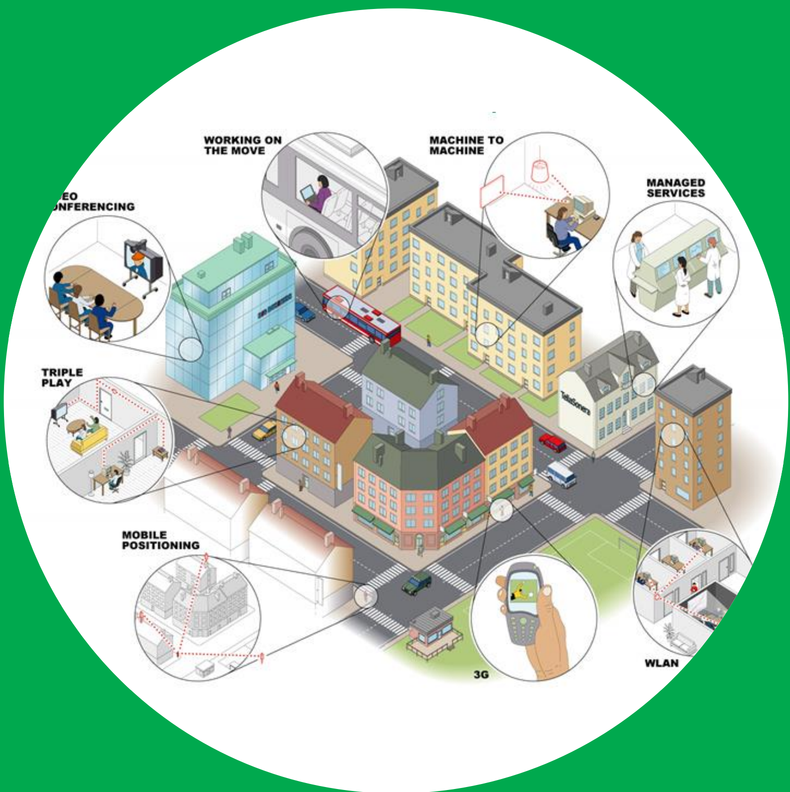
Department of Marketing

Dominant designs in complex technological systems

A longitudinal case study of a telecom company 1980-2010

Henrik Sievers



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Abstract

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Abstract

The different processes used to innovate and produce successful products and services for companies and define service and even industry architectures –dominant designs— have received significant scholarly interest. This study sheds light on this process to understand the evolutionary character of dominant designs within complex technological systems. To do so, it provides longitudinal empirical study of a telecommunications industry and the Nordic case company Sonera from 1980-2010. The units of analysis are Sonera's major businesses, products and strategy that intertwine with industry. To understand the evolution of dominant designs in complex technological systems, theoretical discussion, the management and sociology of technology, an economics perspective, and dynamic capabilities are utilized.

The findings identify the key sources of innovation and the processes that drive managers in a multi-product firm to manage its dominant designs successfully. The findings indicate that the likely sources of innovation (and their variations) lead to the rejection of old dominant designs and the emergence of new ones. A key finding is that these sources of innovation produce a shift to a customer/market orientation from a R&D and science orientation as the industry evolves into a more open and horizontal market form. At the same time, the role of the incumbent multi-product firm diminishes, and that of vendors and niche players strengthens.

Moreover, the research identifies the most important building blocks that can lead to the successful creation of a new dominant design. Evidence of change in the relative roles or contributions of various building blocks was seen, depending on the overall life-cycle evolution of the industry and the specific organization. Finally, the role and nature of firm's products as complex technological systems for shaping the process and outcomes related to dominant designs was seen as important. Instead, new dominant designs emerge in systems characterized by industry convergence when the new technology aligns with the capabilities and incentives of the receiving unit.

This study is a rare example of extensive longitudinal data being analyzed both at the company and an industry level in strategic marketing studies. The study thus contributes by creating a framework for the adaptation of dominant designs. The integration of dynamic capabilities, sensing, seizing, and transformation framework to ongoing industry evolution is especially valuable.

