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**MANAGING STRATEGIC CHANGE:
New Business Models Applying Wireless
Technology as a Source of Competitive Edge**

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ABSTRACT

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The diffusion of mobile telephony began in 1971 in Finland, when the first car phones, called ARP¹ were taken to use. Technologies changed from ARP to NMT and later to GSM. The main application of the technology, however, was voice transfer. The birth of the Internet created an open public data network and easy access to other types of computer-based services over networks. Telephones had been used as modems, but the development of the cellular technologies enabled automatic access from mobile phones to Internet. Also other wireless technologies, for instance Wireless LANs, were also introduced. Telephony had developed from analog to digital in fixed networks and allowed easy integration of fixed and mobile networks. This development opened a completely new functionality to computers and mobile phones. It also initiated the merger of the information technology (IT) and telecommunication (TC) industries. Despite the arising opportunity for firms' new competition the applications based on the new functionality were rare. Furthermore, technology development combined with innovation can be disruptive to industries.

This research focuses on the new technology's impact on competition in the ICT industry through understanding the strategic needs and alternative futures of the industry's customers. The change speed in the ICT industry is high and therefore it was valuable to integrate the Dynamic Capability view of the firm in this research. Dynamic capabilities are an application of the Resource-Based View (RBV) of the firm. As is stated in the literature, strategic positioning complements RBV. This theoretical framework leads the research to focus on three areas: customer strategic innovation and business model development, external future analysis, and process development combining these two. The theoretical contribution of the research is in the development of methodology integrating theories of the RBV, dynamic capabilities and strategic positioning.

The research approach has been constructive due to the actual managerial problems initiating the study. The requirement for iterative and innovative progress in the research supported the chosen research approach. The study applies known methods in product development, for instance, innovation process in the Group Decision Support Systems (GDSS) laboratory and Quality Function Deployment (QFD), and combines them with known strategy analysis tools like industry analysis and scenario method. As the main result, the thesis presents the strategic innovation process, where new business concepts are used to describe the alternative resource configurations and scenarios as alternative competitive environments, which can be a new way for firms to achieve competitive advantage in high-velocity markets. In addition to the strategic innovation process as a result, the study has also resulted in approximately 250 new innovations for the participating firms, reduced technology uncertainty and helped strategic infrastructural decisions in the firms, and produced a knowledge-bank including data from 43 ICT and 19 paper industry firms between the years 1999 – 2004. The methods presented in this research are also applicable to other industries.

Keywords: strategy formulation, innovation, management, technology, business model

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¹ ARP is an abbreviation of Autoradio puhelin (Car radio phone).

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Rautjärvi, June 23rd 2005

Petteri Laaksonen

TERMINOLOGY AND ABBREVIATIONS

The definitions clearly linking with theory framework development have been defined in chapter The Theoretical Framework of the Research.

Internet

The Internet is a technology as well as a wide variety of applications. In this dissertation the Internet² refers specifically to the DARPA Internet and the TCP/IP protocols it uses. The Internet is a collection of packet-switching networks and routers that uses the TCP/IP protocol suit and functions as a single, cooperative virtual network. This global web connects more than one million computers.

Wireless technologies

Wireless technologies are telecommunications in which infra-red, radio, or other electromagnetic waves, rather than some form of wire, carry the signal over part or the entire communication path. It is also a type of networking technology using such electromagnetic waves to transmit data.³

Mobile technologies

Mobile technologies contain wireless technologies and also compatible terminal technologies and supporting services.

Mobile Internet

Mobile Internet refers to available mobile technologies allowing wireless Internet usage. Those technologies include mobile terminal and access network technologies as well as related services. The Mobile Internet market refers to the emerging market of the wireless technologies and services.

Mobile phone

Mobile phone is a device which behaves as a normal telephone whilst being able to move over a wide area. Mobile phones allow connections to be made to the telephone network, normally by directly dialing the other party's number on an inbuilt keypad. Most current mobile phones use a combination of radio wave transmission and conventional telephone circuit switching, although packet switching is already in use for some parts of networks.

Cellular

Cellular refers to the name given to the original concept of dividing a large geographic area into smaller coverage areas called cells. Each cell handles calls on different channels and communicates with the central processing unit, called a switch, or terminal, to facilitate the handing-off of calls from one cell to another as a user moves through the system. Cellular Telephony is currently used in hundreds of countries worldwide and boasts more than 200 million subscribers.⁴

Network operator

Network operator is a telecom or communication service provider who hold own production facilities (i.e. network), and offers the customers data or voice transfer services.

² dssresources.com/glossary/dssglossary1999.html .

³ www.chin.gc.ca/English/Digital_Content/Tip_Sheets/Wireless/glossary.html

⁴ www.braddye.com/glossary.html

Service operator

Service operator is a telecom or communication service provider who does not own the production facilities (i.e. network), but offers the customer service and service packages on top of the network operators infrastructure.

Regulator

Regulator is an official responsible for control and supervision of a particular activity or area of public interest.⁵

WLAN

Wireless-LAN or WLAN is an abbreviation of Wireless Local Area Network. WLAN is operating in the 2.4 GHz and 5.8 GHz unlicensed ISM bands. Using of the spread spectrum technology is presently under development. It is expected that data rates of 1 Mbps and 10 Mbps can be achieved at 2.4 GHz and 5.8 GHz, respectively. A WLAN standard operating at 2.4 GHz (IEEE 802.11) is being defined (with four different versions). European countries are developing an alternative standard (HIPERLAN) for 10 Mbps transmission, using the 5.8 GHz band.⁶

NMT

NMT is an abbreviation for Nordic Mobile Telephone. It was one of the earliest 1G cellular networks developed jointly in Denmark, Finland, Iceland, Norway and Sweden. The network was originally operated in the 450 MHz band. Later the 900 MHz was used as well.⁷

GSM

The Global System for Mobile communications (GSM), is the most widely used digital mobile phone system. Originally it was defined as a pan-European open standard for a digital cellular telephone network to support voice, data, text messaging and cross-border roaming. GSM is now one of the world's main 2G digital wireless standards. GSM is present in more than 160 countries and according to the GSM Association, accounts for approximately 70 percent of the total digital cellular wireless market. GSM is a time division multiplex (TDM) system. The system is implemented on 800, 900, 1800 and 1900 MHz.⁸

SMS

SMS is a Short Message Service. It is available on digital GSM networks allowing text messages of up to 160 characters to be sent and received via the network operator's message center on a mobile phone, or on the Internet, using a so-called "SMS gateway" website. If the phone is powered off or out of range, messages are stored in the network and delivered at the next opportunity.⁹

GPRS

GPRS is an abbreviation for General Packet Radio Service. It is a radio technology for GSM networks that adds packet-switching protocols, shorter set-up time for ISP connections, and offers the possibility to charge by the amount of data sent rather than connect time. GPRS promises to support flexible data transmission rates typically up to 20 or 30 Kbps (with a theoretical maximum of 171.2 Kbps), as well as continuous connection to the network. A 2.5G enhancement to GSM, GPRS is the most significant

⁵ www.cogsci.princeton.edu/cgi-bin/webwn

⁶ www.commsglossary.com/w.html

⁷ www.polyphonic-ringtones-ring-tones.co.uk/glossary.html

⁸ www.polyphonic-ringtones-ring-tones.co.uk/glossary.html

⁹ www.symbian.com/technology/glossary.html

step towards 3G, needing a similar business model, and service and network architectures. GPRS started to appear in some networks during 2000.¹⁰

EDGE

Enhanced Data rates for Global Evolution (EDGE) is a digital mobile phone technology which acts as a bolt-on enhancement to 2G and 2.5G (GPRS) networks. EDGE technology is working in TDMA and GSM networks. EDGE is a superset to GPRS and can function on any network with GPRS deployed on it (provided the carrier implements the necessary upgrades).¹¹

UMTS

UMTS is an abbreviation for Universal Mobile Telecommunications System. UMTS is a third generation standard with a data capacity of up to 2 Mbit/s, 35 times faster than an ordinary 56k modem and standard telephone line. It is based on the world's most frequently used mobile telephony standard, GSM. In various countries, several mobile operators have paid substantial sums for UMTS licensees. These operators hope that UMTS will enable them to launch a range of new interactive multimedia-based services, such as video conferencing, video on demand, and online route directions.¹²

WAP

Wireless Application Protocol (WAP) is an open international standard for applications that use wireless communication, for example Internet access on a mobile phone. WAP was designed to provide services equivalent to a Web browser with some mobile-specific additions, being specifically designed to address the limitations of very small portable devices. However, during its first years of existence WAP suffered from considerable negative media attention and has been criticized heavily for it.¹³

RFID

RFID is an abbreviation for radio frequency identification. It refers to the technology that uses devices attached to objects that transmit data to an RFID receiver. These devices can be large pieces of hardware the size of a small book like those attached to ocean containers or very small devices inserted into a label on a package. The advantages of RFID over bar codes are that it is to hold more data and to change the stored data as processing occurs, it does not require line-of-sight to transfer data and is very effective in harsh environments where bar code labels do not work.¹⁴

¹⁰ www.polyphonic-ringtones-ring-tones.co.uk/glossary.html

¹¹ en.wikipedia.org/wiki/EDGE

¹² wireless-dictionary.rtx.dk/

¹³ en.wikipedia.org/wiki/WAP

¹⁴ accuracybook.com/glossary.htm

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1. **Laaksonen, P., Edelmann, J., Suikki, P.** (2001)

Customer Need Assessment Of Wireless E-Business Applications In Paper Industry. Published in the proceedings of The Australian and New Zealand Marketing Academy Conference, ANZMAC, 1–5 December 2001. Auckland, New Zealand.

2. **Laaksonen, P., Edelmann, J.** (2002)

New Business Concepts and Efficiency Improvement in Paper Industry by Wireless E-Business Applications. Published in the proceedings of International Technology and Strategy Forum, 15–16 October 2002. Berkeley, USA.

3. **Laaksonen, P., Kärkkäinen, H., Koivuniemi, J., Tuominen, M.** (2003)¹⁵

Firms' Wireless Application Needs Assessment in Technology Selection. Published in the proceedings of the 12th International Conference on Management of Technology, IAMOT 2003, May 13–15, 2003. Nancy, France.

4. **Laaksonen, P., Puumalainen, K., Suojapelto, K., Tervonen, A.** (2003)

Players in the Emerging Mobile Internet. Published in the proceedings of the 12th International Conference on Management of Technology, IAMOT 2003, May 13–15, 2003. Nancy, France.

5. **Laaksonen, P., Bergman, J.-P., Tervonen, A., Puumalainen, K., Suojapelto, K.** (2003)

Foresight into the Mobile Internet Game. Published in the proceedings of the 8th Summit on Mobile Multimedia and Communications, MOMUC 2003, October 6–8, 2003. Munich, Germany.

6. **Laaksonen, P., Bergman, J.-P., Edelmann, J.** (2004)

Managing Change — Strategic Innovation. Published in the proceedings of Portland International Center for Management of Engineering and Technology Symposia PICMET '04. 1–4 August, 2004. Seoul, South-Korea.

¹⁵ Article will be published in book: "Management of Technology: Key Success Factors for Innovation and Sustainable Development", 2005 by Elsevier Ltd, Kidlington, Oxford, UK.

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1 INTRODUCTION

The diffusion of mobile telephony began in Finland already in 1971 with ARP¹⁶ telephones (Turpeinen 1996). Technologies changed from manually operated ARP to automatic but analog NMT¹⁷ and later to digital GSM. The main application in the mobile telephony network until the year 2000 was voice transfer. The birth of the Internet created open public data network and easy access to other types of services over networks. The development of radio technology enabled automatic access from mobile phones to the Internet. Other competing access technologies, for instance Wireless LANs, were also introduced from the computer networking industry. This opened the road for the merger of the information technology (IT) and telecommunication (TC) industries (Kangas 2003a).

The combined impact of technology and innovation is held as a source of “creative destruction” of industries. The development of technology creates alternating periods of stability and change in firms, since the firm’s technology can develop either in disruptive or sustaining ways. Firms can experience these changes as either a threat or opportunity. (Christensen 2000; Porter 1980; Schumpeter 1934). In cases where technology is disruptive for the firm’s future and the speed of change is high strategic change is needed. Strategic change can be understood as “descriptive of magnitude of alteration in, for example, the culture, structure, product market and geographic positioning of the firm, recognizing the second-order, or multiple consequences, of any such changes and, of course, the transparent linkages between firms and their sectoral, market economic contexts.” (Pettigrew 1987).

The correct positioning of the firms products on the market is a way of achieving competitive edge (Porter 1979; Porter 1980). On the other hand new resource configurations have been proved to be sources of competitive edge (Wernerfelt 1984), (Barney 1991; Barney 1997; Barney, Wright, & Ketchen 2001). Teece et al (1997) noted that in rapidly changing environment organizational and managerial processes, specific asset positions and path dependencies enable firms to achieve new and innovative forms of competitive advantage. Teece (2003) defines these dynamic capabilities as the skills to shape, reshape, configure, and reconfigure portfolios of assets and competencies so that the firm responds to changing technologies and markets to serve changing customer needs.

Decision-making has become increasingly difficult due to speed requirements and the fast changing competitive environment, and in a turbulent and unpredictable business environment it requires understanding the opportunities embedded in uncertain futures. The firm’s overall performance often depends on how it implements numerous business processes to actually produce through these new resource configurations products and services, which finally compete in markets. (Porter 1985a; Ray, Barney, & Muhanna 2004).

Therefore, the focus in today’s strategy formulation should be less in the organization or the actions, but more in the clarity of the direction, flexibility, and agility for rapid and profound changes, and especially the correct timing of actions (Eisenhardt & Martin 2000; Grant 2003; McGrath & Nerkar 2004; Porter 1980; Prahalad & Hamel 1990). Understanding the need for strategic change and executing the changes becomes a source of competitive edge (Chesbrough 2003; Hamel & Välikangas 2003; Mintzberg, Quinn, & Ghoshal 1998).

Competition between firms actually takes place between business concepts, which are different types of resource configurations. Innovation is a process by which the firm “creates purposeful, focused change in an enterprise’s economic or social potential way of creating alternatives for investments.” (Drucker 2002). In strategy formulation innovation of strategic alternatives as strategic options lets

¹⁶ ARP is an abbreviation for Autoradio puhelin (Car radio phone).

¹⁷ NMT network was taken into use in Finland on the 1st of March 1982 (Turpeinen 1996).

the management of the firm decide upon timing of the change. Therefore strategic innovation creates flexibility in the rapidly changing competitive environment. (Bowman & Hurry 1993).

Innovation processes create ideas, which can be cultivated into investment opportunities to be decided upon. Ideas do not create value, but decisions on right investments; and the management does not decide on ideas, but on investments in business models. The more thoroughly the idea has been described, the easier the decision will be. For the evaluation of alternative investment opportunities, it is very important to understand future customer needs and customer benefits as well as the technology's impact on drivers steering the investments. For the firm, this means focusing on customers' future strategic challenges and opportunities, and turning them into own opportunities supporting the success of the customer. The innovation process should also involve the strategic partners from suppliers, customers, and in some cases even competitors. Technology enables economical solutions to customer needs, and in some cases new solutions can be radical from the existing solution's point of view.

Earlier the focus in business management has been in maintaining the competitive edge by defending the positioning in the markets (Porter 1985a) and the incremental efficiency improvement of the existing business model. Due to rapid changes in external competition and customer requirements, also reflecting in internal competencies, the best defense can be achieved by continuous innovations.

Whipp et al. (1987) map the strategy research on to three broad classes of variables: the inner context refers to the structure, corporate culture, and political context of the firm; the outer context refers to the economic, business, political and societal formations in which firms must operate; and the process of change refers to the actions, reactions and interactions in the various interested parties as they seek to move the firm from its present to its future state. The three variables answer broadly the three strategic questions: what, why, and how. The what addresses the content, the why the change to inner and outer context, and the how the analysis of processes. The word change obviously includes timing, i.e., the question when. As a conclusion, it is important to find a balance between shaping and reshaping, and this requires understanding to balance between the what, why and how.

In the emerging ICT market technologies, services, standards, regulation as well as the customer requirements in the main markets differ from each other, and development can be disruptive to players in the business (Christensen 2000; Porter 1980). New market growth in firms in the ICT industry could come from radical new business processes enabled by the new technologies in their customer industries.

This study concentrates on the impact of technological development on firms, consequent changes in competition, and evident needs for strategic changes in firms as a result (Chesbrough 2003; Christensen 2000; Hamel & Välikangas 2003; Porter 2001; Teece 2003). The focus of the research has been on competitive changes in the ICT industry due to changes in customers' business models. As a case technology, the study concentrates on the wireless technology's impact on firms' business models. The theoretical framework combines the market positioning and resource-based view by strategic innovation.

As a result, the dissertation offers new methods for strategy formulation in turbulent times. The research is divided into content and outer-context (industrial players and change forces, market changes, technology change), content and inner-context (customer need and benefits) and process (new strategy process by triangulation of methods). The study is on the leading firms in two global industries, the paper industry and the information and communication technology (ICT) industry. This focus was chosen to understand the larger extent of the changes in the value creation and capture of industries in particular from the ICT industry's point of view. In this context the paper industry presents an important customer industry. The academic contribution of the research can be found in linking the industrial (content-external context) theories in competence and internal process theories resulting in new practical applications of the methods.

1.1 Background

In Finland the wireless technology's impact on business models of different industries was foreseeable already by the end of the 1990's. Even though the adoption of mobile voice and SMS had reached their near maximum, at the turn of the century it seemed merely a starting point for a new era of wireless technologies. The rapid growth of GSM penetration measured by the number of users ended around the year 1997. In Finland the penetration rate for mobile voice was 66.7% in 1999. The estimated mature penetration rate will level around 92% in 2007 (Frank 2003). The hard competition enabled by new regulation, however, increased price competition. This stopped the revenue growth of the Finnish telecom operators in 2001. The first growth period of cellular services was based mainly on mobile voice and SMS. Device manufacturers and telecom operators pushed new technology to the market in order to generate new growth. The users and technology, however, were not ready for market launch for the Mobile Internet, resulting in a loss of credibility in front of the customers¹⁸.

It was still foreseeable that the rapid development of technology and performance¹⁹ would solve the problems in the near future. New technologies and innovative applications of technology would increase uncertainty for existing business models of the telecom operators. For instance, the introduction of GPRS in cellular networks created a discontinuity for SMS messages because the price of the text²⁰ sent over GPRS was less than one tenth of the price of an SMS message (Laaksonen et al. 2002). The same threat was emerging with Internet calls over GPRS. For operators, even though the volume of data increased fast, the unit prices went down faster. The telecom operators' old business model was losing its resilience. Similarly, new technologies would challenge many industries' present value networks and value creation, and could be destructive for complete industries. On the other hand new technologies could offer great opportunity, if new business models to serve customers were discovered.

