analyzed, and based on this analysis; the e-learning concept was presented. This concept was based on the experiences of the implementation work done in the University of Oulu. The primary objectives of this study was the implementation of the e-learning concept and the determination of whether the concept be transferred from the university environment to the SME environment. This objective was tested with one case company and its customers. The company’s implementation process was observed, and employees and customers were then interviewed.

Results and Contribution

Five years ago, the production and distribution of an e-learning course was expensive, which was a barrier to most SMEs. They could not afford to use e-learning in their business. Technology has evolved since then, and now relatively cheap conference tools (e.g., Adobe Connect Pro, GoToMeeting, or Microsoft Office Live Meeting), good quality web cameras, desktop video capture tools, and
easy web distribution make it possible for SMEs to use and produce e-learning materials with limited recourses and technical skills. The technical quality is usually good enough even for commercial use. Concepts that needed a large professional production team can now be transferred and downsized quite easily to different environments.

This case has proven that organizations that are just starting to use e-learning benefit from ready concepts or models. As Roy (2010) noted, many SMEs remain reluctant to use e-learning because of the barriers in the adaption or they do not know where to begin. However, ready concepts can act as roadmaps for new users and help them avoid unnecessary investments or work. This is especially important for the organizations whose resources are limited.
6 Conclusions

In this chapter, the main results of the research are summarized, and the limitations and further research avenues are discussed.

6.1 Conclusion of the Results

The research process and the results were divided into three parts (Figs. 3 and 7). The research process first focused on the organization’s strategy and its guidance principles for implementation of the strategy. In the second phase, the scope shifted to the implementation process and development projects. In the third phase, the geographically distributed e-learning concept, developed during the research period, was transferred and tested in a company environment. The research questions followed these divisions. The main results and answers to the research questions are presented accordingly.

What was the process and control mechanism behind the ICT strategies in learning and teaching at the University of Oulu during the first decade of this century?

The strategy processes at the University of Oulu followed the principles of the ProActori model. The ProActori model was developed to help Finnish universities to develop ICT strategies in teaching and learning (original article 1). The ProActori model is based on the Balanced Scorecard (Kaplan & Norton 1996, Kaplan et al. 2002) and its Finnish application, the Balanced Success Strategy (Määttä & Ojala 1999). The model and its principles were first piloted at the University of Helsinki and the University of Oulu. After the pilot study, these principles were used during the strategy processes. The ProActori model proved to provide the strategy working group with a clear method of presentation that combines strategic goals, their implementation, and monitoring in a very concrete way.

To avoid implementation difficulties (Sariola & Söderlund 2004, Aaltonen et al. 2001) at the University of Oulu, some special guiding principles for strategy implementation were defined during the strategy process:

– Work is organized in a decentralized networking mode and Campus Futurus will coordinate the work.
Strategy implementation is done through the development projects.

The main part of the work should be done at a faculty or department level.

The university’s day-to-day operations did not get funding.

Three years is the maximum funding period for the development project.

ProAktori model principles and special guiding principles for the strategy implementation formed the guiding mechanisms behind the ICT strategies in learning and teaching at the University of Oulu during the first decade of this century.

How were the ICT strategies in learning and teaching implemented at the University of Oulu during the first decade of this century?

The University of Oulu chose to organize the implementation of the strategy by means of a network model. The center of this network was the Campus Futurus organization, and its main goal was to coordinate and promote educational technology development and virtual university work. To implement ICT strategies in learning and teaching, Campus Futurus used the Ministry of Education’s national virtual university funding. Funding was channeled through the Campus Futurus organization to support faculty and departmental development projects. Funding decisions were made by the Campus Futurus Management Group.

Analysis of the funding decisions, along with those made on the development of the strategic goals, suggests that the implementation of the virtual university environment progressed at the University of Oulu according to the following phases:

- infrastructure building
- resourcing for the new desired working culture
- environments and support services for the new culture and environments

This iterative planning and implementation cycle continued so that when new working culture or environment was established, it created a ground on which the next new cultures and environments could be built. This process created demands for new infrastructure and support services.

During the ten-year period, there were 116 funded development projects. These projects were Campus Futurus’ main tools to implement strategies. To present this development process and to show the trends, stages, and barriers to the development, a method for categorizing project funding was developed.
All 116 project applications were categorized in accordance with the main goals of the projects. These categories reveal the main focus areas of the implementation process in University of Oulu:

- infrastructure (includes basic infrastructure, equipment, video conference, networking and learning environments)
- support and training services (includes user skills and pedagogical training, learning material production and web portals for training purposes)
- course development (funding for course development projects done in faculties)
- mobility and wireless (piloting projects)
- social media (piloting projects and new working culture development)

During the research period, there were fast changes in the focus of the funding decisions, which reflected the rapid technical and cultural change during the ten-year period (Fig. 11).