Keywords dominant design, evolution, innovation, complex technological systems, dynamic capabilities, historical research, telecommunications

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Tiivistelmä

Erityyppiset innovaatioprosessit jotka tuottavat menestyksekkäitä tuotteita ja palveluita yrityksissä, jopa määrittelevät palvelu ja toimiala-arkkitehtuureja – dominant designeja- ovat herättäneet tutkimuksellista kiinnostusta. Tämä tutkimus valaisee tätä innovaatioprosessia jotta ymmärrys dominant designeista kompleksisten teknologisten systeemien kontekstissa lisääntyy. Tutkimus on historiallinen empiirinen kuvaus telekommunikaatiotoimialasta ja kohdeyritys Sonerasta, Pohjoismaisesta telealan yrityksestä, ajanjaksolla 1980-2010. Analyysikohteet ovat Soneran merkittävimmät liiketoiminnat, tuotteet ja strategia jotka muokkaantuvat vuorovaikutuksessa toimialaevoluution kanssa. Jotta evoluutiota voidaan ymmärtää kompleksisissa teknologisissa systeemeissä seuraavat teoreettiset keskustelut on valittu keskeisiksi: teknologian johtaminen ja sosiologia, taloustieteellinen näkökulma sekä dynaamiset kyvykkyydet.

Tutkimuksen löydökset paikallistavat innovaatioiden päälähteet ja prosessit, jotka mahdollistavat yrityksen johdolle dominant designien menestyksekkään hallinnan. Muuttuvat innovaatioiden lähteet ajavat yritykset hylkäämään vanhat dominant designit ja kehittämään uudet. Avainlöydös on että innovaatioiden lähteet muuttuvat asiakas-/markkinaorientointuneiksi tutkimus- ja tiedelähtöisestä samalla kun toimiala kehittyy avoimemmaksi ja horisontaaliseksi. Samaan aikaan vakiintuneen monituoteyrityksen rooli vähenee ja toimittajien/alihankkijoiden sekä 'markkinarakoyritysten (niche)' rooli kasvaa.

Lisäksi, tutkimus paikallistaa tärkeimmät tekijät/rakennuspalikat jotka voivat johtaa menestyksekkääseen dominant designin luontiin. Tutkimuksessa havaittiin lisäksi että dominant design rakennuspalikoiden suhteellinen rooli ja vaikutus muuttui toimialan ja yrityksen evoluutiosta johtuen. Lopuksi, dominant designien systeeminen luonne vaikutti innovaatioprosessiin ja lopputuloksiin. Sen sijaan että puhuttaisiin vain yhden tuotteen luonnista, tulee ottaa huomioon toimialan konvergenssi, joka mahdollistaa uuden teknologian omaksumisen ja kaupallistamisen yli teknologisten raja-aitojen.

Tämä tutkimus on harvinainen esimerkki laajamittaisesta pitkittäisestä datan analysoinnista yrityksen ja toimialan tasolla strategisen markkinoinnin tutkimusalalla. Tutkimus edistää innovaatioprosessin ymmärrystä luomalla viitekehyksen dominant designien omaksumiseen. Erityisesti dynaamisten kyvykkyyksien integraatio (sensing, seizing, transforming) toimialan evoluutioon on arvokasta.

Avainsanat dominant design, evoluutio, innovaatio, kompleksinen teknologinen systeemi, dynaamiset kyvykkyydet, historiallinen tutkimus, telekommunikaatio

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Helsinki, March 2015

Henrik Sievers

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1. Introduction

1.1 Background, Research Gaps, and Questions

In recent decades, the emergence and management of ‘dominant designs’ has attracted growing interest among scholars in the fields of strategic management (McGrath, MacMillan & Tushman, 1992; Schilling, 1998; Suarez & Utterback, 1995; Tegarden, Hatfield & Echols, 1999), technology management and industrial evolution (Anderson & Tushman, 1990; Henderson & Clark, 1990), and marketing (Hauser, Tellis & Griffin, 2006; Srinivasan, Lilien & Rangaswamy, 2004; 2006)[1]. By way of a definition, a dominant design emerges when the product design (i.e., its architecture and/or a set of individual features) of one firm or competitor in an industry becomes a de facto standard in the market or product category (Christensen, Suarez & Utterback, 1998). As such, a dominant design tends to be a commercial success for the firm whose product design achieves this position, and it also changes the competitive situation in that competitors also have the incentive to follow or adopt the design. Well-known examples of dominant designs include mobile phones that have become the industry standard such as Apple’s iPhone (O’Brien, 2010), the Xerox model in photocopiers, and the VHS vs. Betamax standard in videocassettes (Cusumano, Mylonadis & Rosenbloom, 1992; Rosenbloom & Cusumano, 1987).