The paper industry has been strong in Finland for over hundred years. It was one of the first international and global Finnish industries. Over time, the paper industry has managed to respond to competition by improving the efficiency of its business models (Elfvengren et al. 2005). New ICT technologies and emerging services created a visible threat to the paper industry. For instance, the printed media would be under heavy pressure by the electronic media (Härmälä 2001).

High penetration of the Internet and cellular telephony in Finland made good ground for the adoption of new radical applications utilizing wireless technologies enabling completely new business models. On the other hand, there are several factors affecting the adopters' readiness really to invest in new technological applications. For instance, global political and institutional changes (like regulation and trade agreements), infrastructural level changes (introduction of EDGE or UMTS), technology standards, user approval and benefits, knowledge and learning, and return on investment of the alternatives are important in order to evaluate the direction, speed and depth of the change. In order to evaluate the emerging technology's broad impact on the firm's competitive environment, it is important to look at these different change drivers simultaneously.

1.1.1 Institutional Drivers

The difference between the regulation of the operator industry²¹, and the free competition on the Internet and the computer industry have had a great impact on the competition in industries on the national level (USA, EU, Japan) as well as on the global level. The cellular markets were formed through political decisions which led into differences in the regulation of the business between

¹⁸ For instance WAP.

¹⁹ Moore's law is an empirical observation stating, that at our rate of technological development and advances in the semiconductor industry, the complexity of integrated circuits doubles every 18 months.

²⁰ The maximum size for one SMS message is 160 characters.

²¹ For instance radio spectrum for cellular services.

markets. Finally, cellular business developed into three markets, which differed from each other in technology standards, value creation, value capture, and culture.

The objective of the regulation of the cellular market in the USA was to create a competitive environment for the firms operating in the markets; technology was considered a parameter in the competition. The regulation of the market led the mobile operators in the USA to invest in incompatible network technologies. Due to different cellular standards and the regulator's license requirements, the mobile networks have not achieved the same level of interoperability, ubiquity and reliability as in Europe. The industry and national interest also play an important role and have a great impact on the regulator's decisions in the USA.

Within the European Union, regulation of the cellular market is concentrated on equal rights and opportunities from the user's point of view. This standpoint of the regulation in the market derives from the social equality of people and differs from the American regulation. In the EU, GSM standard was chosen as the platform within which all the players had to compete. This decision gave an advantage to the European equipment manufacturers, like Nokia and Ericsson, because they had chosen GSM as their standard and developed their skills around the standard. Consequently, the usability of the services achieved rapidly a high level due to the compatibility of different handsets and networks. The open competition, however, did not take place in telecom operator business, due to national interests especially in France and Germany, and this caused many problems for the operators pursuing internationalization. The radio spectrum auction and huge prices for licenses in Europe in the year 2000 finally spoiled the market and drained the operators' balance sheets for years, driving the whole industry in recession.

In Japan the regulation guaranteed the operators' position as a gate-keeper in the cellular business. This formed the value chain differently, and allowed the operators to build trouble-free inexpensive services, like the i-mode²² and its successors. Technology competition was allowed, but the operators made sure that services were reliable and easy to use. Despite, for instance, the i-mode's success in Japan, it was not transferable to Europe or the USA due to different market structures and cultures. The regulation also left firms operating in different markets in different positions from the points of view of value creation and power.

While cellular telephony and telecom industry were strictly regulated, the Internet and computer industry were at the same time lightly or not at all regulated. This was partly due to the national interest of the USA: it had been the leading market in computer and Internet based technologies and applications. The Internet was developed in the USA in the 1960's. The invention of hypertext²³ and browser²⁴ gave the Internet the growth boost. In the USA governments actions endorsing investments and tax relief for E-Commerce (Porter 2001), further encouraged the diffusion of the Internet innovations and strengthened the leading position of the American firms in the Internet technology.

The merger of the two industries, information technology (IT) and telecommunication (TC) industries was foreseeable due to the development of wireless technologies. For the lead market for cellular

²² With an i-mode phone display, you can get information from i-mode Menu Sites (Programs) and Internet sites that are i-mode compatible, and can exchange i-mode mail. Simple and inexpensive operation is available all over Japan. (Source: http://www.nttdocomo.co.jp/english/p_s/imode/).

²³ A way of presenting information in which text, sounds, images, and actions are linked together in a way that allows you to move between them in whatever order you choose. Hypertext usually refers to any text available on the World Wide Web that contains links to other documents. (Source: www.ionet.co.za/glossary.asp).

²⁴ A browser is an application that provides a way to navigate and interact with all the information on the Web. Technically, a Web browser is a client program that uses the Hypertext Transfer Protocol (HTTP) to make requests of Web servers throughout the Internet on behalf of the browser user. Popular browsers in use today include Netscape Navigator, Microsoft Internet Explorer and Opera.

(Source: www.eseehosting.com/support/glossary.php).

business had developed in Europe, first time in the 20th century, a European based technology and technology firms were challenging the American and Japanese strongholds.

1.1.2 Economic Drivers

The business environment of all the firms was getting more and more complicated towards the end of the 1990's. Globalization and digitalization of the business environment increased the dimensions of the business decisions requiring a completely different speed in decision-making. Business networking created new flexibilities, but also dependencies for the firms. Globalization was enforced by the Internet reducing transaction costs (search and contracting) combined with the expansion of free trade agreements²⁵. The vast amounts of available information having ambiguous meanings hampered the decision-making. Firms on the global level were able to acquire information on the competitors' moves easily. These developments made the business environment increasingly uncertain.

Global competition drove firms to reorganize and relocate their production closer to cheaper labor and raw materials or markets. In the paper industry globalization required firms to increase their size to keep the negotiation powers in their hands, which led the leading firms into mergers and acquisitions. The only meaningful regulatory power was the mergers and acquisitions laws, which limited merger alternatives for firms. In both the ICT and paper industry outsourcing manufacturing, design, and logistics reduced the differentiation and increased competition in the industry.

The Internet enabled E-Commerce which also decreased transaction costs even for individual consumers, and opened global consumer markets. This development tightened the competition even further.

In the mobile telephony market in Europe the national regulators protected national incumbents causing problems for the expansion of new players. However new entrants like Vodafone created a new business model, a global cellular operator, forcing the national telecom operators into new competition.

The fierce competition in the ICT industry and saturation of the market lowered the investment and running costs of large systems from 1990 towards the year 2000. The saturation of the telecom market stopped the investments of operators. Some of the ICT firms, like Nokia, could respond to the development and maintained their profitability, but others went into crisis. In general, in 2001 the growth of the main global firms in the ICT industry slowed down or stopped. Also, the profitability had gone down.

As a global customer for the ICT cluster, the paper industry had been going through consolidation since the 1980's. Leading firms in the paper industry, however, have not been able to improve their value creation remarkably (Laaksonen & Suojapelto 2003). The acquisition and merger risks in the paper industry increased, and achievable returns decreased. Simultaneously substituting products (like the electronic media) were creating a real threat for the end-uses on paper industry products (Härmälä 2001). It looked like the industries had run out of the resilience of their strategies due to the long lasting imitation of competitors and increased competition by the globalization.

1.1.3 Technological Drivers

Technological development and its role in cellular competition were steered by regulation differently in the USA, the EU and Japan as earlier explained. In Europe, cellular technology's diffusion began in 1983 based on NMT and later GSM cellular standards. NMT and GSM technologies were created for mobile voice, but GSM also included a simple text-messaging feature, SMS, which became a real hit and an important add-on revenue generator for mobile operators. GSM was also used for data transfer, but later the operators started shifting from GSM to GPRS technology which offers ubiquitous Internet

²⁵ The World Trade Organization, (WTO), is the primary international body to help promote free trade, by drawing up the rules of international trade.

access with speeds simultaneous to a normal Internet modem. In GSM data transfer, the pricing was based on time (as telephone calls), but in GPRS, the transfer was priced based on the amounts of data transferred. The connection time became irrelevant, and the user could be connected to the network all the time. The International Telecommunications Union (ITU) introduced Universal Mobile Telecommunications Service standard (UMTS) in the year 2000. It meant that in the near future cellular networks could achieve 2 MB access speeds²⁶, offering a wider range of services than GSM.

In the paper industry firms improved the efficiency of their business models by investing in the ICT technology and automation within manufacturing as well as in sales and customer service processes. In the telecom industry digital technologies replaced analog technologies and improved the efficiency of the service management dramatically.

The terminal development towards new communication devices began at the end of the 1990's. PC's were developing through various models of personal assistants towards mobile phones, and mobile phones reciprocally towards PC's. Different network access technologies were integrated into devices. That was the first clear signal of the collapse of two markets, the IT and telecommunications markets, into one. The end result of this collision would be a market of at least 1.5 billion mobile terminals with a universal and ubiquitous access to services on the Internet and corporate networks (Edelmann et al. 2003b). However, it took until the year 2002 before the equipment was mature for first tests (Kytölä & Sissonen 2002).

A good example of new competition arising from the emergence of the information technology industry and the telecommunication industries into the ICT industry is Microsoft and Nokia in the operating systems market. The business model the Microsoft has launched into the mobile telephony market is based on a new Windows-based operating system licensed to manufacturers of the mobile devices. By this move, Microsoft attacks Nokia's leading position in the mobile device market and pursues to achieve similar position as it has in the PC market. In order to defend but also to offend, Nokia developed within Symbian alliance the EPOC (Series 60) operating system as a new business model for itself. By licensing Series 60 to its competitors, Nokia can enjoy slices from the revenues of its competitor's sales, but simultaneously achieve strategic flexibility and defense by being independent of Microsoft's monopoly (Edelmann et al. 2002b; Laaksonen, Lopperi, Bergman, Soininen, Kanerva, Edelmann, & Kytölä 2002). In 2004 Nokia reached its goal by achieving 40% share of the intelligent phones market. Today, probably half of the other manufacturers' phones run also on the Symbian licensed by Nokia (Koskinen 2004).

The USA was behind Europe and Japan in the application of the Mobile Internet (Cellular Online 2000). In the USA, the Internet was the main driver for the development of Wireless technology, and the Wireless Local Area Networks (WLAN), as an extension of the Internet, gained a lot of focus. This development was possible due to the poor level of cellular networks and partly because the radio frequency used by WLAN was not regulated. New operator business models²⁷ were introduced to compete with the cellular networks. The USA was also the leader in the Internet-based commerce.

1.1.4 Summary of the Driving Forces

It looked like the IT and communication industries were about to enter a new turbulent era, during which they would merge into one Information and Communications Industry (ICT). This would put firms into new competition with firms with which they had not competed before. The development would also create a new market. When measured by the number of terminals, approximately 300 million personal computers and 1 billion mobile phones markets would merge into a new fast growing market with new opportunities. The driving forces would be new customer needs and technology, particularly the wireless technologies.

²⁶ 3G networks.

²⁷ For instance co-operative networks in San Francisco area.

The Internet had become the main driver for data transfer prices. Competition drove prices down, even though quantities increased, transferring huge volumes of data inexpensively (Communications Week International International 2001). Comparing the amounts of data-transfer with the amounts of cellular phone call and movie file transfer, it was easy to see that main business models for operators, mobile calls and text messages would shrink very fast due to unit price erosion even if the volume development in existing business models would be very positive. A protecting element for the operators' mobile call pricing was the licensing of radio spectrum. On the other hand, there were already wireless technologies operating on non-regulated spectrums. Wireless-LAN frequencies were free, and could break the protection from the industry.

In the paper industry, the strategy had for centuries been focusing on improving the present business model, the production of paper and board reels and pallets. The strategy focus for the past twenty years or so had been in improving the production process, delivery process, and the management of capital (both working capital and investments). This has led the firms in the paper industry to concentrate on cost cutting and consolidation. The strategy, however, has not led into improvements in value creation in the industry. The return on capital employed for leading global players could hardly exceed the risk-free interest rate in 2004. Electronic means affecting the end usage of paper were creating obvious threats to firms. For instance, newspaper consumption had gone down for years in the USA and the Nordic countries; simultaneously, the electronic media had rapidly increased its share.

As a conclusion, the paper industry was about to face disruptive changes in its customer demand due to the impact of emerging technologies. The paper industry needed new business models and improvement in the efficiency of its existing business model. The ICT industry needed deeper understanding of the customer industries to learn about customers' future needs, which could lead to new growth areas for technology applications and support services. For a researcher, it seemed important to increase the level of understanding of the changes in competition enabled by the wireless technologies; and for the firms, it was time to move from imitation to strategic innovation. Summarizing the drivers into one, it looked like the competitive environment for both industries was about to enter a new era of rapid changes enabled by the development of emerging technologies.

1.2 Origins and Motives

The interest in the research of the chosen topic arises from my personal experience with large corporate firms' information systems and their development. Having been involved for almost ten years first as a project manager and later as an information systems manager with a large industrial firm, thereafter as a director on the supplier's side in a large IT project and communication services business, and finally in different management positions with a telecom operator has given me a longitudinal view on the development of the industry. Also, practice has shown that the development of technology takes place through periods of stability and breakthroughs.

Over the sixteen years of my professional career, there has been at least three major breakthroughs in the IT technology, which can be easily pointed out. The first shift was from centralized mainframes to mini-computers. It also initiated the first wave of networking to integrate decentralized systems.

The second shift was from mini-computers to personal computers, local area networks, office software and local servers. The importance of reliable network connections and technical standards increased allowing decentralized computing to take place. This shift also changed the IT equipment market from brands (like IBM, Digital and Hewlett Packard) towards standards (like Windows, UNIX, TCP/IP and Ethernet).

The third shift was from closed corporate networks towards a public Internet and services. This changed the focus from internal networking to external networking enabling rapid diffusion of E-Business over the Internet. The shift also included simultaneous diffusion of mobile voice services based on GSM and other standards.

The cellular development differed from the earlier, and was therefore something extraordinary: it was initiated in Europe compared to the earlier technology shifts, which were initiated and driven by US

based firms. This made the European market a lead-market for cellular business and technology firms. Cellular technology was unknown to IT firms, and therefore, disruptive for the industry.

These different technological evolutions offered an interesting framework from the application point of view. Wireless technology is not just one, but many technologies; it can be said that it has the mobility and technology aspects. Technology can be presented in five dimensions: Networks, Terminals, Operating Systems, Enabling Services, and Programming Languages (Kytölä & Sissonen 2002). More importantly it offers the application developers a new function, wireless mobility, from the application point of view. This new functionality could improve the efficiency of business processes radically. A huge opportunity for new business models in most industries was arising.

It was also foreseeable that the effects of emerging wireless technologies would be of two kinds. Firstly, Internet and mobile telephony companies would face technology convergence, which might have a big impact on their existing business models, and secondly the basic-industry companies, like the paper industry and retail, would face uncertainties to their existing business models arising from wireless technologies. The technology's impact would not only be on the way the companies operate with their present customers and suppliers, but it would enable firms to innovate entirely new services, products, supply chain configurations, and address new customer segments. The wireless technology would not only increase the efficiency of the existing business models, but it would enable completely new business models.

1.3 In the Search of the Research Gap

1.3.1 Strategy Formulation

Since the end of the 1990's, changes in macroeconomics, rapid changes of exchange rates, the development of computers and networks, microelectronics revolution, business networking and the emergence of newly industrialized countries' market ended the postwar economic stability. Market uncertainty and technological uncertainties increased for the firms in the global economy (Grant 2003; Hamel & Välikangas 2003; Tapscott, Lowy, & Ticoll 2000). The world was divided into many culturally different markets whose maturity and structure differ immensely. Customers individualized and user groups fragmented, which made the anticipation of the customers' expectations more and more difficult (Stähle et al. 2002).

The increase in uncertainty as well as in the speed of change raised the requirements for strategy formulation methods responding to changes. The change took place in the emphasis of strategic planning, and the need for strategic innovation was realized (Baum & Wally 2003; Eisenhardt 1989b; Eisenhardt & Sull 2001; Grant 2003; Hamel 1996; Hamel 2000; Hamel & Välikangas 2003). Even though the decentralization and informality of the strategic planning process permitted access to a broader range of expertise, there was limited use of new tools and concepts in strategic analysis, and little evidence that the systems of strategic planning were conducive to strategic innovation (Christensen 2000).

Strategy formulation in a turbulent and unpredictable business environment requires understanding of the uncertainties embedded into the futures as well as preparing for the unexpected. Flexibility and agility can be achieved by deferring decisions or striking them in steps, while the knowledge and environmental uncertainties decrease. In business, uncertainty is often linked with risk, but as the real-option literature points out, options also contain opportunity. (Bowman & Hurry 1993; Grant 2003; Kyläheiko, Saarnio, & Sandström 2002; McGrath 1997; McGrath & Nerkar 2004; Porter 1980; Prahalad & Hamel 1990).

1.3.2 Technology Development

In this research, change is driven by an emerging set of wireless technologies and other ICT technologies, but affected by political and economic levels as well. The technological development over the past 15 years in the ICT industry has been very fast. Due to the fast development of

technology and the diffusion of services, the form of the thesis was chosen to be based on publications made during the research work. The starting point in 2001 was that fast wireless networks and terminals were coming to the market; however, they were not available. In the year 2004, UMTS and Wireless LAN were available in Finland and the rest of Europe in the most densely populated areas.

Schumpeter (1934; 1942) proposed that the combined impact of the technology and innovation can be a source of “creative destruction” of the industries. Similarly, technological innovations can be categorized as incremental and radical depending on their impact on firms (Hamel 2000; Tushman & Anderson 1986). Christensen (2000) divides technological change into sustaining and disruptive. Technologies develop in periods of stability through incremental improvements and in revolutions ignited by radical technological breakthroughs. Similarly, industries also develop in technology cycles, and the change is ignited by technological discontinuity.

The phases of rapid development in technology are a great source of uncertainty for firms. The uncertainties include opportunities to build competitive advantage, but they also contain threats. Chesbrough (2003) points out that “the capability and performance of the fledging technology is not yet well understood and therefore technology uncertainty is compounded by market uncertainty, when early-stage technology projects address an uncertain market.” For, an incumbent rapid technological change can create a real threat, if new business models radically apply technology in a more efficient process (operative efficiency), reduce the cost of investment (capital efficiency), or sets a new value-creation model offering better value to customers. Rapid technological change creates a new design space for firms (Palmborg & Martikainen 2003). Creative destruction is based on the structural changes in competition. Rapid technological development affects the customer behavior and increases the efficiency battle within the industry, but it also opens up an opportunity for new entrants and can create substitutes which shake up the industry rules. Often firms, especially the leading ones (Chesbrough 2003; Christensen 2000; Hamel & Välikangas 2003) face difficulties in the era of technological change on the basis of their industry. Due to the increased impact of the technology on the firms’ performance, innovation and product development are now ever more critical to the success of organizations and firms (Torkkeli 2002), strategic innovation becomes increasingly important in emerging markets (Chesbrough 2003; Chesbrough & Teece 2002; Drucker 2002; Hamel & Välikangas 2003; Porter 2001; Prastacos et al. 2002; Teece 2003).