One discovery made during the first four-year period was that development initiatives and decisions were made via a top-down process. When the organization achieved maturity in its use of new technologies, it enabled further pressure for more development to come from the “bottom up”, rather than from the “top down”. During the process of change from the top-down to bottom-up approach, the same kind of combined mode was formed that de Freitas and Olivier (2005) recommended for organizations. They suggested that most organizations would benefit from a combined approach to e-learning development, mixing top-down and bottom-up policy, strategy and activities that interact and inform one another.

Overall, this decade of development demonstrated that the decentralized and networked working model was a good way to use limited resources to generate different development projects. The basic decision to apply most of the funding to the development work done at the faculty or departmental level also helped to create new working practices and cultural change among the teaching staff.

In the area of the research question, one special interest areas was represented by a sub question:

*How was the geographically distributed e-learning concept developed by the development projects during the implementation period?*

The course production model was developed by the development projects, which were mainly supported by virtual university funding. The second version of this
model was called the DoPro model. It was developed with FVU for all Finnish universities. These production models created the basis for the course production part of the geographically distributed e-learning model. The implementation part was added to ensure the concept’s transferability. It was based on the principles of the ProAktori model and experiences in the University of Oulu’s implementation process. The implementation part of the concept offers guidelines for the organization when it implements e-learning in its geographically distributed learning or working environment. It is called the “Analyze situation → Identify barriers → Create strategy / plan for implementation- thinking model”.

The first part of this model is used to analyze the organization’s situation, goals, challenges, and resources. These all should be concrete and connected to e-learning implementation. In this thinking model, barrier identification plays an important role. Organization analysis provides material for barrier identification and for the actions and resources to overcome the identified barriers. If barriers are wrongly identified or some important barriers are not noticed, the actions, defined in implementation plan, are focused on the wrong targets. This leads to inefficient or partly failed implementation.

The guiding principles of the developed production model are the following:

- Iterative production
- Modular structure
- Continuous feedback
- Agility
- Tutoring
- Recorded lectures
- Material for long term use
- Web based distribution

This basic concept was modified for SMS use in the company case. These modifications are discussed in the following section.

*How could the geographically distributed e-learning concept developed in the university environment be transferred and used in a company environment?*

Five years ago, when the original version of the geographically distributed e-learning concept was developed in the DoPro project, the production and
distribution of an e-learning course was expensive, which was a barrier for most SMEs (Roy 2010) that could not afford to use e-learning in their business.

Technology has evolved and relatively cheap conference tools, good quality web cameras, desktop video capture tools, and easy web distribution now make it possible for SMEs to use and produce e-learning materials with limited resources and technical skills. The technical quality is usually good enough, even for commercial use. Concepts that needed large professional production teams can now be transferred and downsized to use in different environments.

In the company case, the geographically distributed e-learning concept’s implementation was used as it was designed. The course production part was modified based on company interviews and observations. The basic principles of the concepts did not change. The modified company case concept proposal included the following principles:

– Only one tool should be used.
– Learning material should be modular and include practical sections (e.g., videos) for the most difficult tasks.
– Online learning sessions should be shorter than face-to-face sessions.
– Tutoring and helpdesk services should be included to support customers’ learning.
– Learning material should be stored in the learning environment for future use.

User and staff interviews proved that, in this company case, the geographically distributed e-learning concept was successfully transferred to the SME environment. The case also showed that organizations that are just starting to use e-learning can benefit from ready concepts or models. As Roy (2010) noted, many SMEs remain reluctant to use e-learning because of barriers to adoption or because they do not know where to begin. Ready concepts can act as roadmaps for new users and help to avoid unnecessary investments or work, which is particularly important for organizations where resources are limited.

6.2 Validity and Reliability of the Research

According to Yin (2009), four tests have been commonly used to establish the quality of any empirical social research. These tests are construct validity, internal validity, external validity, and reliability. Because the case studies and action research used in this thesis are forms of empirical social research, the following tests were used to consider validity and reliability. In addition, because most of
the research work was a case study, the recommended case study tactics are used in the tests. The test results are shown in Table 9.

Table 9. Case study tactics for four tests.

<table>
<thead>
<tr>
<th>Test</th>
<th>Case study tactic</th>
<th>Implementation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct validity</td>
<td>Use multiple sources of evidence</td>
<td>Documentation</td>
<td>Section 3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Archival records</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Interviews</td>
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<td></td>
<td>Direct observations</td>
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<td></td>
<td></td>
<td>Participant-observations</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Surveys</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish chain of evidence</td>
<td>Publication process of original articles 1–8</td>
<td>Section 5</td>
</tr>
<tr>
<td></td>
<td>Have key informants review draft case study report</td>
<td>Publication process of original articles 1–6</td>
<td>Table 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Company approval before publishing articles 7–8</td>
<td></td>
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<tr>
<td>Internal validity</td>
<td>Pattern-matching</td>
<td>Pattern-matching</td>
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</tr>
<tr>
<td></td>
<td>Explanation building</td>
<td>Explanation building</td>
<td>Articles 2, 6 and 8</td>
</tr>
<tr>
<td></td>
<td>Addressing rival explanations</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Logic models</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>External validity</td>
<td>Use theory in single studies</td>
<td>Use theory in single studies</td>
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<tr>
<td></td>
<td>Use replication logic in multiple-case studies</td>
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<td>Reliability</td>
<td>Use case study protocol</td>
<td>Data collection methods</td>
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<tr>
<td></td>
<td>Develop case study</td>
<td>Source of evidence</td>
<td>Section 3.1</td>
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<tr>
<td></td>
<td>database</td>
<td>Evidence database</td>
<td>Section 3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Articles 1–8</td>
<td>Section 5</td>
</tr>
</tbody>
</table>