However, although previous research has introduced a number of different perspectives on the emergence and management of dominant designs on industry and firm levels, four notable research gaps remain. First, there have

[1] Closely related concepts, such as service-dominant logic (Vargo & Lusch, 2004; 2006), or dominant service design (Lee & AbuAli, 2011) are also used. However, I concentrate on the more established concept. Still, offering can be understood as being dominant (a ‘de facto’ logic and structure).

been relatively few studies explicitly focusing on how multi-product firms attempt to create and/or adopt multiple dominant designs (a) across product categories as well as (b) over time.

Indeed, incumbent firms in many industries (especially high-tech industries) have operations and/or development efforts in (1a) multiple product categories: these product categories and efforts are likely to be somewhat interlinked, as will be the related dominant designs. There is thus a need to study the particular motivations and processes of multi-product incumbent firms regarding the creation of dominant designs – as preliminarily noted by Srinivasan, Lilien, and Rangaswamy (2006). More specifically, how a company can increase the odds of creating dominant designs, as they can only be verified *ex post at industry level (*McGrath, MacMillan & Tushman, 1992; Tegarden, Hatfield & Echols, 1999; Suarez, 2004). Moreover, the (1b) sequential nature of the related development efforts over time is also a highly relevant issue for multi-product firms, especially those that are concerned about the long-term management of their overall product portfolio, including the transition from one dominant design to another. These issues pertaining to the management of dominant designs in multi-product firms comprise the explicit and primary focus of the present research. In this respect this study differs from previous research that has tended to rely on longitudinal case studies charting the development of one product standard on the firm level (e.g., Cusumano et al., 1992; Rosenbloom & Cusumano, 1987) and industry level (Anderson & Tushman, 1990; Tushman & Anderson, 1986; Utterback & Abernathy, 1975).

Second, previous literature has paid little explicit attention to the distinction between life cycles pertaining to products and life cycles[2] governing overall industries, or (multi-product) organizations in industries. It is self-evident that dominant designs as a phenomenon are directly related to individual product life cycles in that, by definition, they emerge during the growth period of a product category, before the market reaches maturity (Abernathy & Utterback, 1978; Anderson & Tushman, 1990). Interestingly enough, many studies even seem to treat individual product life cycles and

[2] Vernon (1966) states that product life cycles typically incorporate new products, maturing products, and standardized products, and that these stages follow each other. Different kinds of resources are required during the different stages: new products use scientific knowledge and are capital-intensive, whereas standard products are low-cost and are sold based on the cheap price. Abernathy and Utterback (1978) and Utterback and Abernathy (1975) draw a parallel between product and industry life cycles. Windrum (1998, p.1046) refers to these models as 'The Vernon-Abernathy-Utterback models".

industry life cycles as somewhat synonymous (e.g., Anderson & Tushman, 1990; Tushman & Anderson, 1986; Tushman & Murmann, 1998). However, it should be noted that there may also be evolutionary[3] aspects pertaining to industry life cycles or the overall organizational structure – over and above individual product life cycles – that also influence the development of dominant designs within and across product categories. Earlier research implicitly recognizes some aspects of this kind (e.g., aspects of the industrial environment such as regulation and the evolution of the broader technological field; Suarez, 2004), but little explicit attention has been given to the issue. What are the (second-order) implications of aspects related to the industry's and the firm's overall life-cycle evolution in terms of how firms manage their dominant designs within and across (first-order) product life cycles?

Third, despite the number of conceptual studies (McGrath et. al., 1992; Lee et al., 1995; Suarez, 2004; Schilling, 1998) and surveys (Srinivasan et al., 2004, 2006) concerning the determinant factors or building blocks in the creation of dominant designs, there is a dearth of empirical research on the relative role of and linkages between the different blocks. This applies in particular in the case of multi-product firms, and the possible longitudinal evolution of the major building blocks over time in line with broader industrial and organizational evolution.