The literature review revealed that there was quite a lot of articles and books about the impact of the Internet on business models (Hamel 2000; Hartman, Sifonis, & Kador 2000; Järvinen 2001; Martikainen, Raatikainen, & Hyvärinen 2002; McGrath 2001; Tapscott, Lowy, & Ticoll 2000), but very little about impact of wireless technologies on firms’ business models (Müller-Veerse et al. 2001).

1.3.3 Innovation

Companies develop by imitating and innovating. Depending on the speed of the technological development, the balance between innovation and imitation differ. Imitation does not change the business model by which the firm competes, but it adjusts the firm on the same level in the competition with the business models in the market. However, large organizational process changes always contain inertia, meaning that followers are always behind in applying the innovations. The path dependencies of the firm set limits to the pace of change and alternative goals for the firm’s future skills, market place and position. Chesbrough (2003) points out that the more effective the existing business model has been, the more tied it is into the firm. This creates a risk for the firm, if it is not able to recognize the opportunities to renew its strategy (Hamel & Välikangas 2003), but opens for the innovator an opportunity to improve its business model continuously, and lead the competition.

From the strategy formulation point of view, new business models can be seen as strategic options for the firm. These options become real by emerging technologies. Innovations can be held as new resource configurations, on which the management has to make investment decisions.

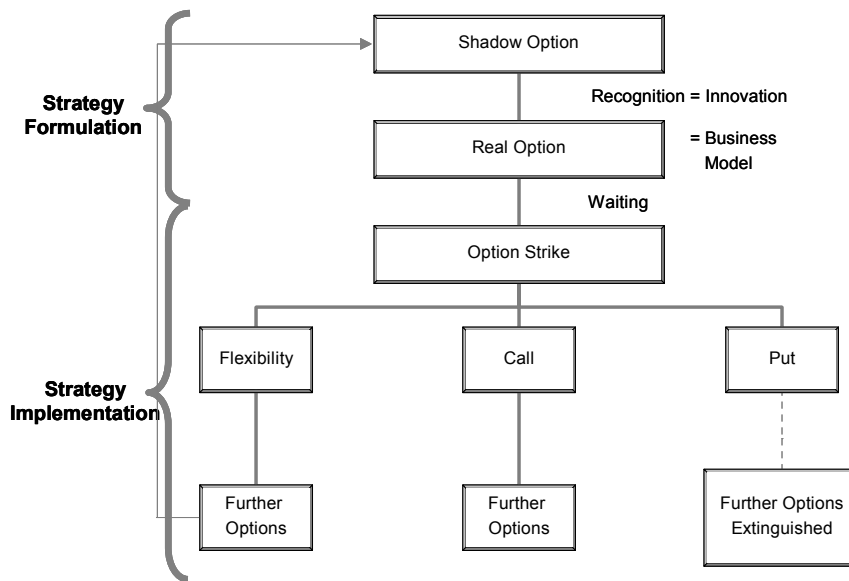


Figure 1. Strategy formulation based on the business model innovation. Adapted and modified from Bowman & Hurry (1993).

The strategic options thinking contain concepts of shadow and real options as well as implementation decisions (wait, call, put, etc.) illustrated in Figure 1. Shadow options represent all the possible different new resource configurations that could be done. In real life, however, very few of these shadow options will ever be revealed. Recognizing the shadow options makes them real. This framework contains in principal two parts: Firstly, the innovation of options resulting a limited number of new resource configurations. Secondly the configurations are subject to investment decisions where management decides upon the discovered alternative investments. In this study, strategic options are business models containing both tangible and intangible assets. The real options literature, however, gives rather little emphasis on innovation. Instead, it goes straight to categorizing options and decision-making (for instance Amram & Kulatilaka 1999).

1.4 The Research Gap

Technology's impact on industries has been known and studied many times. There was a lot of research and literature on the Internet's impact on business models and competition. However there was very little about wireless technologies' impact on competition and competitive advantage.

The strategy literature pointed out the increased environmental uncertainty and limited time. Studies report cases and best practices, but do not, however, offer practical tools or methods for firms to better prepare and run rapid changes in markets. (Eisenhardt & Sull 2001; Hamel 2000; McDermont & Colarelli O'Connor 2002; Mintzberg, Quinn, & Ghoshal 1998). The strategy literature revealed a real need and a gap in methodology to formulate strategies in fast changing environments (Christensen 2000). Fast decisions had a positive impact on firms' performance, but it would be much better already to know the alternatives and make fast decisions only on timing rather than both timing and resource configurations.

Consequently, there was a research gap in analyzing the wireless technologies impact on competition of the business concepts as a source of competitive edge. Simultaneously, there was also an

opportunity to develop strategic innovation in strategy formulation to respond to the new needs in the firms' business.

1.5 Research Questions and the Objectives of the Study

The saturation of the market for ICT firms and changes explained in the previous chapter, Background, changed the external environment and competition within the industry rapidly in the year 2000. The management of firms in markets suddenly faced problems arising from 1) the maturity of cellular markets and the end of growth leading to fierce competition focusing on incremental improvements with present business models²⁸ and 2) the emerging new cellular and other radio based Internet access technologies and terminals seemed like new growth areas²⁹.

Firms faced simultaneously the problems of the rapid growth period ending and the uncertainty from the substituting technologies increasing. Due to the end of growth in the cellular and Internet businesses the share values of ICT firms went down and are still much lower than in the year 2000.

These managerial problems led to research questions:

- i. Are there already business models containing wireless technology and services within industrial customers of the ICT industry?
- ii. What benefits and return on investment have firms already gained with their wireless applications?
- iii. What role has the wireless technology had in those business models?
- iv. What new business models could firms create based on wireless technologies ?
- v. How big a business potential would they represent for the ICT industry?

The Internet technology had already shown that it has an impact on the firms' competition and competitive advantage (Porter 2001). Would the same happen, when the wireless technologies would mature? This leads into research propositions 1 and 2:

P1) Wireless technologies enable new business models.

P2) The potential for efficiency improvement by the wireless technologies in firms is big.

There were good examples, like Dell, on the Internet how firms had gained competitive edge by applying new technology in innovative ways. However there were only few success cases in application of mobile technologies.

This led into research proposition 3:

P3) The opportunity in firms enabled by wireless technologies has not been widely utilized.

If P2 and P3 were true, it would lead us into additional conditional research questions:

- vi. If the efficiency improvement potential in customer firms was big, why were firms not investing in new wireless business models?
- vii. If this was due to technology uncertainty, how could it be reduced?

The question of industry borders would also arise as Schumpeter (1934) has pointed out:

- viii. Will there be changes in the industries due to emerging wireless technologies?

²⁸ The mobile telephony market's growth was already slowing down, and the market was maturing. As explained earlier, it led into fierce price competition within the ICT industry.

²⁹ Substitutes can conquer the existing market, but simultaneously create completely new markets by expanding the usage to a new functionality, geographical area or a new user group (Porter 1980). Simultaneously regulator's actions lowered the entry barriers (WLAN, RFID, Service Operators and Network operators, etc.)

Business models offer customers the service or the product in more efficient ways and therefore could completely destroy parts of the industry clusters by bypassing them in value-chains.

As often in constructive and case study research, towards the end of the study the broad research question was extended to

- ix. How can strategic changes be planned and prepared for in a rapidly changing technology environment?

Analyzing Porter's (1980) five forces model, one can assume that horizontal forces affect in times of stability. This means that market competition is affected by customers' and suppliers' powers as well as the internal structure of the market. This stability can be shaken up by new entrants or substitutes. As Porter presents, new entrants can come to market by acquiring existing firms and operating an existing business model. Depending on the market structure, there are always entry barriers of different strength. Substituting products are extremely dangerous if they either "are subject to trends improving their price-performance tradeoff with the industry's product, or are produced by industries earning high profits." (Porter 1980). Substitutes can conquer the existing market, but simultaneously create completely new markets by expanding the usage to a new functionality, geographical area or a new user group. Mobile telephony is a good example of this. It did not entirely cannibalize the fixed telephony market, but extended the use of telephones to a new functionality and new user groups. At the time of initiating the research, the mobile telephony market's growth was already slowing down, and the market was maturing.

It looked like fast wireless technologies were about to offer a new, partly substituting business model to the Internet due to similar functionality as mobile phones did to fixed telephony. According to earlier experience, firms had a lot of ideas and needs, which could benefit from wireless solutions.

Due to the expected impact of wireless technologies on firms, the broad research question of this study has been to understand the strategic³⁰ impact of emerging technologies on the competition between the business models of firms. As a case technology the study concentrates on different wireless technologies. The research focuses on the future adoption of technology and its impact on competition between firms. The chosen focus consequently affected the selection of methods and acquisition of data. The objectives of the study were 1) to produce new information of the firms' future needs satisfied by the wireless technologies, 2) to study the wireless technology's strategic impact on business models, value chains and industry structures, and 3) to apply and test new methods in strategy formulation.

If the research propositions could be even to some extent and validity proved to be true, the managerial problems stated earlier could be solved. This meant that research focuses in this research were in understanding how to gain and maintaining competitive advantage for a firm in a fast changing environment by innovation and understanding strategic customer needs.

1.6 The Theoretical Framework of the Research

Strategy work and interest in strategic planning emerged in the 1950's and the 1960's as long-term planning (Ewing 1956). Until the 1990's, strategic planning was focusing on two areas: "the impact of strategic planning on firm performance and the role of strategic planning in strategic decision-making" (Grant 2003). Changes in the business environment ignited a new need for strategy planning. When uncertainty and the speed of change increased, the need for new strategy formulation methods responding to these requirements emerged.

The purpose of strategy is to achieve competitive edge over competitors. In the environmental models, competitive advantages are based on an external view of the industry. The structure of the industry affects the sustainability of the firm's performance, whereas positioning reflects the firm's ability to

³⁰ "Strategic" is just a description of the magnitude of alteration in changes.

establish competitive advantage over its rivals (Porter 1980). Having gained such an attractive position, a firm can exercise market power (Teece, Pisano, & Shuen 1997), and gain "monopoly-type" rents.

Andrews (1980) pointed out that "corporate strategy is the pattern of decisions that determines and reveals its objectives." He realized that resources that the firm possessed are the tools for strategy implementation but they also restrict the implementation opportunities. The Resource-based view of the firm was developed from Penrose's (1956) theory of the growth of a firm and Andrews's strengths and weaknesses by Barney (1991), Eisenhardt & Martin (2000), Teece et al (1997), Wernerfelt (1984), and other researchers. The Resource-based view of a firm explains that firms' resources and their unique and competitive configurations are a source of competitive advantage.

Barney (1991) defines the resources of the firms as including all the assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by the firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness. According to Wernerfelt (1984), the examples of resources are brand names, in-house knowledge of technology, employment of skilled personnel, trade contracts, machinery, efficient procedures, capital, etc. In the language of traditional strategy analysis, the resources of firms are strengths that firms can use to conceive of and implement their strategies. (See Figure 2.)

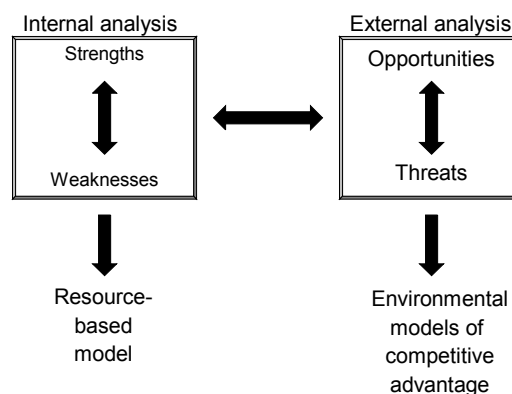


Figure 2. The relationship between traditional "strengths-weaknesses-opportunities-threats" analysis, the resource-based model and models of industry attractiveness (Barney 1991).

Seth and Thomas (1994) suggested that theories on firms should focus on the structure and behavior of firms. Ray et al. (2004) note that terms "resources and capabilities are used interchangeably and refer to the tangible and intangible assets firms use to develop and implement their strategies." Sustained competitive advantage is available for the firm if the resources it possessed are valuable, rare, costly to imitate and efficiently organized (Barney 1991).

When developing the theoretical framework further it can easily be seen that the firm's rents are achieved by sales of products and services, not resources or capabilities. Wernerfelt (1984) points out that resources and products are two sides of the same coin. "Most products required the services of several resources and most resources can be used in several products." (Wernerfelt 1984).

As in case of new open technologies emerging, for instance the Internet, it becomes harder for a firm to sustain operational advantages. If a company cannot exceed the average operational efficiency in the industry the only way is to gain a cost advantage or price premium by competing in a distinctive way. To compete in a distinctive way, according to Porter (2001), means strategic positioning, i.e., "doing things differently from competitors, in a way that delivers a unique type of value to

customers”. The same idea was presented by Hamel (2000) who combined the resource-based view and the industry positioning into the business model and stated that “business models compete, not firms.”

Teece et al. (1997) had found out that in a rapidly changing environment the dynamic capabilities become important for the success of a firm. Dynamic capabilities reflect in the firm's ability to achieve new and innovative forms of competitive advantage. These encompass organizational and managerial processes (i.e., coordination/integration, learning and reconfiguration), specific asset positions (i.e., technological, financial, reputational etc. assets) and path dependencies (i.e., the firm's history). (Teece, Pisano, & Shuen 1997). Teece (2003) defines the dynamic capabilities as the skills to shape, reshape, configure, and reconfigure portfolios of assets and competences so that the firm responds to changing technologies and markets to serve changing customer needs. Dynamic capabilities are “the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die.” “Routines are purposefully simple to allow for emergent adaptation, although not completely unstructured. Since new knowledge must be rapidly gained in each new situation, experiential activities such as prototyping, real-time information, multiple options, and experimenting that generate immediate knowledge quickly replace analysis.” (Eisenhardt & Martin 2000).

Summarizing the above literature means that in order to formulate competitive strategy a firm has to focus both on internal resource configurations as well as external strategic positioning (Spanos & Lioukas 2001). Depending on the speed of the external changes the dynamic capabilities become more or less important. Figure 3 explains the relationships between the strategic approaches.

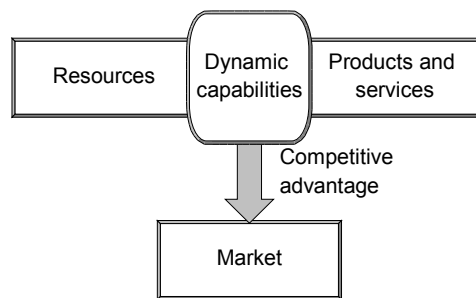


Figure 3. The relationships between the resource based-view, strategic positioning and the dynamic capabilities to achieve competitive edge over competitors. Adapted from Barney (1991), Porter (1979), and Teece, Pisano, & Shuen (1997).

Eisenhardt and Martin (2000) point out that long-term competitive advantage lies in the resource configurations that managers build using dynamic capabilities. They continue that “in high-velocity markets, dynamic capabilities rely extensively on new knowledge created for specific situations.” Therefore, entrepreneurship and especially innovation becomes important in the rapidly changing environment (Chesbrough 2003; Chesbrough & Teece 2002; Drucker 2002; Hamel & Välikangas 2003; Prastacos, Söderquist, Spanos, & van Wassenhove 2002; Teece 2003). Drucker (2002) defines innovation as a specific function of entrepreneurship. “It is the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth.” He continues that innovations are “the effort to create purposeful, focused change in an enterprise's economic or social potential.” (Drucker 2002). Long-term competitive advantage lies in the resource configurations that firms build using dynamic capabilities. The business model represents this resource configuration. According to Hamel (2000), the business model is as a radical business process improvement containing four elements: customer interface, core strategy, strategic resources, and value network. (See Figure 4).

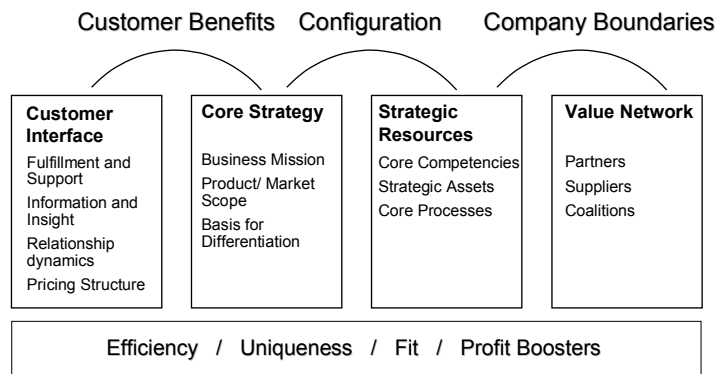


Figure 4. Business model structure (Hamel 2000).

In the publications of the dissertation due to their nature, both the terms business model and business concept have been used. According to Hamel (2000), the business concept is a new, non-implemented business model. Therefore in the Introduction of the dissertation the concept *business model* is chosen to cover both meanings.

Firms may also possess competitive advantages at the level of business processes that are not reflected in a firm's overall performance (Ray, Barney, & Muhanna 2004). The innovation process therefore could represent dynamic capability creating competitive edge for a firm in the form of a process. The research framework was developed accordingly as presented in Figure 5.

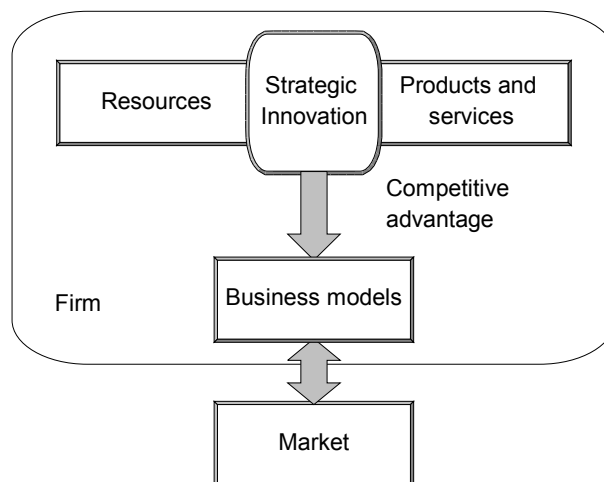


Figure 5. Achieving competitive edge by business model innovation. Adapted and further developed from Barney (1991), Porter (1985b), and Teece, Pisano, & Shuen (1997).