To secure the construct validity of all parts of this research, methodological triangulation was applied by combining several data collection methods. Triangulation of the data sources was applied by comparing the documentation from different parts of the research process and the perspectives of the people interviewed (Runeson & Höst 2009, Yin 2009). The construct validity was also ensured by publishing reviewed articles in scientific forums throughout the research process. The continuous publication process gave continuous feedback about the validity and importance of the research. These publications also established a chain of evidence and gave key informants a way to review the
results. In the company cases, articles were reviewed by the participating companies, which as Yin (2009) suggests, is a validating procedure.

Internal validity can be strengthened if patterns coincide when the pattern matching technique is used. In such cases, the empirically based pattern is compared with a predicted one (Yin 2009). These kinds of predictions were made when new models were developed in this thesis. In the ProActori case, the course production model development case, the DoPro case, the strategy implementation case, and the geographically distributed e-learning case, concept predictions were made based on positive outcome results. In these cases, the predicted outcomes that models would affect positively the working context coincided with predicted outcomes.

External validity deals with the problem of knowing whether study findings are generalizable beyond the immediate case study (Yin 2009, Wohlin et al. 2000). Case studies rely on analytic generalization. In analytical generalization, results are generalized to a broader theory (Runeson & Höst 2009). It would be good if this generalization could be tested by replicating the findings. In this research, the distributed e-learning concept was used in two different environments, so it is possible to say the findings were replicated.

Reliability in a case study can be determined if another researcher can conduct the same research and achieve the same results (Runeson & Höst 2009). Thus, the research procedure should be documented. In this research, documentation was done through the publishing process.

The researcher’s role as a manager of Campus Futurus and member of the management group provided access to many confidential data sources that could not otherwise have been reached, which greatly enriched the material used in the analysis. On the other hand, the researcher’s close connection to the research material could be considered a factor of bias. To avoid bias in the university case, analysis was done by two researchers with backgrounds in two different disciplines (education and information processing science). Categorization and analysis results were also reviewed by an external researcher.

6.3 Limitations of the Research

This thesis has some limitations. In the university context, many external development projects were undertaken outside of these officially financed development projects during the decade reviewed by this thesis. These external development projects could not be included in this research because they usually
were not reported formally, and the work done in these projects could not be analyzed.

A method based on funding decisions was used to reveal how the implementation process was achieved in 116 development projects. The method simplified the real life phenomena and left out some minor phenomena, but such simplification enables a clearer picture of the development stages and trends.

In the company context, it was not possible to work with more than one company. It would have been desirable to have more company cases to validate the research findings, but it was not possible during this research. However, this limitation allowed the researcher to concentrate on the single company case for a longer time and use more resources for the data collection. The time for the pilot study and the data collection was extended as long as possible from 2009 to 2011. Moreover, the data collection used multiple data sources and data source triangulation.

6.4 Recommendations for Further Research

The results of this study both indicate a need and offer a good base for further study. In particular, further research is needed to explore the generalizability of the findings. Proposals for further research can be divided into two categories according to the research environments.

As previously noted, because strategies are value choices, it not possible to rank them. One way to evaluate them, however, is to examine the implementation process and its effect on the organization. Universities are large and complex organizations, so it is very difficult to determine how technological and cultural changes are actually implemented. Moreover, strategic management is organic and changes over time, responding flexibly to changing circumstances and outcomes. The literature on change management is voluminous, but it is dominated by descriptions of single short-term projects. To overcome the limitations of such case studies, this study applied a longer and wider perspective to the institutional ICT strategy process and its implementation. To explore the generalizability of the results, it is important to have long-term research results from other institutes of higher education. Another issue might be the methodology used in this study, which categorizes the investments and shows the trends, stages, and barriers to the development. In this case, it served well, but more examples of its use are needed.
Because it was not possible to work on more than one company, more research is needed on a larger number of company cases to validate the findings and conclusions. Many different factors (e.g., pedagogy, technology, and organization) interact to affect the results of the e-learning concept’s transfer and use, so it is impossible to include all of them in one research. Therefore, further research is needed on the implementation of the e-learning model in company environments. Furthermore, cases of this kind need longer research terms to determine how these concepts evolve during long-term use.
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