Fourth and finally, most existing research on dominant designs focuses on relatively simple product businesses and isolated product categories. Yet, many (especially high-tech) industries concentrate on complex technological systems and solutions rather than simple one-off products or gadgets. Given the aforementioned factors related to multi-product firms and overall industry and organizational evolution (vis-à-vis individual product life-cycles), it would appear that the study of dominant design and its development in complex technological systems is warranted in its own right. Namely, multi-product firms often face the additional challenge of deciding in what form to offer their basic technologies across market segments (e.g., product-oriented vs. service-oriented offerings vs. integrated solutions) – as well as over time. Thus, the present focus on a firm offering complex

[3] At this stage I briefly define what evolution means on the general level. It is "a process of change in a certain direction" (www.merriam-webster.com/dictionary/evolution, accessed 17th September 2013). According to Christensen (1997), evolution differs from product life cycles in that products are constituted as attributes (e.g., capacity, reliability, convenience and price). The basis of competition is evolutionary when there is a change in the appreciation of these attributes.

technological systems, the format of which changes over time, is an ideal setting in which to study how dominant designs and the firm's technologies and product portfolio evolve across categories and over time.

The overall research objective of this study is to advance the theory of dominant design by means of a longitudinal multiple case studies (cf. Danneels, 2010, p.2). The purpose of the study is to enhance understanding about the antecedents [the source of innovative ideas] and, related to this, the adaptation process on the company level intertwined with the industry level. I interpret the adaptation process to mean creating, modifying or simply adopting dominant designs. More specifically, the aim is to contribute to current knowledge regarding how the industry life cycle affects the management and adaptation of dominant designs, and how corporate-level strategies affect their potential creation over time.

In line with the aforementioned four research gaps and the research objective, I specify the research questions for the present study as follows:

- RQ1: What sources of innovation and what processes are related to (a) a multi-product firm's successful management of its dominant designs and (b) successful transformation from one dominant design to the next?
- RQ2: What are the relative roles of the sources of innovation in the successful adaptation of dominant designs and their 'building blocks' in terms of a) the process, and b) how they change over time?
- RQ3: What role does the nature of products as complex technological systems play in dominant-design adaptation processes and outcomes?

1.2 Theories employed

As is common in the field of dominant design studies, the present research evokes both the economics perspective on (industry) life cycles (e.g., Arthur, 1989; Klepper, 1996, 1997), and the management and sociology of technology (Anderson & Tushman, 1990; Tushman & Anderson, 1986; Suarez, 2004). According to the former, increasing returns and network externalities drive the industry, through economies of scale, to shakeout and maturity, whereas the latter focuses on the emergence of dominant designs through discontinuities in technology, regulation, customer preferences, and entrants from adjacent industries (see also Peltoniemi, 2011).

I also refer to complementary theories from adjacent research streams. Most notably, the literature on dynamic capabilities in the area of strategic management is integrated into the dominant-design perspective in that dynamic capabilities could be seen as key firm-level organizational capabilities related to successful product innovation, and thereby dominant designs (e.g., Tushman & Murmann, 1998; Eisenhardt & Tabrizi, 1995). Dynamic capabilities are also potentially involved in bridging various building blocks of dominant design related to issues such as governance structure in companies and transformation processes (di Stefano et al., 2010; Teece, 2007). In particular, I apply Teece's (2007) framework of the micro foundations of dynamic capabilities in my analysis of the management of dominant design in the case company: the sensing, seizing, and transformation of knowledge and capabilities. Furthermore, I refer to and build on the traditional literature on product innovation (Abernathy & Clark, 1985; Henderson & Clark, 1990), as well as theories of exploration and exploitation (Gilsing & Nooteboom, 2006; Hauser et al., 2006; Simsek, Heavey, Veiga & Souder, 2009), given the inherent link between dominant design, innovation, and exploration–exploitation.

It is evident from the above discussion that dominant design as a concept relates to both industry life cycles and strategic management in companies (e.g., Abernathy & Utterback, 1978; McGrath et al., 1992; Schilling, 1998; Suarez & Utterback, 1995; Utterback & Abernathy, 1975, cf. Miles & Snow, 1978).