When markets do not yet exist, understanding the strategic future of customers' becomes valuable. (Porter 2001; Teece 2003; von Hippel 1986; von Hippel, Thomke, & Sonnack 1999). In order to understand the changes taking place in the ICT sector, it would be important to understand the changes taking place in the market where the customers of ICT firms operate. The actions that players do to achieve competitive edge depend in the long run on the changes in customer demand. This developed

the strategy formulation towards a holistic view (Mintzberg & Lampel 1999). In order to achieve sustainable competitive advantage, which allows a company to outperform the average competition, strategic innovation must be a continuous and iterative process. It also has to cover the strategic partners³¹ of the firm.

Most of the research focused on change and speed. Very little emphasis, however, has been put on time. Speed in physics is defined as distance traveled per unit of time. It means that there are two elements in change: distance and time. Distance can be defined as the magnitude of change and time as the time to achieve competitive edge by the change. This means that the time required for change is relative, i.e., it is measured against the change capability of the competitors in the market. Time is therefore an essential aspect of strategy. (Eisenhardt 1989b; Eisenhardt & Martin 2000).

Due to the high uncertainty of the technology adoption rate and standards, the key issue in strategy formulation in times of uncertainty is to build flexibility for the firm by multiple and competing investment alternatives, from which the firm decides upon. The timing and the extent of the investments are essential for managing uncertainty. These opportunities are called options of real-options. An option is the right, but not obligation, to take an action in the future. Options include value if there is uncertainty. Real Options Approach (ROA) is a way of thinking (Amram & Kulatilaka 1999). Bowman and Hurry (1993) suggest that strategy can be seen as a process of organizational resource-investment choices, through the option lens. Management is holding options open when uncertainty increases, and closing them when it decreases. The literature on strategic options thinking focuses more on valuing and striking the options than recognizing them.

Instead of defending themselves against competition, firms should be able to rapidly create new alternative resource configurations by internal innovation systems to challenge their existing business models and strategy as well. This would allow firms to consider the timing of the market launch and wait for competitors' actions, and finally make quick but well prepared decisions on actions. The dynamic capabilities that drive competitive advantage are themselves unstable processes that are challenging to sustain (Eisenhardt & Martin 2000). Fast strategic decisions also improve the performance of firms in the fast changing environments (Baum & Wally 2003; Eisenhardt 1989b).

In business organizations there is unfortunately not enough time for deep strategy analysis. Consultants can prepare expensive external analysis of the market and estimated changes, but how would the management of the firm develop a strategy based on the resources available and what tools could be offered for them to do so?

Porter's model offers a useful framework to explain the logic for the research framework even though it was developed for static industries. Porter presents that five forces defining the competition in an industry are industry's internal competition, supplier and customer power, and the threat of a new entrant and substitutes. The importance of the horizontal forces in the model (industry competition, power of customers and suppliers) increases in times of technological stability. Similarly, the importance of vertical forces (threat of new entrants and substitutes) increases in time of technological breakthroughs increasing the uncertainty in industries. In times of stability firms should concentrate on incremental improvements in their business model and in times of technological breakthroughs on strategic innovation. In a rapidly changing environment innovation, decision-making and the successful implementation of strategic options can be held as a key to sustainable competitive edge. By breaking down the industry competition onto the business model level, the competitive landscape becomes more complicated as shown in Figure 6.

³¹ Customers, suppliers, and in some cases also the competitors.

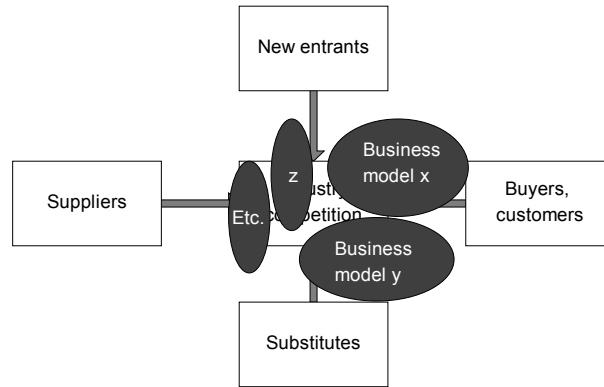


Figure 6. Five forces on the business model level. Adapted and modified from Porter (1979) and Hamel (2000).

Radical business model innovation, i.e., innovation of new resource configurations, creates sustainable competitive edge in a rapidly changing environment by both operating at lower cost and by commanding a premium price. In this study, competition is assumed to take place between the business models of firms holding and investing resources into competing business models. Here, Hamel's business model has been used as a structure for describing new innovated business models. The main point is that the management in a firm does not make decisions on ideas, but on investment alternatives. These alternatives must be thoroughly described and studied before decisions can be made. For the evaluation of the ideas, they must be described in detail.

The firm's present business model competes not only with external other business models but also with new internally innovated models. The competencies how to renew the firm's business by innovating new radical business models are dynamic capabilities. These competences include skills to inspire co-operation with strategic partners and to coach the firm's own personnel to rethink and renew business models through their tacit knowledge to compete with other business models within industries or even to create new industries. New business models can also reform industries by integrating existing profit sources by splitting existing models into smaller entities (e.g., outsourcing).

Technology innovation enables application innovations. In practice, wireless technologies enable new applications in many industries. The technology impact on competition differs from industry to industry and must therefore be evaluated from the firms competition point of view (Porter 2001). In Figure 7, competition has been divided into two: competition between existing business models and competition between new business models. The difference is in the level of change. The competition between existing business models leads into imitation, incremental improvements and intensified competition. The operative strategy of firms focuses on improved efficiency through cost control and volumes, where "fat markets" define the prices. The focus is on efficiency of purchasing raw materials, services and goods, customer service and delivery and production processes. Normal means of implementation are the better acquisition of raw material and services, replacement of investments geographically nearer to markets or cheap labor, pricing of products, sales volumes, and customer loyalty.

However, when technology creates uncertainties and instability in markets, decision-making in firms should concentrate on radical process improvements driven by customers' strategic needs. Understanding these change forces becomes most important for maintaining strategic flexibility. See Figure 7.

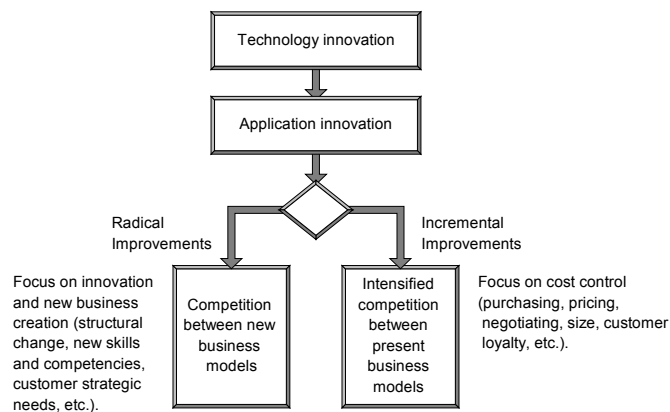


Figure 7. Technology impact on competition.

Figure 8 illustrates the idea that understanding customers' strategic needs helps a firm to anticipate the strategic changes in the structure and content of the customer demand. It also shows the importance of deep co-operation between strategic customers (Thomke & von Hippel 2002; von Hippel, Thomke, & Sonnack 1999). The same thinking applies to suppliers: the more firms outsource their suppliers, the more they also outsource their strategic innovation.

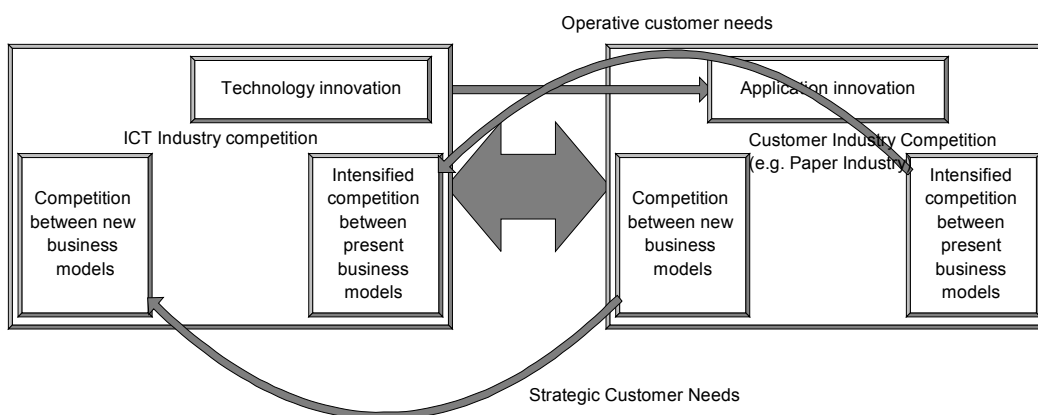


Figure 8. Technology impact on competition between industries.

1.7 Research Approach

The chosen research approach emerges from the phenomenon explained, its characteristics and the objectives of the research. Especially the business driven managerial problems have been important through-out the research work. The broad research question in this thesis has been to understand the strategic impact of emerging technologies on the competition between the business models of firms. Wireless technologies have been chosen as a case technology for the study.

Wireless technologies have not yet been widely integrated into firms' business models, and therefore, have not yet had real impact on the industries. This means that the focus of the research has been in understanding better the technological uncertainties embedded in the alternative futures. The strategy leads into choosing among a combination of methods, which are mainly empirical, either normative or descriptive (Kasanen, Lukka, & Siitonen 1991). The research approach required strong interaction between the partner firms. Therefore the constructive research approach was chosen.

The constructive research approach in Accounting Research was first presented by Kasanen et al. (1991). Constructive research concentrates on producing innovative constructions intended to solve problems faced in the real world, and to make a contribution to the theory of the discipline in which it is applied (see Figure 9). Constructions can be, for instance, models, diagrams, plans, organizational structures, and information systems designs. It is particularly important that both major parties, the target organization's personnel and the researchers, honestly disclose all relevant data.

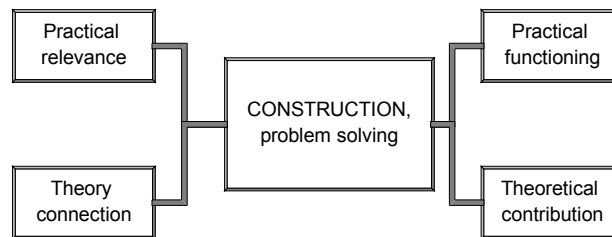


Figure 9. Elements of constructive research (Kasanen, Lukka, & Siitonen 1993)

An essential part of the constructive approach is to tie the problem and its solution with accumulated theoretical knowledge. The innovation phase is the core element of a successful constructive study, and is often heuristic by nature; stricter theoretical justification and testing of the solution typically come afterwards.

Constructive research can be phased into seven steps: 1) finding a practically relevant problem, 2) examining the potentials for long-term research co-operation with the target organization, 3) obtaining a deep understanding of the topic area both theoretically and practically, 4) innovating a solution idea and developing a problem-solving construction, which also has potential for theoretical contribution, 5) implementing the solution and testing how it works, 6) pondering the scope of the applicability of the solution, and 7) identifying and analyzing the theoretical contribution. Constructions are entities which produce solutions to explicit problems. They also tend to create new reality. Constructive research may be either quantitative or qualitative or both. Constructive research typically applies the case method. (Kasanen, Lukka, & Siitonen 1993).

Case study research focuses on understanding the dynamics present within single settings. Case studies can involve either single or multiple cases, and numerous levels of analysis. Case studies typically combine data collection methods such as archives, interviews, questionnaires, and observations. The evidence may be qualitative (e.g., words), quantitative (e.g., numbers), or both. Case studies can be used to accomplish various aims: to provide description, test theory, or generate theory. (Eisenhardt 1989a; Yin 1994).

Characteristic of field and case studies is the use of small samples. The usual aim is to gain a more profound and comprehensive understanding of the studied subjects than what could be possible by collecting large samples through surveys. The distinctive feature of case and field studies is the smaller distance between the researcher and his or her research object. (Kasanen, Lukka, & Siitonen 1993).

Conducting constructive research creates potential benefits in the form of new possibilities to get access to interesting research sites, to get relevant managerial problems and processes under critical

scrutiny in order to get solved, and to narrow the gap between practice and research. On the other hand potential risks in the constructive research approach may be that the relevant problem can be too delicate an issue to get published, the commitment of the target organization cannot be maintained, there may be a failure in keeping continuous contact with the target organization, the researcher may not be able to be committed to innovative development and still maintain a neutral, or even critical, overall attitude, and constructive research can be considered as an emerging research approach, and therefore the results can be held unreliable (Kasanen, Lukka, & Siitonen 1991; Lukka 2000; Lukka 1991; Lukka & Kasanen 1993; Lukka & Tuomela 1998; Neilimo & Näsi 1980).

1.7.1 Research Construction

The construction for this research emerges from the above frameworks and managerial problems. Research construction was created and presented in the main project plan (Laaksonen 2001) and is displayed in Figure 10 as a process diagram.

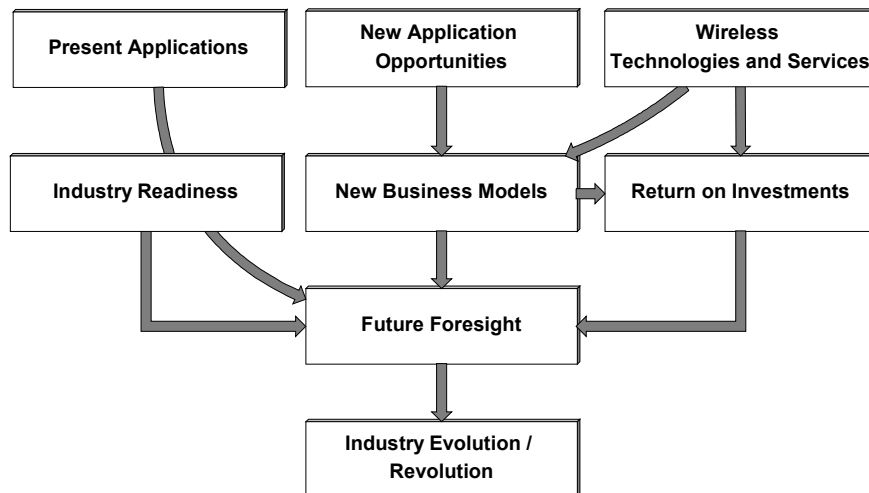


Figure 10. The research construct of the research project “New business models arising from the convergence of E-Business and mobility in the USA and Europe”.

The authors’ main responsibility was in analyzing new application opportunities based on wireless technologies through new business models, the industry game between the global players, and integration of methods in new strategy formulation process. This approach combined the theoretical framework in practical and innovative problem-solving. The related publications, their relation to research questions and research results are explained in more detail in chapters Outline of the Study, Summary of the Publications, and Review of the Results.

As manager of the project and innovator of the primary solution, I have also contributed to other parts of the project and been involved in the research of them (Bergman et al. 2004; Bergman et al. 2003; Edelmänn, Laaksonen, Lopperi, Soinenen, Bergman, Kytölä, Korppas, & Sissonen 2002b; Edelmänn et al. 2002a; Edelmänn, Kyläheiko, Laaksonen, & Sandström 2003b; Edelmänn & Laaksonen 2002; Edelmänn & Laaksonen 2003; Laaksonen, Lopperi, Bergman, Soinenen, Kanerva, Edelmänn, & Kytölä 2002; Laaksonen & Edelmänn 2003; Laaksonen, Edelmänn, & Suikki 2001b). Due to the structure of this dissertation, however, those publications have been restricted out of the scope of the study. The results show that the author has actually obtained a deep understanding of the topic area both theoretically and practically.

Figure 11 explains the hierarchy of the constructions of this research, their relation to the whole project and their relation to methods.

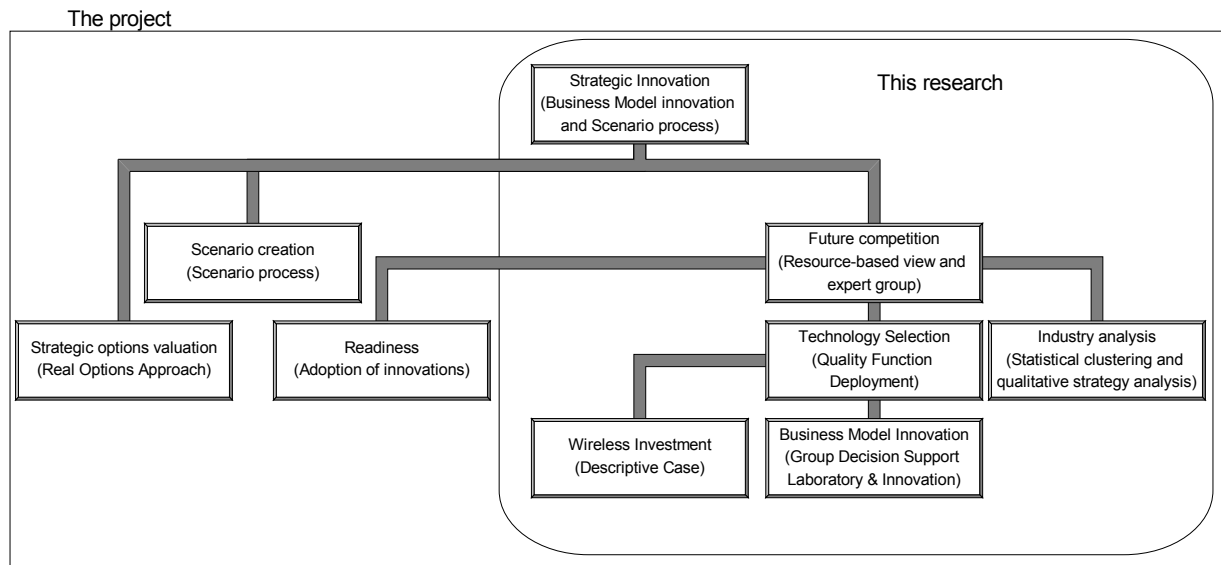


Figure 11. The hierarchy of constructions in the research

As defined by Kasanen, Lukka and Siitonen (1993) constructions can be models, diagrams, plans, organizational structures, and information systems designs. In this study constructions are business model innovation (process), technology selection (application of a method), industry analysis (integration of statistical and qualitative methods), competition analysis (process), and finally strategic innovation (process). Strategic innovation process is the main level construction in the hierarchy of the constructions for this study.