1.3 Empirical methodology

In terms of methodology, the essentially dynamic nature (development over time) of the research questions and related theories necessitated longitudinal empirical study. The research gap related to complex technological systems, in turn, warranted a focus on an industry in which such systems are perhaps the most prevalent: telecommunications and telecom operations. It is an industry that is well suited to the research questions, having faced several technological, regulative, and market-preference changes (cf. Athreye, Kale & Ramani, 2009; Henderson & Clark, 1990; Suarez, 2004; Tripsas, 1997;2008; Tripsas & Gavetti, 2000) throughout the study period. In addition, the telecommunications industry has been the focus of much previous research on dominant designs (Suarez, 2004).

More specifically, the case industry focus is telecommunications, the case company being Sonera[4] and its major businesses and products during 1980-

[4] Sonera is currently part of TeliaSonera following the merger between Telia, a Swedish incumbent telecom operator, and Sonera in 2002.

2010. Sonera is one of the largest telecom operators in northern Europe. It is an interesting company theoretically, having created and adopted numerous dominant designs during the 30-year period under analysis. It has held an incumbent monopoly position in specific markets, and has also been a market challenger. Furthermore, it represents a typical technology company with a rather silo-like organizational structure, which means that at the outset it may face challenges related to technology commercialization in particular. Yet, the company's culture and strategy have also changed over time: from a closed monopoly firm to an open company, and from an entrepreneurial to a bureaucratic, more risk-avoidant enterprise. These changes bring a multi-faceted perspective to this investigation into dominant designs.

Given this industry and case-company focus, I decided that a longitudinal, in-depth case study would be my primary methodology. The reasons for this choice were two fold. First, the emphasis in the research questions on the sources of innovations and processes of the firm and its management, as well as on 'how' questions, and the need for qualitative and historical data and materials, warranted it (e.g., Golder, 2000; Yin 2003; 2009). Second, I had unique access to data at a particular company in the industry, Sonera, having some 15 years of work experience there, which I believed would give me in-depth insights. Specifically, I had the opportunity to utilize an extensive and qualitatively rich and robust set of industry and company material to investigate the research questions.

1.4 The Structure of the thesis

The thesis is structured as follows.

Chapter 1. In this first chapter I have introduced dominant design theory and discussed the motivation for the research. Although the study has progressed in several areas and theoretical discussions, I identified four relevant research gaps. In order to find a way of narrowing the gaps I set three research questions. Finally, the study is positioned theoretically, and methodology is discussed.

Chapter 2. In this chapter I discuss the theoretical background of my study and define four key concepts. I use these concepts later on as tools when I analyze dominant designs and their related life cycles in the case company, and more generally in the telecommunications industry. I discuss the classic models of dominant design, and vary the discussion by identifying the key building blocks that facilitate the creation or acquisition of dominant designs. I also present two earlier theoretical studies (McGrath, MacMillan & Tushman, 1992; Suarez, 2004), and discuss the authors' views on how a company and an industry as a whole can pursue dominant designs. At this point I connect the literature on dynamic capabilities to that on the creation or acquisition of dominant design, positioning the building blocks of the latter within the micro foundations of the former, in other words sensing, seizing, and transforming. I continue and chart the empirical case history, the evolutionary context in this study, at the industry level. I start with a historical analysis and tie together the classic frameworks of dominant design, industry evolution, and life-cycle evolution in the case company. The company went through seven different eras, which were dominated by different cognitive mindsets among management. I classify the eras and the cognitive mindsets based on input from the interviews, participant observation, historical industry analyses, and the company's strategy materials.

Chapter 3. I discuss my methodological choices in the third chapter. I use the case study as a research method, and therefore introduce my case company, telecom operator Sonera, and the related time period (1980-2010). The use of a Temporal Bracketing Strategy (Langley, 1999) enabled me to structure the case history in adjacent periods and to make sense of it. I adopted an abductive approach because I wanted to develop a dominant-design framework to use in my investigation of the case company's most important innovations, some of which turned out to be dominant designs. I argue that company and industry evolution should be studied in parallel. Next I describe the data-collection procedures and material, how the interviews were conducted and analyzed, and how I dealt with the other empirical material I collected. Finally, I discuss the reliability and validity of the study.