1.8 Restrictions and Limitations

Some assumptions and limitations were made in the beginning of the research. Firstly, the focus was chosen based on the assumption that the diffusion of applications utilizing wireless technologies would begin in firms rather than in the consumers segment as it happened with PC's and mobile phones. This development could be understood by the competitive forces arising due to new business models of firms. Therefore, consumer and society services and needs were restricted out of the research scope. The study focuses on the benefits which firms could achieve by applying wireless technology in a radical way.

Secondly, it was assumed that the corporate segment would follow the development of E-Business on the Internet. This kind of development took place in firms already with the Internet in the USA and Europe. Therefore, it was justified to assume that firms had already learned to use Internet applications, and such functionality would be required also in wireless applications. Existing mobile applications at the onset of the research in 2001 were so simple from the functionality point of view that it was difficult to see them gain a lot of ground as a user interface compared to web pages.

Within the focus of the research there were two industries: the information and communication technology industry (ICT) and the paper industry both of which are global. Leading players within the industries are large companies like Microsoft, IBM, Nokia, Vodafone, Ericsson and Motorola in the ICT industry; and International Paper, Stora Enso and UPM in the paper industry. Both industries have

a great impact on the Finnish economy. They differ a lot in structure, maturity, and resources. The firms also have a large, global customer base and complicated processes.

The paper industry was used as a customer industry to study the strategic customer needs in order to understand the change drivers for the ICT industry. The paper industry is a large and important customer for the ICT industry. The ICT costs in the paper industry are only around 1% of turnover; however, the impact of the ICT applications on the firms' profits is much more. From the value chain point of view, the ICT industry offers support services to the paper industry. In the future, new ICT applications will replace some end-user products (e.g., newspapers). Technology also integrates into traditional products like packaging (e.g., RFID³² in EPC³³). Especially the electronic distribution of content has become a real option due to the rapidly reduced cost per transferred unit. This can also have an effect on the economical configuration of the business models (e.g., degree of centralization in the production of end-products).

In the year 2000 Finland held the tenth position in the world as a paper producer. In 2002 the ranking had changed to sixth place (Metsäteollisuus ry 2003). The three biggest paper and board producer firms in the world are Stora Enso, International Paper (IP), and UPM. The traditional view of the paper industry cluster is formed of forest products production (chemical and mechanical) supplied by machine manufacturing, raw material and energy production, support services, and construction (Lammi 2000). First tier customers are usually value-add producers converting the raw material further. The value chain is very solid up to this point, and players in the value network rather dependent on each other. When moving to content production, paper industry products become only a minor part, in some cases alternative distribution media, competing of the final product offered to end customers. (See Figure 12.) For instance, media distribution can be made in another way than printing on paper.

³² Radio frequency identification (RFID) tags are small integrated circuits connected to an antenna, which can respond to an interrogating RF signal with simple identifying information, or with more complex signals depending on the size of the IC. Rolltronics' technology can produce thin, small and durable RFIDs in a cost-effective process. www.rolltronics.com/glossary.html

³³ The Electronic Product Code (EPC) is a new product numbering standard under development by the Uniform Code Council (UCC) that can be used to identify a variety of items using radio frequency identification (RFID) technology. The 96-bit EPC code links to an online database, providing a secure way of sharing product-specific information along the supply chain.

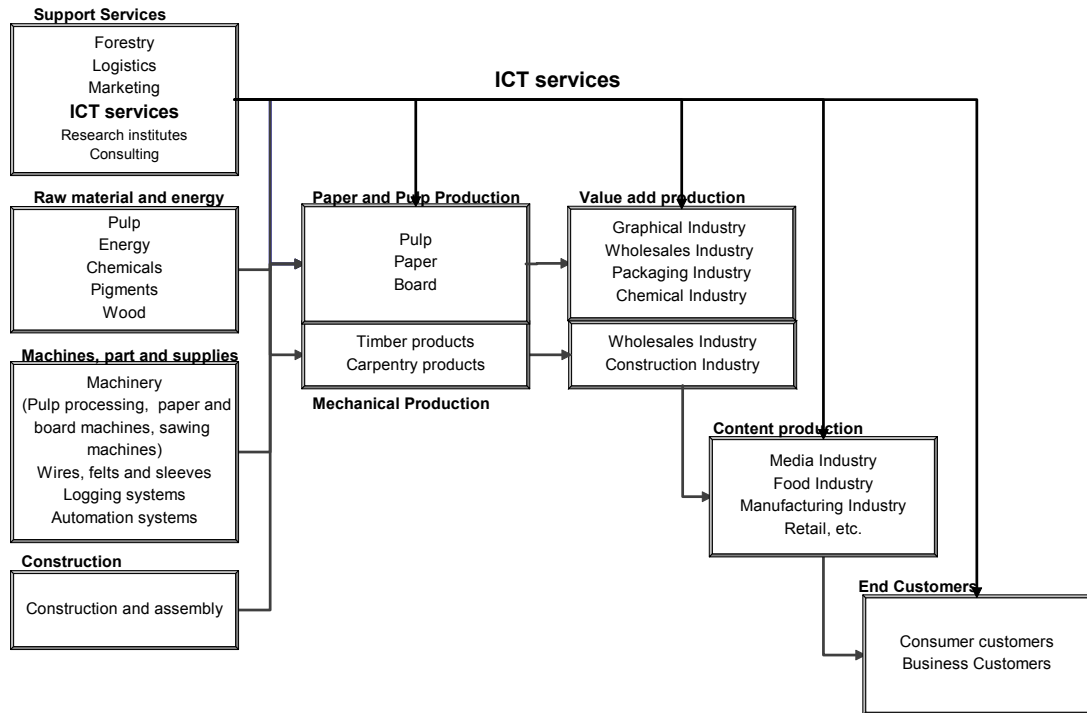


Figure 12. The forest industry value chain in relation to the value chain in the ICT services industry. Adapted and modified from Lammi (2000) and Paija (2001).

2 OUTLINE OF THE STUDY

The main goal of the research was to study and evaluate the wireless technology's impact on the firms' future competition. The main goal, its relation to the research questions and finally to research propositions are presented in Figure 5. The publications have been structured to answer the research questions following the research strategy. The relation between research questions and the publications is described in Figure 13.

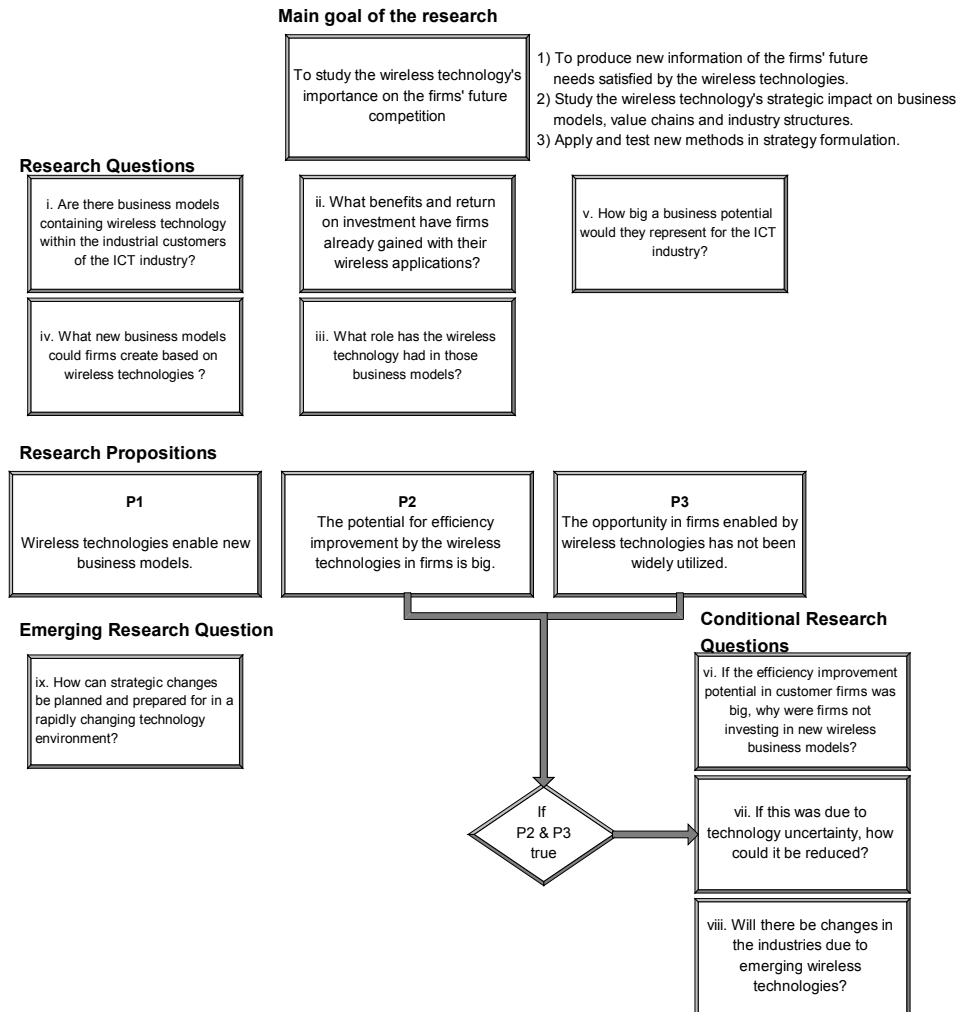


Figure 13. Research goal in relation to research questions and propositions.

The publications containing the research results respond to the corresponding research questions and link them to research propositions. The relation between research propositions and publications has been presented in Table 1.

Table 1. The publications in relation to research questions.

Research questions and proposals									
Publications	Q1 Are there business models based on wireless technology?	Q2 What new business models firms could create based on wireless technologies?	Q3 What role wireless technology has had in the business models?	Q4 What benefits and return on investment firms have gained?	Q5 How big potential they would represent?	Q6.1 Why the firms are not investing on wireless business concepts?	Q6.2 How to reduce market and technology uncertainty for the firms?	Q6.3 Will new business change industry structures and boundaries?	Q7 How can strategic changes be planned and prepared for in firms in rapidly changing environment?
	P1 Wireless technologies enable new business concepts.					P2 The potential for efficiency improvement by the wireless technologies in firms is big.		P3 The opportunity in firms enabled by wireless technologies has not been widely utilized.	
	Conditional Research Questions			Emerging Research Question					
Customer Need Assessment Of Wireless E-Business Applications In Paper Industry									
New Business Concepts and Efficiency Improvement in Paper Industry by Wireless E-Business Applications									
Firms' Wireless Application Needs Assessment in Technology Selection									
Players in the Emerging Mobile Internet									
Foresight into the Mobile Internet Game									
Managing Change - Strategic Innovation									

The research question “Why are firms not investing in wireless business models,” was related to the main construction (i.e., the project). The results concerning the readiness of the case industries to apply wireless technologies showed that the paper industry and the ICT industry are on different levels of adoption of wireless technologies. It also indicates that adoption of new technologies in organizations is a result of the balance between innovation, knowledge and learning (Bergman, Käppi, Taalikka, & Laaksonen 2004).

The contribution of the research can be presented as managerial or theoretical, but also as creating substantive knowledge or methods. The results present new knowledge into the discussion of the post-industrial phase of the industries by looking at technological uncertainties (like the terminal and access network development), based on the future needs of large corporate customers, the selection of technology based on application functionality, and the benefits of alternative investments. This reduces the risks for the firm’s investment decisions on infrastructure and standards. The results also present new information about the competitive landscape and changes in the ICT industry by analyzing the present firms and their pursued strategies. Finally, the results present new ways of applying methods improving the strategy formulation process by the triangulation of the strategic innovation and future research methods.

2.1 Summary of the Publications

The papers in this dissertation have been published and presented in academic conferences, in their proceedings and in other scientific publications. Table 1 links the publications with the research questions, and Table 2 summarizes the purpose, methods, and acquisition of data of the research papers.

The publications presented in Part II of this dissertation present results validating the chosen research propositions. The process starts by analyzing customer needs in the ICT industry, in this case the customer being the paper industry. Publication 1 presents a modified innovation method and its application to the paper industry. The purpose of the study was two-fold: firstly, to generate new wireless innovations for the firms participating in the sessions, and secondly to generate research data for the latter phases of the research. Publication 2 presents a case study of a radical business process improvement in the paper industry based on the wireless technology, and shows the profit potential of such an investment. Publication 3 summarizes the innovations generated and described in Publication 1, and compares them to available technology utilizing the Quality Function Deployment method. Publication 4 concentrates on analyzing the changes in the competition between firms in the ICT industry. It analyzes the resource allocations of the firms, and combines the results with publicly available qualitative information. Publication 5 proposes a method for a firm to evaluate its competence requirements in the future competition. Publication 6 presents an improved strategy formulation process combining separately tested methods into one. (See also Table 2).

2.1.1 Customer Need Assessment of Wireless E-Business Applications in Paper Industry

Laaksonen, P., Edelmann, J., Suikki, P. (2001). Published in the proceedings of The Australian and New Zealand Marketing Academy Conference, ANZMAC, 1–5 December 2001. Auckland, New Zealand.

The first publication concentrates on how beneficial future applications and business models can be generated for the case firms, two globally leading companies in the paper industry, Stora Enso and UPM, utilizing wireless technology. In this publication, the methodology was based on the lead-user method (von Hippel 1986) in the Group Decision Support Systems (GDSS) laboratory³⁴ for new business model innovation. Publication 1 provides results to support the research proposition P1 “Wireless technologies enable new business concepts”.

³⁴ Media technology used to promote idea creation and democratic decision-making in computer-assisted conferences. Source: highered.mcgraw-hill.com/sites/007248392x/student_view0/glossary.html

2.1.2 New Business Concepts and Efficiency Improvement in Paper Industry by Wireless E-Business Applications

Laaksonen, P., Edelmann, J. (2002). Published in the proceedings of International Technology and Strategy Forum, 15–16 October 2002. Berkeley, USA.

Publication 2 shows through a case investment that wireless technologies enable new, radically more efficient business models based on the radical improvements in factors of return on investment (ROI). It also shows that the model could not be created without the innovative application of wireless technologies. Publication 2 supports research propositions P2 “The potential for efficiency improvement by the wireless technologies in firms is big” and P3 “The opportunity in firms enabled by wireless technologies has not been widely utilized.”

2.1.3 Firms' Wireless Application Needs Assessment in Technology Selection

Laaksonen, P., Kärkkäinen, H., Koivuniemi, J., Tuominen, M. (2003). Published in the proceedings of the 12th International Conference on Management of Technology, IAMOT 2003, May 13–15, 2003. Nancy, France.

The third publication applies the Quality Function Deployment (QFD) method in technology selection. It utilizes the firms' future needs innovated in the GDSS laboratory in order to assist firms to choose technology under uncertainty. The method combines the understanding of the firms' future application needs, and links it with the present situation. It presents a new application of the QFD method to analyze and choose technology with a lesser risk. The application helps firms to avoid from choosing non-standard, dead-end technologies and increasing the possible applications to be used over the same equipment. Simultaneously it compares all the innovated solutions needs against available technologies and helps firms to choose an infrastructure which enables them to collect most of the returns of the applications on single infrastructure investment. Publication 3 answers to the conditional research question “How can market and technology uncertainty be reduced for the firms?”

2.1.4 Players in the Emerging Mobile Internet

Laaksonen, P., Puumalainen, K., Suojapelto, K., Tervonen, A. (2003). Published in the proceedings of the 12th International Conference on Management of Technology, IAMOT 2003, May 13–15, 2003. Nancy, France.

Publication 4 analyzes the structure of the global ICT industry, and presents as results the positioning of the leading ICT firms and the evaluation of their executed strategies. The publicly available annual report information of 32 ICT firms was gathered and unified for the study. The firms were clustered by factors generated from the gathered data. The qualitative information³⁵ was combined with the results of the statistical analysis in order to evaluate the probable strategic alternatives of the firms. Publication 4 answers to the conditional research question “Will new business models based on the wireless technologies change the structures and boundaries in the industry?”.

2.1.5 Foresight into the Mobile Internet Game

Laaksonen, P., Bergman, J.-P., Tervonen, A., Puumalainen, K., Suojapelto, K. (2003). Published in the proceedings of the 8th Summit on Mobile Multimedia and Communications, MOMUC 2003, October 6–8, 2003. Munich, Germany.

Publication 5 proposes a new way for the firm to analyze resource requirements in alternative future scenarios. This publication is by nature a theoretical research proposal, but as a result it extends the methodological use of the resource-based view as proposed, for instance, by Das & Teng (2003) developing their approach into future competition analysis by integrating scenarios into resource

³⁵ For instance, Internet reports, Magazines, Annual Reports and Investor Information.

estimates and competition about resources. Publication 5 answers the emerging research question “How can strategic changes be planned and prepared for in firms in a rapidly changing environment?”.

2.1.6 Managing Change — Strategic Innovation

Laaksonen, P., Bergman, J.-P., Edelmann, J. (2004). Published in the proceedings of Portland International Center for Management of Engineering and Technology Symposia PICMET '04. 1–4 August, 2004. Seoul, South-Korea.

The sixth and final publication integrates the methods into a new strategy formulation process by triangulating the methods presented in the earlier publications. Publication 6 integrates business model innovation in scenarios for the evaluation of the innovations in alternative futures based on the firms’ own competencies and resources answering the emerging research question “How strategic change be planned and prepared for in firms in a rapidly changing environment?”

The summary of the publications’ objectives, theoretical perspectives, methodology, research constructs and data, and the main contribution are presented in Table 2.

Table 2. Outline of the publications.

	Publication 1	Publication 2	Publication 3	Publication 4	Publication 5	Publication 6
Title	Customer Need Assessment Of Wireless E-Business Applications In Paper Industry	New Business Concepts and Efficiency Improvement in Paper Industry by Wireless E-Business Applications	Firms' Wireless Application Needs Assessment in Technology Selection	Players in the Emerging Mobile Internet	Foresight into the Mobile Internet Game	Managing Change - Strategic Innovation
Objectives	Find out if the firms had new radical ideas for applying wireless technologies in their business.	Show the potential of radical improvements in business models enabled by the application of the wireless technologies.	Analyze the innovations and test the technologies' match to requirements. Create proposal for technology standardization.	Analyze the strategic capabilities of the firms from a resource-based point of view.	Evaluate the ICT firms in the future competition from a resource-based point of view.	Create a new strategy formulation process integrating business model innovation, scenarios and strategic options into one process.
Theoretical perspectives	Innovation studies. Case study research (explorative) and constructive research approach.	Case study, within-case analysis (descriptive).	Technology selection. Case study research, cross-case analysis (explanatory) and constructive research approach.	Industry analysis. Cross-case analysis (descriptive) and a resource-based view of the firm.	Resource-based view. Cross-case analysis (explorative) and future research methods.	Future studies. Case research study approach. Qualitative cross-case analysis (explorative).
Methods and tools	Application of lead-user method in GDSS.	Description of the investment and achieved return on investment.	Quality Function Deployment (QFD).	Factor and cluster analyses combined with qualitative data.	Triangulation of the scenario method and qualitative data on the ICT firms.	Triangulation of the scenario and business model innovation methods. Strategy formulation methods.
Research construct / Acquired data	Creation of the research data by business model innovation of future business models enabled by the wireless technologies.	Large wireless process innovation in the paper industry. One case.	Quality Function Deployment matrices analyzing the 98 innovations recorded in the GDSS innovation sessions.	Financial information from annual reports of global ICT firms 1999-2001.	Scenarios and qualitative data from the ICT firms.	Scenarios and business models.
Main contribution	Application of the GDSS in Business Development. Improvement in innovation process of strategic alternatives. Generation of 98 wireless technology innovations with firms in the paper industry.	Proving the potential of the radical innovations in-case enabled by wireless technologies.	Creation of standards for the partners and reduction of uncertainty. Strategy enhancement for partners. Application of QFD in a new area.	Collection and unification of the numerical annual report data of the 32 global ICT firms. Clustering of the firms and strategy analysis of the case firms.	Presenting an improved new method, based on the resource-based view. The method can be utilized in strategy development of any firm to analyze competence requirements in the future competition.	Showing that presented process with triangulation of the methods creates manageable constructs for the management to evaluate and decide upon. New methods.
Notes			Best student paper in IAMOT 2003, Nancy, France.			

3 METHODS APPLIED FOR DATA COLLECTION AND ANALYSIS

As earlier explained, rapid technological change creates a new design space for firms (Palmberg & Martikainen 2003). External uncertainty and the speed of change increased the need for internal changes which become an important source for competitive edge. Competition takes place between firms' business models and innovation; therefore, applying new technologies in new ways becomes more and more important in the tightening competition (Torkkeli 2002). Managing strategy is about making fast decisions on strategic options in an uncertain and fast changing environment still maintaining flexibility for unexpected maneuvers. This leads us thinking (1) how to improve innovation of strategic options, (2) how to analyze and develop ideas into investment proposals for accurate decision-making, (3) how to reduce technological uncertainty, (4) what kind of competition new investments will face, (5) what resources become important for the future success of the firm, and (6) how to manage the change from the present to future. The publications presented in Part II of this dissertation bring new knowledge on these questions. The chosen methods have been used to answer the research questions presented in Chapter 1.

The methods presented here are used to generate new radical business model innovations within the leading firms in the customer industry in order to understand the changes driven by the emerging technology in customer demand and need. The innovations made with the firms in the paper industry represent new strategic options for them. On the other hand, for an ICT firm they represent market intelligence responding at the right time and serving the customer need, linking these options for the two industries. This innovation method was used to generate research data and real ideas for the participating firms. The method for business model innovation and results achieved have been explained in more detail in Chapter "Lead-User Method for Business Model Innovation in Group Decisions Support Systems Laboratory" and Publication 1.

The ideas generated with the firms in the paper industry explained strategic customer needs. There was, however, real uncertainty hindering decision-making in both industries: what technologies would best solve the actual application satisfying the original customer need, and more generally, what technologies could form an infrastructure satisfying the majority of the needs? This kind of information would reduce uncertainty in decision-making, and ignite investment decisions. The Quality Function Deployment (QFD) method was used to analyze the technologies' applicability to those strategic needs. The application of the QFD method and achieved results have been explained in more detail in Chapter "Quality Function Development" and Publication 3.

The case research method (within-case analysis, descriptive) was used to describe a new business model, a successful investment, based on wireless technology. The findings of the case have been explained more thoroughly in Publication 2.

Statistical Analysis (factoring and clustering) was used in order to picture the present competitive environment in the global ICT industry, and the resource-based view to describe the future competitive environment. The results achieved by statistical methods from external data have been presented in Publication 4.

Publications 5 and 6 concentrate on further developing strategy formulation methods. In Publication 5, the resource-based view theory is applied in the analysis of the future markets competition. In Publication 6, the business model innovation and scenario process have been integrated by triangulation, which proposes a new strategic options evaluation tool to support decision-making in firms.

3.1 Methods for Innovation and Evaluation of the Innovations

3.1.1 Lead-User Method for Business Model Innovation in Group Decisions Support Systems Laboratory

Having the customer closely involved during new product development can greatly increase the success rate of new products (von Hippel, Thomke, & Sonnack 1999). Still, many companies do not effectively bring the customer into their new product development process. Von Hippel (1986) notes that users in general are strongly steeped in their present experience. The lead-users expect to benefit significantly by finding a solution to their needs. Lead-users are not the same as “early adopters”, i.e., people who purchase an existing product or service from suppliers operating in markets — lead-users have needs for products or services that do not exist yet (Figure 14).

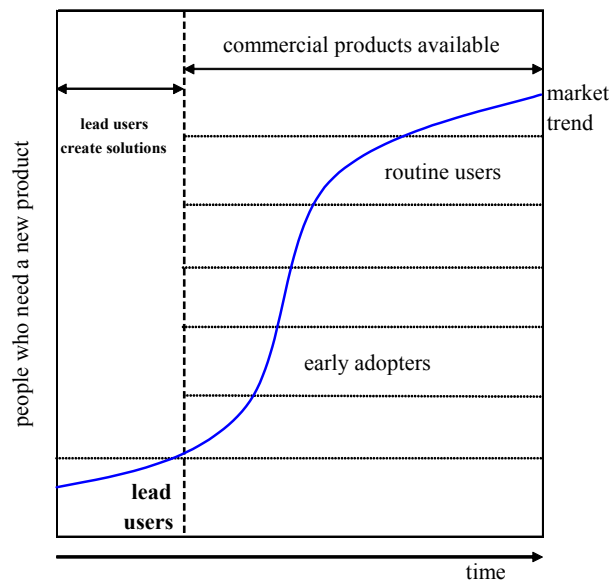


Figure 14. Positioning of lead-users relative to the market life cycle (von Hippel 1986).

Group decision-making process can be centralized (same place) or decentralized (different place); it can also be executed simultaneously (same time) or in steps (different time) as noted by DeSanctis & Gallupe (1987). The Group Decision Support Systems (GDSS) laboratory was founded in 1994 at Lappeenranta University of Technology in the Department of Industrial Engineering and Management. The GDSS laboratory in Lappeenranta is a modern meeting room facilitated with video projectors and group-ware to support different decision-making situations. The software consists of GroupSystems for Windows, Expert Choice, Idegen ++, I-Think, Decision Explorer and QFD Scope. The GDSS environment has been used earlier in product development and technology selection processes resulting in a research tradition in Lappeenranta (Piippo, Torkkeli, & Tuominen 1999; Torkkeli 2002).

In order to analyze the customer future needs possible to satisfy by wireless technologies, an innovation process for GDSS environment was developed. The developed process was modified and adapted from the lead-user method. The requirements of the new business model innovation process fit well with the design and equipment of the GDSS in the laboratory at Lappeenranta University of Technology. Business model innovation in Group Decision Support Systems follows a carefully designed process from brainstorming to evaluation and prioritization, and finally the selection of the

best ideas. The application of the method and the achieved results have been explained in detail in Publication 1.

From an operator's point of view, like TeliaSonera, the Finnish paper industry firms represent global customers. In this study, the lead-user thinking was adapted and modified to cover both parties in a business network assuming that partners in a business network can greatly increase the success rate of the innovation of new business models.

3.1.2 Quality Function Deployment

Quality Function Development (QFD)³⁶ is a method which was originally developed by Japanese firms for product development purposes. The method is based on translating customer needs in the functionality of the product or service in order to choose the best fitting technological solution and design for effective and successful deployment. The QFD method has been widely used in product development (Akao 1990; Bossert 1991; Daetz, Barnard, & Norman 1995). However, only in few cases the QFD method has been applied in research for service development in the ICT industry (Kyeongtaek, Kwangman, & Seungwoo 1996). Partly this indicates that the ICT industry has been in the past technology driven and is now facing a shift towards customer need driven industry.

In this research, the QFD method was adapted and modified into the selection of corporate standards for wireless technologies. The QFD method consists of six steps: (1) identifying customers' future application needs, (2) defining application requirements, (3) identifying present and future technologies available, (4) defining technology capabilities and restrictions, (5) filling in application requirements, and (6) summarizing technologies servicing best application requirements. (Adapted and modified from (Kyeongtaek, Kwangman, & Seungwoo 1996). The method consisting of six steps integrated well into the lead-user method. The first of the steps was performed through the business model innovation process in GDSS. The present and future technologies (step 3) was done as a separate research within the main project (Edelmann, Laaksonen, Lopperi, Soininen, Bergman, Kytölä, Korppas, & Sissonen 2002b; Kytölä & Sissonen 2002; Laaksonen, Lopperi, Bergman, Soininen, Kanerva, Edelmann, & Kytölä 2002) and was adopted into this study. Steps 2, 5 and 6 were done within this research. The results are presented in detail in Publication 3.

3.2 Methods for Analyzing the Firms and Competitive Environment

The analysis of the competitive environment combined the resource-based view (Barney 1997; Eisenhardt & Martin 2000; Wernerfelt 1984) with strategic positioning (Porter 1980) as presented in chapter 1.4. In order to analyze the changes in competition in the ICT and the paper industry, we had to concentrate on publicly available data. As earlier pointed out, the fact that data was available only on the firm level had to be accepted.

If we look at the context, the paper industry had been operating in global markets for many decades, probably for nearly one hundred years. On the contrary, for the ICT industry the global market was born only in the 1960's. There were a lot of export limitations in the USA for European countries still in the 1980's. Because of changes in world politics (like collapse of the Soviet Union), regulation was reduced and markets emerged.

The wireless technologies were creating a disruptive moment for the ICT industry, but consequently in the long run also for the paper industry. In this research, the focus has been on the merger of cellular and Internet markets into the Mobile Internet market. The players have been analyzed based on different available information like annual reports, investor information and press releases and technology strengths and weaknesses. In some cases it is possible to estimate the resilience of the

³⁶ A system of project management developed for use in very complex situations such as the production of automobiles. Especially useful to new products is the first part, the House of Quality, a careful statement of customer needs and wants for the item being developed, followed by stipulation of technologies that will be used to achieve each of those characteristics. Source: faculty.catawba.edu/jbgreen/DrGreen/glossary.htm

strategy through the success of the business models of the firms. The convergence of the markets is led by technology standards³⁷ and user requirements³⁸. In order to describe and understand the starting point, a simple chart was made to describe the financial resources of global players in the “Mobile Internet Game.” In the beginning three resource parameters were chosen to describe the firms in the game. The parameters were revenue, liquid cash reservoirs and return on capital employed. Revenue describes the size, cash reservoirs reflects the flexibility and power and ROCE the profit potential of the firm’s business compared to its capital requirement. It gave a starting point in understanding the complicated data about the players.

3.2.1 Statistical Analysis — Factoring and Clustering of the Data

When further studying the chosen firms, we gathered annual report data between 1999 and 2001 from altogether 32 firms. For each firm, data consisted of 158 variables. The firms applied in bookkeeping either International Accounting Standards (IAS) or different national principles. Due to the fact that the shares of all the firms were listed in the USA, they have to present their whole financial statements or at least their income and equity according to the US GAAP³⁹. All the financial data gathered was unified according to the GAAP regulations. Also, the forms for the US Securities and Exchange Commission (SEC) were used as sources of data. The currencies were converted into euros using the exchange rates of the Bank of Finland at the end of the year 2001. The firms were clustered into two cases: Changes 1999—2001, and ICT Cluster 2001. The first category grouped firms with similar developments over the period of three years, and the latter their financial position in 2001 at the end of the period. The strategy analyses were made by combining the statistical results with the qualitative information⁴⁰.

3.2.2 Evaluating the Firm’s Future Competition

The resource-based view suits well for analyzing firms in high-velocity market (Eisenhardt & Martin 2000; Kangas 2003b). We applied the resource-based view (Barney 1997; Eisenhardt & Martin 2000; Wernerfelt 1984) to evaluate the firms in the future competition i.e. in alternative scenarios (Bergman, Laaksonen, Edelmann, Suojapelto, & Käppi 2003). Further development of the theoretical view was based on the research report published by Das & Teng (2003). Evaluation was based on an expert team’s estimates of the resource requirements in a future scenario, and benchmarking the chosen firms against one reference firm, in our case Microsoft, in acquiring necessary resources in the scenario. Scenario creation was not within this research focus; therefore, the scenario method is not widely explained here (see also Figure 11: The hierarchy of constructions in the research). The presented methods based on combining the estimates of the resource requirements in the alternative futures (i.e., scenarios), and firms’ comparative strength in acquiring the resources in the alternative futures. Relative strengths in the alternative futures are achieved by multiplying the relative market requirements by firms’ relative strengths which represent the firms’ competitive position according to the resource-based view. Publication 5 explains the application of the resource-based view in more detail.

³⁷ For instance Internet standards like TCP/IP, HTML, WLAN and cellular standards like GSM, GPRS, EDGE, UMTS.

³⁸ The Internet application interface with Windows had become de facto standard, and the users would not accept anything of lower usability.

³⁹ Generally Accepted Accounting Principles. A standard established by the Accounting Practices Board of the American Institute of Certified Public Accountants. These rules, conventions, and procedures define accepted accounting practices. Source: www.kraft.com/investors/definitions.html

⁴⁰ Gathered from magazine articles, newspapers, the Internet, research reports, books and annual reports.

4 REVIEW OF THE RESULTS

The results can be dealt with by the analytical framework. If we look at the content, the research has created new information on the competitive environment in which the firms in the ICT and paper industry are operating. Contextually, the research increased knowledge about the change drivers of industries, like consolidation, globalization, and the impact of technology on industries, but also their interdependencies between these two clusters. From the process point of view, the final results are presented in Publication 6 (Managing Change — Strategic Innovation), which presents a new strategy formulation process linking the used methods into a generalized Strategic Innovation Process. The novelty of the results is in new knowledge and new methods. The results are discussed in the following in a publication, and then summarized in the end.

4.1 Customer Need Assessment of Wireless E-Business Applications In Paper Industry

In the year 2001 the number of radical business models utilizing wireless technology was small. Publication 1 addresses Research Proposition 1 “Wireless technologies enable new business models” where the focus is in the business model innovation process and creation of beneficial innovation for the case firms. The created innovations⁴¹ were also research data in the latter stages of the process (Publication 3). The property rights issues of the created innovations were dealt with, as von Hippel et al. (1999) suggest, in advance so that the arranging firm had all the rights to the generated ideas. Firms also had their partners in the innovation sessions; in these cases their service provider⁴². Due to the confidentiality of the innovations, the actual details of the business models could not be reported publicly. This is a normal situation in constructive research (Kasanen, Lukka, & Siitonen 1991; Lukka 2000; Lukka & Tuomela 1998). Therefore, the actual business models have not been presented in the results, but in the research report they were categorized and summarized on a categorical level in order to maintain the confidentiality, and to enable reporting the research.

4.1.1 Main Contributions of the Publication

The application of the lead-user method in this research explores business model innovation in a lead-user group, and brings a new research dimension into new product development research conducted earlier at Lappeenranta University of Technology. By merging business model thinking into the lead-user method, we applied the method in a new area of research. The method has been earlier applied in product development and technology selection, but now it was applied in business and strategy development.

As the broad research question was to analyze the impact of wireless technologies on the firms’ business models, the process was tuned accordingly. During the study we held altogether five innovation sessions with different firms. One of the sessions was held in the USA at San Francisco State University. All the sessions were steered through the same process, which allows certain amount of flexibility within a session. The participating firms were large global firms and small regional firms. The results show that the innovation process can be reliably repeated and transported, and is independent of the participating firms.

The results show that it is possible to repeat the developed process in GDSS and to create new business models proactively. Results also show that there are differences between industries, but usually no big differences in the execution of the innovation process itself. The process was repeated altogether five times with the same steps and in each of the sessions 50 new ideas on average were

⁴¹ Altogether 97 from the first two sessions with paper industry firms (Stora Enso and UPM).

⁴² TeliaSonera

generated⁴³ which contained both incremental and radical ideas. The distribution between incremental and radical ideas seems to depend on the group members' capabilities, but this needs further research⁴⁴.

Business model innovation during the innovation sessions was possible only on a business idea level, describing roughly the idea and few main elements of the configuration, and the general functionality of the model. In order to make strategic decisions based on the ideas, however, the models have to be further developed towards a solid configuration of the business model allowing then the evaluation of the strategic potential of the model⁴⁵.

According to Eisenhardt & Martin (2000) the developed process can also be recognized as a dynamic capability, if properly and consistently performed.

Hamel (2000) suggested that business model innovation is dependent on the entrepreneurs in the firm. The innovation sessions, however, indicate that supporting proactive innovation creation within a group can lead to much better results than just hoping that someone in the organization was revolutionary. By utilizing business model innovation with lead-users, the firm can reduce uncertainty of the idea creation and increase the volume of innovation. The number and applicability of the business model innovations made in the GDSS prove Proposition 1 true: There are a lot of opportunities for new, beneficial business models enabled by the wireless technologies.

4.2 New Business Concepts and Efficiency Improvement in Paper Industry by Wireless E-Business Applications

In the beginning of the research there was discussion, whether wireless technologies represent only an access and allow only a new type of access to firms' systems. It was not clear at all that wireless connectivity could expand the functionality of applications, and additionally enable new process configurations. The case replied to research questions "Are there business models based on wireless technology?", "What benefits and return on investment have firms gained?", and "What role has wireless technology had in the business models?" The purpose of this publication was to validate Research Proposition 2 "The potential for efficiency improvement by the wireless technologies in firms is big."

The case presents wood procurement system investment⁴⁶, a new business model i.e. large radical process innovation enabled by the wireless technology. The investment was started already in 1990, much earlier than most of the other applications found in Finland. By the generous help of the Stora Enso management, detailed information of the return on investment was made available.

4.2.1 Main Contribution of the Publication

The publication is based on the case study research method, and presents the effects of a new business model. As a case-in study, it shows that it is possible to achieve remarkable efficiency improvements by the application of wireless technologies. The process, in which the technology has been applied, contains large quantities of material logistics, geographic coverage of a country, changing demand and supply side effect (dynamic), and involves a lot of capital tied into the process. The case results can be

⁴³ The innovations were mainly made during the brainstorming phase of the process, which normally took 30–40 minutes. After that the active brainstorming phase was finished and the following phase initiated. However, the GDSS tools allow users to enter new ideas in the latter phases of the process as well.