Chapter 4. In Chapter 4, the Analysis section moves from the company level to individual cases (i.e. the service offerings of the case company), which I analyze from the perspective of dynamic capabilities (sensing, seizing, transforming [Teece, 2007]). This chapter also comprises an analysis of the case and the industry and its corporate history in the light of the two theoretical frameworks constructed in Chapter two. I also present the dominant design adaptation framework in some detail. Finally in this chapter I develop a number of propositions, a manifestation of reasonable arguments, conclusions and theoretical contributions of the research (Muller & Wiener, 2009).

Chapter 5. In chapter five I summarize my responses to the research questions, discuss the theoretical contributions and managerial implications, and set out the limitations of the study. Finally, I suggest some avenues for future research.

The Bibliography is organized as follows: 1) Theoretical sources; 2) Empirical research material (dissertations, books, company histories, newspaper articles, press releases, legislative regulator decisions, Business White Papers, industry studies, industry statistics, product-development documents (project set-up letters and follow-up studies), internal documents (strategy), internal documents (business plans), external documents (product material), electronic material; 3) Interviews and emails.

The Appendix contains complementary corporate material, the interview questions, organization charts, Sonera's strategic decisions, industry history events, and shows in detail the numerical values of the dominant-design building blocks that complemented the case study.

2. Towards a theoretical framework

My aim in this chapter is to develop the theoretical framework of the study. First, the key concepts used in the study are defined. Second I explore two seminal ideas in the research on dominant design: (1) the locus of innovation in the design's life cycle and (2) the technology cycle. I also explicitly link the concepts of strategy and dominant design in order to establish a connection between corporate-level considerations and the changing conditions in an industry over its life cycle. The discussion then moves to the more concrete firm level with a view to identifying the antecedents and building blocks in the evolution of a dominant design through the related phases of sensing, seizing, and transforming (Teece, 2007). The end result is a two-part theoretical framework. The first part focuses on the intersection of the industry and corporate levels, and the second on the business-unit level within the corporation, thereby going deeper into the process of managing products and services related to a dominant design. The two parts are connected, as demonstrated in the empirical study in which they are applied from an historical perspective. Finally, the history of the industry and the case company (the evolutionary context) is applied to the theoretical framework, the emergence of the dominant design at industry and corporate levels.

2.1 Key concepts

The key concepts applied in this study are those of dominant design, innovation, complex technological systems, and dynamic capabilities. The importance of dominant designs and complex technological systems was discussed in the introductory chapter. The emergence of a dominant design is a manifestation of an innovation that has achieved significant success in the market and has become a de facto standard, used by the innovating firm and competitors alike. The literature on innovation has a long history, starting with the work of Joseph Schumpeter (see e.g., Malerba, 2006; Pepall, Richards & Norman, 2005; Tirole, 1989), who discussed the occurrence of technological competition and market renewal through innovations (in Van de Ven and Garud, 1989).

Dynamic capabilities, in turn, are (second-order) organizational capabilities enabling renewal and change in current (first-order) capabilities. They are necessary for organizational survival and performance in that they contribute to achieving and maintaining fit with the changing business environment (Teece et al., 1997). The building blocks of dynamic capabilities (Teece, 2007) and dominant designs have similar elements: path dependence[5], learning, appropriability, an installed base, technology, product and revenue architecture, control over bottleneck assets, the recognition of inflexion points and complementarities, demonstrable leadership, and well managed strategic fit so that asset combinations are value-enhancing (e.g., Suarez, 2004). The management and correct recognition of the building blocks, in turn, enhance the successful creation of innovations.

2.1.1 Dominant design

There are a number of definitions of dominant design. Abernathy and Utterback (1975) developed the first model. Complementing the strict definition of the concept, studies have also focused on how to create a dominant design, how the industry structure changes following its emergence, and what elements should be included in the research (Lee et al., 1995; McGrath et al., 1992; Srinivasan et al., 2004, 2006; Suarez, 2004).