⁴⁴ The division of the ideas into incremental and radical is partly subjective and was formed by the members of the group. However, radical ideas had to be new business process innovations according to definition.

⁴⁵ Descriptions of the business concept configurations, based on the ideas generated in the sessions, must be made by an expert group after the innovation session.

⁴⁶ Stora Enso

generalized in other similar industries like steel, farming, and postal services. It can be, therefore, argued that Proposition 2 “The potential for efficiency improvement by the wireless technologies in firms is big” was proved true.

As noticed in the innovation sessions, there are a lot of useful innovations for the paper industry utilizing wireless technologies. Combining the conclusion of the innovation sessions with findings of the expected high potential also indicates that the organizational learning had not started. By combining the ideas generated and reported in Publication 1, case results in Publication 2 (the Stora Enso Case), and the results of the Master’s Theses by Hiltunen (2002) and Korppas (2002), Proposition 3 “The opportunity in firms enabled by wireless technologies has not been widely utilized.” can to certain extent be accepted to be true.

The technology represents the enabler’s role in Stora Enso innovation. Publication 2 shows through a case that a new, more efficient business model can be created by wireless technologies, and more importantly, some of them can be done only with wireless technology. In the case, the actual return on investment is achieved by better optimization of the process. However, the new process could not have been made with other technologies, but the wireless technology, due to the real time need of the actual status data from the process for planning purposes.

4.3 Firms' Wireless Application Needs Assessment in Technology Selection

The main objective of the study was to reduce the uncertainty in technology selection for the participating firms, and to enable the firms to create sustainable standardization for equipments, applications and support as the research approach in this study represents constructive research (Kasanen, Lukka, & Siitonen 1991).

The study concentrated on summarizing innovations created in the GDSS laboratory (Publication 1), and on the formal evaluation of the application needs by Quality Function Deployment (QFD). The available technologies were estimated against the innovation needs, and the best suitable technology was chosen accordingly. QFD had been used earlier in product development in manufacturing firms, and only in very few cases in service development in ICT industry services. In this publication, QFD was applied to wireless technology selection for a firm. The technology standard proposal arises from the best match of 98 functional needs of the two paper industry firm lead-user sessions. Publication 3 was awarded in IAMOT 2003 conference in Nancy, France, as the “Best Student Paper”.

4.3.1 Main Contribution of the Publication

Earlier, the QFD method had not been widely adopted into technology selection in service development (Kyeongtaek, Kwangman, & Seungwoo 1996). The novelty of this study was in the application of QFD in wireless technology selection based on customers’ future needs. Also, the resulting knowledge of the applicability of the technology to the functional requirements of the firms was valuable for the case firms⁴⁷.

The research results of Publication 3 concentrate on answering the question “How can market and technology uncertainty be reduced for the firms?”. The publication applies the QFD method to the ideas generated in the GDSS laboratory, and improves the technology selection for a firm to fit all the future application requirements. Uncertainty arising from the huge variety of technologies has been one of the drags in firms on the investments in wireless technology.

As results, the publication presents an infrastructure standard to satisfy the future needs of the lead-users. The standard consists of the selection of terminal and access network technologies to achieve the maximum return from firms’ future applications and to avoid technology risks. The method also reduces the uncertainty from the service and technology provider’s⁴⁸ point of view. As managerial

⁴⁷ Modultek, Stora Enso, UPM and TeliaSonera.

⁴⁸ E.g., TeliaSonera.

results, the proposal helped one of participating firms to enhance its strategy as expected in constructive research.

In a strategic context, the study also shows that the majority of the benefits achievable by investments in wireless technologies could be achieved with existing technologies. Taking into account the lead-time of large systems and process changes, normally a minimum of two to three years, firms should already begin the investments due to the rapid development of technology⁴⁹. For a supplier of the industry, this means that the market is about to start growing. Success, however, requires a different approach. Suppliers must be able to reduce risks in equipment investments, for instance, by leasing the infrastructure. Suppliers could also offer support to their customers' process development in order to bring up the opportunities enabled by the emerging technologies. This means a deeper understanding of the customer industries and their strategic intentions. Finally the technology selection links the customer needs to the ICT industry's future competition. This link can be considered vague based on the results, but by analyzing more industries the relation would be more reliable.

4.4 Players in the Emerging Mobile Internet

The competitive environment in the ICT industry was about to enter a new era of rapid technological change enabled by competing wireless technologies. It seemed important to increase the level of understanding of the firms in global competition. The results of Publication 1 showed evidence of large undetected potential in firms; the results of Publication 2 gave evidence of good return on investment in the case study; and the results in Publication 3 of the best fitting technologies and standards suggest that there would be an impact on both industries, the paper and the ICT industry.

Publication 4 introduces a new term the *Mobile Internet Game*. The term is based on the earlier finding of the Internet and mobile market's collision and merger into one (Edelmann, Kyläheiko, Laaksonen, & Sandström 2003b).

The focus of Publication 4 is on the global ICT industry firms, their competitive strategies and strategic intentions. The publication summarizes the leading firms in the global ICT cluster and enlightens the research question "Will new business models based on the wireless technologies change structures and boundaries in the industry?"

The publication analyzes the chosen firms based on their financial capabilities' point of view. The study follows a descriptive cross-case analysis (Eisenhardt 1989a). Factor and cluster analyses were used to group altogether 32 firms into manageable groups. The results of the statistical analysis were combined with qualitative information gathered from different sources resulting in an estimate of the intended strategies of the firms and their financial flexibility to execute their chosen strategy.

4.4.1 Main Contribution of the Publication

Publication 4 presents new knowledge about the leading ICT companies, based on annual reports and other publicly available information. This leads into what strategies the studied firms can exploit and are exploiting. The publication presents new information on the ICT industry change drivers for future research and a strategy analysis of the leading firms, to understand better the starting points of the firms in the changing ICT cluster. The contribution of the publication is mainly managerial. The global paper industry firms were analyzed with the same methodology.

The results published in Publication 4 did not theoretically or methodologically create anything new, but pointed out the need for further strategic research: today it is possible to collect easily vast amounts of data, but there is need for a method to analyze complicated numeric and qualitative information on the networked firms and their intentions for strategy formulation purposes. Knott (

⁴⁹ Moore's law shows that performance of technology is rapid and continuous. In 18 months the performance of technology will double. This solves the majority of the piloting level problems in the implementation phase. This argument was also proved in the Stora Enso case.

2003) has applied a simulation to the innovation of the firm, but the entity of complicated dependencies requires a lot more research. In strategy analysis, it is no longer enough to understand one firm and its competitive position, but the understanding of the dynamic value-network and inter-dependencies of the linked firms becomes more and more important.

4.5 Foresight into the Mobile Internet Game

Publication 5 focuses on the research question, which emerged during the work: “How can strategic change be planned and prepared for in a rapidly changing technology environment?” The leading idea is the firm’s future competition in alternative scenarios. Depending on the alternative futures, the starting point, both financially and capability-wise, and the path dependencies lead firms into different kinds of competitive situations in the future markets. The study combines in an innovative way (Kasanen, Lukka, & Siitonen 1993) the results of the quantitative information collected on the case firms and the results from Publication 4, scenarios (Bergman, Laaksonen, Edelmann, Suojapelto, & Käppi 2003), and an application of the resource-based view theory (Barney 1991; Eisenhardt & Martin 2000; Kangas 2003b; Teece, Pisano, & Shuen 1997; Wernerfelt 1984) in analyzing the future competition of the firms.

The method combined the future competitive environment with firms’ relative capabilities, and finally estimated their competitive positions in the futures relative to one of the chosen firms. The example presented in Publication 5 shows that even though Microsoft seems to be outlying the clustering (Publication 4) exceeding all the measures, in some of the futures Nokia could be more competitive. For the management of Nokia, this should mean that these favorable futures are the ones to strive for in order to win Microsoft in the Mobile Internet Game. Finally, the method also reveals the competence gap between the present and the intended future.

4.5.1 Main Contribution of the Publication

Publication 5 utilizes the futures research conducted in Lappeenranta, and expands the firm’s strategic competition analysis into alternative futures. The main contribution of the results in the publication is in presenting a new pragmatic expert group method for analyzing alternative futures and their competence requirements during strategy formulation. This assists the management to improve the firm’s success in future competition. The application of the resource-based view was based on Das & Teng’s (2003) application of the theory, and follows its proposal for its development. The study strives to show that future competition between the firms can be evaluated in an expert group through an analytical method. The value of the application of the method can be proved only when applying the method to practice in the firms’ strategy planning processes. The quantitative results of the publication were produced by the research team, and therefore, cannot be held very reliable as such.

4.6 Managing Change — Strategic Innovation

In emerging industries, innovation is the firms’ primary resource to gain competitive advantage. Today, firms do not have effective methods for analyzing strategic alternatives to full extent. New technologies and the emerging business environment create threats and possibilities, but very little attention has been given to strategic innovation.

As noted by futures researchers (Meristö 1990; Schoemaker & Gunther 2002), future is not something that happens; it can be also affected. The challenge for the firm’s strategy formulation in a rapidly changing environment lies in questions like “how to recognize and manage multiple new opportunities enabled by rapid development of technology”; “how to maintain the competitiveness of the present business model in lesser time”; “how to understand uncertainties embedded in alternative futures”; “how to evaluate market potential of the new alternative business models in the futures”; “how to realize the change of the resources and capabilities that the firm possesses today and understand the limits of how much and fast a firm can change”; “when to execute the change”; and “in what steps the change should be promoted.” (E.g., Bowman & Hurry 1993; Eisenhardt 1989b; Eisenhardt & Martin

2000; Hamel 2000; McGrath & Nerkar 2004; Mintzberg & Lampel 1999; Porter 1985a; Prahalad & Hamel 1990; Teece 2003).

Publication 6 continues focusing on the emerging research question “How can strategic changes be planned and prepared for in the rapidly changing technology environment?” The publication presents an innovative method which is based on the triangulation of the business model innovation method (presented in Publication 1), the scenario method (Bergman 2002), and the strategic options approach (Bowman & Hurry 1993; Edelmann, Kyläheiko, Laaksonen, & Sandström 2003b; Edelmann et al. 2003a; Jantunen 2000; Stähle, Kyläheiko, Virkkunen, & Sandström 2002) for the formulation and management of strategy in the rapidly changing environment.

4.6.1 Main Contribution of the Publication

Publication 6 presents an important methodological improvement in strategy formulation by triangulation of the innovations in alternative futures (i.e., scenarios). The ideas created in the innovation process can improve the scenarios and bring new dimensions in scenario creation. On the other hand, the innovation process is enhanced by scenarios; due to new ideas emerging from the scenario process.

The publication also presents an amendment and modification into von Hippel’s (1986) lead-user method for strategy formulation. The expansion of the lead-user method led us to develop the steps in a strategic innovation process:

1. Set-up an expert group
2. Gather information about trends (and present situation)
3. Network with leading experts in the world
4. Create and collect *business model* innovations
5. *Describe business model innovations in detail*
6. *Evaluate and select business models from the strategic portfolio*
7. *Plan the implementation of the chosen models in detail*

(Adapted and further developed (*italics*) from von Hippel (1986)).

Later the developed method has been successfully adopted in other projects for other industries (Bergman et al. 2005). The contribution of this publication is a *new, improved strategy formulation process by triangulation of the used methods* for firms in the rapidly changing environment. It takes into account the changing internal and external environments, involves strategic partners into the process, and is effective and easily repeated (Laaksonen, Edelmann, & Suikki 2001a; Laaksonen, Edelmann, & Suikki 2001b).

Finally, Publication 6 integrates the earlier applied methods and the gathered and created knowledge into a new, effective strategy formulation process. Theoretically the proposed process integrates the internal view (RBV) and the external view (Strategic Positioning) of the firm into a dynamic innovation process, which can be a source of competitive edge.

4.7 Summary of the Results

Constructive research can be phased into 1) finding a practically relevant problem, 2) examining the potentials for long-term research co-operation with the target organization, 3) obtaining a deep understanding of the topic area both theoretically and practically, 4) innovating a solution idea and developing a problem-solving construction, which also has potential for theoretical contribution, 5) implementing the solution and testing how it works, 6) pondering the scope of applicability of the solution, and 7) identifying and analyzing the theoretical contribution (Kasanen, Lukka, & Siitonen 1991). As shown in the methods and results, this research can lead to a deep understanding of the topic

area both theoretically and practically. Also, the constructions proposed are innovative. Testing of a construction is always difficult, and it can be said that in this case testing of the proposed constructions requires more work to obtain solid results. Theoretically, the results fill in a research gap, which has been pointed out in the literature both in the industry analysis point of view as well as from strategy formulation methods in the rapidly changing competitive environment. Simultaneously it is strongly supported by the literature on the resource-based view and positioning strategists.

The summary of the results consists of the following findings:

- Wireless technologies have not been applied widely; even though technologies are mature enough to result in great benefits, when applied.
- There are a lot of opportunities for radical process improvements in firms.
- Opportunities include high competitive potential.
- The majority of new opportunities have not been recognized.
- The impact of the new wireless applications will be strategic to industrial competition in the focus industries (ICT and paper industry). The impact will be great probably also in other industries.
- The main problem today in firms is that they concentrate too much on incremental improvements and too little on innovation on the strategic level.
- Present strategies repeat themselves, and there is not enough emphasis on new business models challenging existing strategies. This leads into imitation and decreasing returns.
- Known methods can be applied reliably, as proposed, in order to improve the quality of strategic work and to create sustainable competitive edge.

5 CONCLUSIONS

5.1 Research Question, Propositions and Results

The broad research question of this study was to understand the strategic impact of emerging wireless technologies on the competition between the business models of firms. As presented in “Objectives of Study” there were three main level goals in the research: to produce new information of the firms’ future usage of the wireless technologies, to study the wireless technology’s impact on business models and industry structures, and to apply and test new methods in strategy formulation. The propositions derived from the research questions were P1) wireless technologies enable new business models; P2) the potential for efficiency improvement by the wireless technologies in firms is big; and P3) the opportunity in firms enabled by wireless technologies has not widely been utilized.

The results of the research indicate and partly prove that all the three propositions presented are true. Wireless technologies enable new business models for the ICT and paper industries. The results of the innovation sessions held, and the Stora Enso’s wood procurement case show that in the paper industry P1 and P2 are true: wireless technologies enable new business models, which could not be created without the technologies. Also, the profit potential of the models can be big. The extent of the installations is still narrow, and there are only few real investment cases in the focus industries (Hiltunen 2002; Korppas 2002). This indicates that P3 is true in these industries.

The success of the firm is dependent on its ability to innovate new resource configurations, i.e. business models, which combine new customer needs and opportunities enabled by technologies in new, effective ways, and balance the implementation speed of its strategic options with external competition and internal learning capability.

Business model innovation is not a value in itself, but it creates value when the existing strategy is continuously monitored and challenged by innovative new business models. Future and new business models contain uncertainty. A successful strategy in the fast changing technology environment contains elements of correctly made choices between alternative resource allocation decisions containing uncertainty still maintaining maximum flexibility. The key issue in strategy formulation in times of uncertainty is to build flexibility for the firm by multiple and competing investment alternatives, i.e., business models from which the firm can choose the ones it wants to implement. These alternatives also reveal the future competence requirements and the gap between present and future competencies. As a result strategic innovation gives more time for the management to prepare for changes and therefore brings flexibility in investment decisions.

The introduction of wireless 3G services has been delayed in Europe due to a financial crisis followed by the UMTS license auction sales. Additionally, there has been lack of new business models and loose connections between business actors (Kallio 2005). Operators have focused on offering services to consumers and neglected the strategic needs of their corporate customer segment. New markets but also new competition, however, arises in the ICT market due to rapid technological development. Wireless technologies are merging into one large hybrid network containing different technologies⁵⁰.

The operator environment becomes more complicated, because the user can access services through many networks on multiple devices. For the equipment manufacturers and the service providers, the market place expands when PC and cellular markets merge. The new market requires skills from firms in multiple technologies to succeed. This leads in the development of new competences in firms either organically or externally through mergers (or alliances) between firms. In the rapidly changing technological environment for industrial firms, like the paper industry, strategic partnering with key technology and service providers becomes a source for new growth and competitive edge through strategic innovation in the value network.

⁵⁰ For instance, GSM, GPRS, EDGE, UMTS, WLAN, and GPS.

The problem with the Porter's competition model is the outsider's view (content – outer context). The industry and industry competition, from the firm's point of view, is never the same. Porter (1980) has described the nature of the emerging industry extensively. The competition model applies well to the general structure of the competition within an industry. Also, the general laws of competition, for instance, entry barriers, are valid. However, the sources for and the level of profit and competition in the firms in an industry normally differ. This applies also to the ICT industry. Porter's model does not offer good enough tools to analyze these differences.

The future success of firms depends on the efficient configuration of their business models and the firm's capabilities to match the offering to external changes and even drive them. The example shows that the competitive landscape is always different for each firm, and competition takes place between business models, not firms. Due to the path dependencies, firms choose the most suitable business models for them to develop, and therefore, firms also differ by resources, skills and competencies, capabilities, culture and organizational configuration. In the academia there has been debate about the terms *evolution* and *revolution*. The question to my mind, however, is more or less semantic. Rapid changes take place and high-velocity markets exist. The speed of change is always depending on its factors: the size of the change and the relative time requirement for the change.

To summarize the contribution of the results of my research, they can be divided as in constructive research into four elements: practical relevance, practical functioning, theory connection and theoretical contribution (Kasanen, Lukka, & Siitonen 1993).

5.2 Theoretical Contribution of the Research

Competition takes place between business models, and is affected by the resources of the firms (Hamel 2000; Porter 1980; Wernerfelt 1984). Business models are the resource configurations of a firm, and their success in competition represents the level of dynamic capabilities of the firm. The success of a business model depends on how well a business model fits with the company and its customers. The pace of renewal in the firm is, therefore, dependent on the competitive forces of externally competing business models satisfying the changing customer needs, and on the firm's capabilities to create and develop internally required new skills and competencies and the dynamic capabilities innovating new resource configurations, i.e., business models from them. The success of a business model is dependent on an innovative configuration of the model, primarily creating its profit potential, as well as the continuous development of the model. A successful business model adapts to technological maturity as well as to the readiness of the customers. The business potential of the business model depends on the future market size, diffusion speed of the innovation, efficiency of the business model compared to competitors as well as the protection of the business by temporary monopolies. The business potential of a business model also depends on the firm itself, because success is tied into the firm's own capabilities as well as its resources (path dependencies).

Business model oriented research has not achieved a lot of attention with the economists. Partly it can be due to the fact that it is difficult to get access to extensive business model level data for statistical analysis from external sources, when most of the large, successful firms are multi-business-model firms.