The broad term 'consolidation in innovation and learning' (Nooteboom, 2000, p.172), meaning that players in the industry start to act similarly in their innovation and learning activities, describes well the major view in the discussion on dominant design. Nooteboom (2000) states on the theme of consolidation (he also uses the term dominant design): "*Across all these fields of technology, organization, knowledge, and language*

[5] A typical definition of path dependence is that 'history matters'. I follow a more strict definition: "Organizational path dependence can be defined as rigidified, potentially inefficient action pattern built up by the unintended consequences of former decisions and positive feedback processes" (Sydow, Schreyögg & Koch, 2009, p.696).

novelty become consolidated in a standard practice, which provides the basis for efficient exploitation" (p.172). Table 1 below lists various definitions of dominant design.

Table 1 Definitions of dominant design

Definition	Author
The most strict selection mode is one in which one design emerges that accounts, over time, for over 50 percent of new implementations of the breakthrough technology.	Anderson and Tushman (1990)
A dominant design in any market knoll is that design that lies the most northeast in that knoll's product attribute space.	McGrath et al. (1992)
The distinctive way of providing a generic service or function that has achieved and maintained the highest level of market acceptance for a significant amount of time.	Lee et al. (1995)
A dominant design is one whose major components and underlying core concepts do not vary substantially from one product model to the other, and the design commands a high percentage of the market share. The rate of major product innovations decreases and emphasis shifts to process innovation and incremental innovation.	Afuah and Utterback (1997)
A dominant design emerges in a product category when one product's design specifications (consisting of a single or a complement of design features) define the product category's architecture.	Christensen, Suarez, and Utterback (1998)
A dominant design exists in a technological class when the majority of designs have the same technologies for the high-pleiotropy core components.	Murmann and Frenken (2006)

The definitions listed in Table 1 are the ones I find most useful, and capture the essence of the concept. Anderson and Tushman's (1990) definition is pragmatic, based on the market share of the new technology. McGrath et al. (1992), in turn, introduce a product attribute space, implying that a dominant design has the maximum market share in any given segment (see also Lee et al., 1995). Afuah and Utterback (1997) stress the change in the nature of competition that a dominant design brings about. Namely, before its emergence the competition is largely about exploring and finding the most acceptable overall product architecture (the major components, the core concepts, and the relationships therein), but afterwards the focus is less on major exploration and more on incremental product differentiation. Similarly according to Christensen et al. (1998), in the case of a dominant design, one product's design specifications define the commonly accepted architecture of the product category. Murmann and Frenken (2006) further propose that dominance exists when the majority of designs have the same technologies in their core components.

Reflecting the main notions in the above definitions, I use the following definition of dominant design in the present study – wherein the first part comes from Christensen et al., (1998), and the second part stresses the notion of commercial success, drawing from earlier studies such as Suarez and Utterback (1995), Anderson and Tushman (1990), Cusumano, Mylonadis, and Rosenbloom (1992), and Tegarden, Hatfield, and Echols (1999):

A dominant design emerges in a product category when one product's design specifications (consisting of a single or a complement of design features) define the category's architecture. As such, it is typically a commercial success for the firm whose product design achieves dominance, and it also changes the competitive situation so that competitors also have the incentive to follow or adopt the design.

2.1.2 Innovation

Scholars have analyzed the concept of innovation from the following perspectives, inter alia: 1) by type (e.g., product innovations, process innovations, business-model innovations, or continuous streams of innovations, e.g., Pepall, Richards & Norman, 2005, p.562; Tushman & Smith, 2002); 2) innovations as changing and renewing the organization's competitive advantage (Christensen & Rosenbloom, 1995; Henderson & Clark, 1990; for an overview of the effect of technical change on incumbent firms, see Chesbrough, 2001); 3) by source (the company, customers, macro-level institutions e.g., Drucker, 1998; Geels, 2004; Kaplan & Tripsas, 2008; Suarez, 2004); and 4) organizational motivations and capabilities (Teece, 1986; 2007).

Most of the researchers mentioned above have a broad view of the concept, covering many of the types and aspects. According to Schumpeter (1934, p. 66), for instance, an innovation can be a new good (e.g., product), a new method of production, the opening up of a new market or a new source of supply, or creating a new type of organization. I adopt the following general definition of innovation in this study (in Garcia & Calantone, 2002): "*Innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention that leads to development, production, and marketing efforts to achieve commercial success*" (ibid., p.112).