In this study the theory connection has been presented in Chapter "The Theoretical Framework of the Research." The main theoretical contribution of my research can be seen in the improvement and application of the innovation methods in strategy formulation. The constructions presented in the research integrate theories of the resource-based view, strategic positioning and dynamic capabilities and integrates the customer future needs and scenario planning methods in a logical and repeatable way. The results support the findings of the other researchers (Eisenhardt & Martin 2000; Ray, Barney, & Muhanna 2004; Spanos & Lioukas 2001). This study further develops one dynamic capability, strategic innovation.

As a method for strategic innovation in firms, the lead-user method has been developed further. New applications of methods were made in GDSS and QFD. New methods were developed for analyzing future competition and strategic innovation.

The last two publications propose that the future competitive situation can be evaluated in scenarios from the resource-based view, and that the triangulation of business model innovation method with the scenario method combines the external changes into internal opportunity detection and assist the management in faster strategic decisions (Eisenhardt 1989b; Eisenhardt & Martin 2000).

5.3 Managerial Contribution of the Research

Managerially, the contribution of this dissertation has been in the creation of new understanding considering the emergence of the Mobile Internet, and its impact on case firms' business models in the paper and ICT industries. The practical relevance and functioning of the constructions have been explained in more detail in the publications in Part II of this report.

In constructive research the market-based validation can be made by three leveled test including weak market test, semi-strong market test and finally with strong market test. (Kasanen, Lukka, & Siitonen 1993) The weak market test answers the question: "Has any manager responsible for the financial results of his or her business unit been willing to apply the construction in question in his or her actual decision making?" The semi-strong market test has to fulfill the criterion: "Has the construction become widely adopted by companies?" and finally the strong market test validation by criterion: "Have the business units applying the construction systematically produced better financial results than those which are not using it?"

When looking at the criteria, it can be said that constructions presented in the research pass the weak market test. For instance the business model innovation-process has been applied altogether five times during the project and many times after the project. Passing the semi-strong test requires wide adoption or diffusion of the construction. It cannot be said that any of the constructions involved in my research would have passed this strong validation.

As pointed out, the constructive research approach can result in problems when publishing the results (Kaplan 2004; Kasanen, Lukka, & Siitonen 1991; Lukka 2000). This problem arose with the results of the business model innovation sessions with the case firms. The innovations were held as trade secrets, and they could not be reported publicly. However, evaluating the innovation requirements from the wireless technology and summarizing the results for technology selection solved the problem from the point of view of research propositions.

The large data banks collected from firms' annual reports and other available public sources during the research also build solid bases for future research. New managerial knowledge created in my research is the following:

- The new innovations for the case firms, altogether almost 250.
- The functional requirements of the innovations from the wireless technologies and architectures.
- Analysis of the players of the Mobile Internet (resource based-view) and their assumed strategies.

These results reduce the uncertainties embedded in customer future needs, technology, and the competitive landscape.

6 DISCUSSION

The meaning of innovation has increased rapidly over the past years. The firms in Finland are beginning to realize that knowledge and innovation are the sources for competitive edge in the networked business environment. Owning physical assets is less important compared to the management of the business model (Zysman 2004). Innovation, however, is still an underutilized opportunity in firms. Even though Finland has been recognized a leading country in innovation and competitiveness^{51 52}, the applications of wireless technologies are still in their initial phase in firms. The market is unstructured and has started growing; however, the potential for growth seems great. Looking twenty years ahead, it is easy to say that wireless technology, as such, has lost its interest being a new and interesting research subject. The technology will be largely integrated into many corporate, individual and social purposes. The strategic impact of the technology has not been widely understood in firms. The learning, however, and therefore the diffusion of the innovation has already started. At this point, innovation of new strategic business models with key business partners, as presented in results, will generate new competitive potential for ICT firms.

For the evaluation of the business opportunities in alternative futures, it is very important to understand future customer needs and benefits driving the investments. This means focusing on customers' strategic challenges and probable new business models. Due to the trend of business networking and outsourcing, the innovation process should involve the strategic partners from suppliers and in some cases even competitors.

Business model innovation gives foresight on beneficial innovations and their importance for the firms. The innovation method with strategic partners will give all the participants new information on the alternatives in the future, and increase understanding within the partners in the business-networks of the impact of the technologies on their present business models.

In order to understand the future, it is important to understand the present and how we got here. Forecasting methods like diffusion models can estimate the development of existing phenomena, or try to forecast new developments based on past learning. Analyzing the existing environment or forecasting the future based on past information provides good tools for strategy work. Mathematical modeling, including statistical methods, as used in the publications, is good for understanding the past, the present and continuum. For strategy formulation, recognizing the discontinuities is important and they cannot be forecasted by mathematical models. Therefore, mathematical modeling is not enough for strategy work; more views are needed.

Due to long lead-times in large change projects within organizations, the lead-user method applied in new business model innovation creates us knowledge of changes in competition by defining the future customer needs and requirements from technologies in the near future. The lead-user method concentrates on the people in organizations who can see their future requirements. Therefore, lead-user methods give us information on when the changes will start happening and to certain extent why. The business model innovations indicate the profit potential of the innovation for the owner of the model, but also to the partners of the model owner. Very often technology enabled business models require a system level diffusion, and therefore, require co-operation between partners.

Measuring the readiness of firms can be based on the readiness index developed (Bergman, Käppi, Taalikka, & Laaksonen 2004). Readiness indicates the lead-time for the innovation to mature in the markets. Readiness differs between industries and firms due to differences in the competitive environment. Readiness is a measure of the learning, innovation and knowledge levels in the

⁵¹ According to the EU Innovation Scoreboard 2002, for instance, Sweden and Finland are the two innovation leaders measured by 14 indicators among the EU Member States (Alasoini 2003).

⁵² The United States and Finland have the most competitive economies in the world. Finland (1) remains in the lead among nations with less than 20 million inhabitants (Alasoini 2003).

organization indicating the organization's readiness to adopt an innovation. The results of the readiness study bring more light into the timing question, which is crucial for success in competition. Readiness results are not included in this study, but are an addition to strategy formulation tools presented leading towards successful strategy implementation.

The constructive research approach was a good choice for the research conducted. The elements of the constructive research are practical relevance, practical functioning, theory connection, and theory contribution (Kasanen, Lukka, & Siitonen 1993). The relevance of the problem and functioning of the constructions have been proved in the research results and the publications. Theory connection is obvious in strategy, innovation and competition areas. Theoretical contribution lies in developing and integrating the Resource-based view with market positioning and dynamic capabilities.

Constructive research is a step by step procedure, so that the nature of the steps is specified in the framework system, within which the method is applied. As presented earlier the project and the research conducted within match this definition.

An essential part of the constructive approach is to tie the problem and its solution with accumulated theoretical knowledge as made in Chapter "Theoretical Framework of the Research." The innovation phase is the core element of a successful constructive study, and is often heuristic by nature; stricter theoretical justification and testing of the solution typically come afterwards. In this research there has been innovation in construction creation as well as in the creation of the sub-constructions. From the main construction point of view (project) the approach was innovative. Similarly, the innovativeness was continued in sub-constructions like the strategic innovation process.

In constructive research there must be a possibility to check every step or every phase in the construction. The research results and methods as well as test environments for this dissertation have been documented and presented in the publications and appendices. They have been already applied in other industries.

The procedure as a whole serves some definite purpose. This research served a purpose on many levels. Firstly, it had to produce concrete answers to the management of the participating firms. One of these concerns was the choice of the most valuable infrastructure. Secondly, it served a purpose to improve the strategy formulation methods and tools in high-velocity markets. Thirdly, the research generated new data and created and distributed new knowledge of the ICT market structure, changes in ICT markets and changes in strategic customer needs (the paper industry).

6.1 General Findings and Conclusions

Customers' technological uncertainties can be reduced by the actions of suppliers to speed up investments in new opportunities. From the supply point of view, this could be done, for instance, by offering the whole wireless infrastructure as a service covered with service level agreements. However, a configuration of this kind of infrastructure requires deep understanding of wide variety of the customers' future requirements of the infrastructure. The other means for reducing uncertainty could be large co-operation in the development of technology and services between the suppliers and customers to meet the customer requirements. The level of co-operation on the strategic level between the parties is still rather narrow at least in Finland.

When making cross-case evaluation the following points also came out:

- In general, Finnish firms are not prepared for radical changes in the business environment, neither from the opportunity nor from the threat point of view. The present strategy process in firms supports continuum, and underestimates radical changes both in the external and in the internal environment. Most of the firms exercise their present business model, until there is no other alternative than change. This path is usually painful.
- The ICT industry has very little knowledge of the future customer needs, and therefore, uncertainty is high. The ICT industry is only in the beginning of its reformation. The wireless

technologies will change the usage and meaning of the Internet. Consequently, the competitive environment and the rules of the industry will change too.

- The paper industry has been following two main strategies, consolidation and costs cutting over the past twenty years. Those strategies are coming to their end. It has led the firms to compete with the same business model resulting in decreasing returns. New ICT technologies like display, printing, and wireless technologies will have an effect on their customers over the following strategy period.
- As a conclusion of the above, there is a knowledge gap between these two industries. The paper industry does not have enough knowledge and resources to research the opportunities and threats enabled by the new technologies. On the other hand, the ICT industry having a lot of knowledge on the technology does not really understand customer needs.
- There is little strategic co-operation over the industry borders between the leading firms in Finland. It is evident that co-operation between the two case industries would create benefits for both.
- Innovation in firms is sporadic and executed internally. Even if the opportunities are recognized at some level, the strategy process does not support the development of the opportunities, not to mention piloting them. This observation is relevant not only for the mentioned two industries but for most of the firms.
- New business models can reform industries. Radical business model innovation is not usually part of firms' strategy formulation, as we see, in an effective way.
- New business models create new wealth. This means that the firm expands to new markets or increases its market share, changes its costs structure remarkably or affects its capital employed in its business. The new business models created in this study were radical. They also indicated that investment into a new business model could be less risky, although uncertainty is higher, and could create more wealth in a shorter time period than investing in present business models.
- Despite the many innovations with the case firms, none or very few of them went to actual further planning and piloting.

To summarize all the above, a large efficiency improvement potential is available in all industries due to emerging ICT technologies. The speed of technological development enables new operational models for firms. Hindering factors are learning and innovation. Due to fast changes, restricting factors can be removed by strategic partnering and innovation.

6.2 Validity of the Study

In constructive research creating a construction requires using the correct method, in mathematics and also elsewhere. The results of research must be generalizable, and the generalization of managerial constructions may be regarded as a diffusion process of innovations occurring among practitioners. After designing a working managerial construction, we may begin to consider, what the more general features are which are revealed by the creation of a new reality. (Kasanen, Lukka, & Siitonen 1993).

The research presented includes new knowledge from an area which has not been extensively studied. In the telecom industry the main focus is often on consumer behavior and technology operability for the single person use or on single service. New business models for industrial firms enabled by wireless technologies are an area that has not been studied widely. There has been very little research on process improvements in industries by wireless technologies based on actual customer needs. The achieved results bring new information for both focus industries. The constructive research approach gives value to results, because based on the results of the study some of the case firms have already implemented them in their strategic guidelines and operational instructions.

The research also applies methods in a new way to strategy formulation. The methods have been tested earlier in the research in other areas, like product development and technology selection, in order to confirm their validity. The results of the research can be generalized to certain extent, especially from the methods point of view. The research found differences between industries in the learning and the benefits of the applications of wireless technologies, although they have not been extensively discussed within this publication. This limits the generalization of the results to some extent.

Due to the holistic approach to the research question, the depth of the study cannot exceed the same depth as focused research in one area. The research results presented in the research, however, increase understanding of large changes in the ICT industry driven by strategic customer needs. New competition will take place between new business models, and therefore, even though the research approach partly affects the reliability of the research results due to the limited number of cases, it gives a good view of the future challenges and opportunities.

6.2.1 Credibility

The credibility of the case study research is subject to identification, description and interpretation. In this research, the data was acquired in three different ways (Publications 1, 2 and 4) representing quantitative and quality information.

The collection and recording of the data for Publication 1 was made through previously planned process in GDSS automatically by the decision support system. The collection of the investment information for the Publication 2 was done within the organization in question and it was supported by investment follow-up calculations of the organization itself. The annual report information for Publication 4 was gathered from public sources which can be held reliable. The unification of the annual report information into the US GAAP⁵³ contains interpretation due to inadequate information given by the firms. The interpretation was made by two persons, which reduces the impact on credibility. The made interpretation confirms the comparability between the results achieved.

For Publication 1, the reliability and value of the results could be improved by repeating the innovation process with more groups. Consequently, the selection of the members would become less important. This, however, increases the costs and lead-time of the innovation process. The effective selection of lead-users in an organization would require further research.

6.2.2 Transferability

The purpose of transferability in qualitative research is to provide a description which helps the reader to understand the findings. Transferability may also mean that the study is used in the development of further studies in a variety of settings. (Hallikas 2003).

In this respect the research follows other studies utilizing the GDSS laboratory environment and QFD method. However GDSS was not the only method used for acquiring data. During the study altogether five innovation sessions were arranged. All the sessions were steered through the same process adapted and modified in this research. The results of the sessions showed that the process is flexible, reliable and repeatable. One of the innovation sessions was held at San Francisco State University in a similar facility to that in Lappeenranta. The results of the session did not differ from the other four sessions. This proved to an extent that the method itself is easily transferable. Later, the same method and the developed innovation process have also been used in other industries' innovation groups with good results. The other methods used, modified and developed are easily transferable between industries. However, for instance, clustering of the firms based on their financial performance does not

⁵³ Generally accepted accounting principles (GAAP) are the accounting rules used to prepare financial statements for publicly traded companies and many private companies in the United States. en.wikipedia.org/wiki/US_GAAP

give similar results in the paper industry as in the ICT industry due to different characters and maturity of the industries.

The innovation process, scenario method and the triangulation of them in strategic innovation are not industry dependent. This also applies to other methods used in the research. Therefore methods should be easy to transfer to other rapidly changing industries. However the construction settings should always be balanced according to industry-specific requirements.

6.2.3 Conformability

The consistency between data, process and findings presented is important in assessing the conformability of the research. Due to the nature of this study and confidentiality of the results achieved in the GDSS sessions, it is impossible to report the actual innovations in detail in the publications. This has been pointed out as a potential problem in the constructive research approach (Lukka 2000). However, the general description of the business model innovations has been presented in Publications 1 and 2, and solutions allowed the research to follow the original research plan and address the research questions.

The technology selection links the customer needs into the ICT industry's future demand in Publication 3. This link can be considered vague due to only one customer industry in focus. By analyzing more industries, the link between strategic customer needs and demand would be more reliable.

6.2.4 Construct Validity

In constructive research, the validity of constructions depends on their usefulness in practical problem-solving. In my research many useful constructs have been applied and presented in practice, e.g., business model innovation (process), future competition competence requirements analysis (tool), and strategy formulation tool (process). Especially the business model innovation process in GDSS was well approved by participants with high scores in the after-session evaluations (Elfvingren et al. 2002).

Publication 5, presenting a tool for competence requirements analysis, utilizes futures research conducted in Lappeenranta, and expands the firm's strategic competition analysis into alternative futures. The study also indicates that future competition between firms can be evaluated in an expert group with an analytical method. This expert group should be the firm's management group. The value of the developed method can be proved when applying the method to practice in the firm's planning processes. The quantitative results presented in the publication were produced by the research team, and therefore, cannot be held very reliable as such.

6.2.5 Limitations of the Study

The study has been carried out as part of a larger project, which supported the findings of the research presented in this dissertation.

This research focused on two industries, the paper industry and the ICT industry. The purpose of the study was to concentrate on the changes of the competitive environment in the ICT industry, through both changes in customer industries as well as the competitive actions and capabilities within the industry. This setting obviously limits the validity of the results.

Due to the rapidly developing technology, the article dissertation has been a correct choice for publications. On the other hand, if the research were to start today, the research questions on propositions could be different to some extent. Therefore, some of the results presented could look too obvious when presented today. They should be, however, related to a situation almost four years back.

When further analyzing the limitations of the research, the selection of the members of the lead-user groups in GDSS was done based on organizational tacit knowledge. There are no scientific methods for the selection of the participants into a lead-user group. The selection of a lead-user group requires a

lot of experience from the organization itself in order to pick up the right people to attend the sessions. If there were a method to pinpoint the real lead-users in the organization, the proactive innovation processes and strategy work could be much better focused, and therefore, could be much more effective.

6.3 Proposals for Further Research

The research presented here explores the technology's and strategic innovation's role for firms to achieve and maintain competitive advantage. It also integrates the theories of the Resource-Base View and Market Positioning. Bowman and Hurry (1993) suggest for future research in strategic options, for instance, market exploration, innovation, comparative global strategy, and organizational structure and decentralization. There is quite a lot of literature about the innovations' role in competition, but rather little methods developed for it (Stähle, Sotarauta, & Pöyhönen 2004).

This dissertation concentrates on the emerging technologies, in this case the wireless technologies', strategic impact on competition between firms. Instead of analyzing only the changes taking place, the study approaches the question proactively by extending the focus to the future, and by offering the case firms tools and methods to take and maintain competitive advantage.

The research has been on two industries. The paper industry represents an important customer industry to the ICT industry in Finland, and therefore, it has been used as a model for analyzing new customer needs emerging through new business models. Expanding the research in other customer industries, for instance, the automotive, construction, food, and media, would give a broader vision of the opportunities arising for the ICT industry from new applications of emerging ICT technologies.

Hence, the borders of the study limiting the technology into only wireless technologies was very good from this research point of view; it leaves the door open for studying the impact of other emerging ICT technologies on competition. Other emerging technologies could include, for instance, flexible screens, fast wireless communication devices, systems integrated of many different components, location-based services, and user identification. It looks obvious that the next phase of the technological development is the systems level integration phase, where new competition takes place between new business models enabled by the system level integration of technology components. A good example of this is, for instance, retail shops and related logistic chains. When the integration phase has reached an adequate level, the fundamental weaknesses in the existing infrastructure will be revealed generating a new phase of technological development.

In strategy analysis, it is no longer enough to understand one firm and its competitive position, but the understanding of the dynamic value-network and inter-dependencies of the linked firms becomes more and more important. Therefore, my personal interest is in the development of tools and methods modeling the competition of business models in a multi-firm environment as well as understanding the competitive moves and changes on the firm level in a global scale. The research question in this case is to analyze value creation and competition from the strategic view in the rapidly changing competitive environment. Another, probably even more interesting research area is strategic innovation within firms and the management of the strategic change process. I would continue the research of this subject. However, the subject is very delicate due to its confidentiality in firms, and has already caused problems in initiating further research.

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