In the context of dominant designs, innovations are seen as the (managerial) mechanisms utilized in trying to transform an innovative idea into a dominant design on the market, or in adopting or adapting an existing dominant design (Teece, 2006) – designed in-house or by competitors. Like any innovative activity, this involves non-trivial managerial effort and routines in terms of outlining the current situation and future opportunities: "*In the course of innovation routines, people within the firm scrutinize what the firm is doing and why it is doing it with the thought of revision or even radical change*" (Nelson & Winter, 1982, p.17; see also Sastry, 1997).

With regard to the effect of further innovations on the firm and its motivation to innovate, economists refer to the replacement effect, meaning that firms may well earn profits with their existing products and technologies (earlier innovations), but "*introducing the new process displaces and therefore undermines that investment*" (Pepall et al., 2005., p.566, see also Reinganum, 1985). This replacement effect may demotivate or discourage firms from innovating. A counterpart of this effect is the efficiency effect: "*What drives the efficiency effect is the fact that the cost of non-adoption becomes higher once we recognize that it is precisely in that case that a rival may adopt. Such an increase in the cost of non-adoption makes the monopolist more willing to pay for the innovation*" (Pepall et al., 2005., p. 568). In sum, the firm faces a dilemma: should it keep the old technology or should it invest in new technology. It is a dilemma that also applies to dominant-design-related innovative activities.

Of particular relevance to the present study is Abernathy and Clark's (1985) innovation classification framework (see Figure 1). With its more fine-grained outline of the market/customer and technology/production aspects of innovation it elaborates on the replacement and efficiency effects mentioned above (see also Henderson, 1993), and introduces an innovation typology. Furthermore, it expands the notion of drastic innovations, dividing them into two types (revolutionary and architectural) and outlining the replacement vs. efficiency effects on both types. Most notably, in the case of architectural innovations the innovator may adopt new technology and new customers, or enter a new market altogether due to competitive pressure. The key point is the concept of transilience, "*the capacity of an innovation to influence the established systems of production and marketing*" (Abernathy & Clark, ibid. p. 3). Different innovation types have either high transilience, meaning that linkages to existing markets and customers are no longer worthy (Tripsas, 1997) or low transilience, i.e. in regular innovations. The model also summarizes well the challenges organizations face: should the firm engage in regular incremental innovations or riskier architectural, radical innovations, or both and in what proportion? (See also Nooteboom, 2000, p.189)

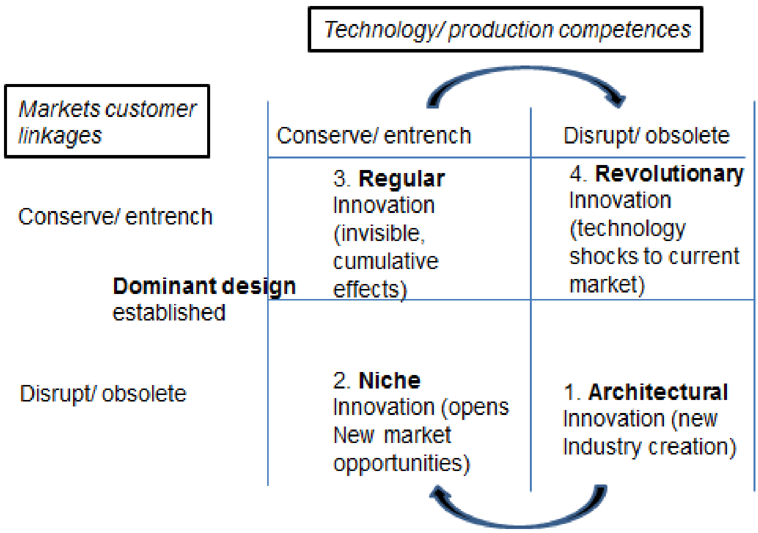

Figure 1 Abernathy and Clark's innovation typology (Murmann and Frenken. 2006; Abernathy and Clark, 1985)

I build upon Abernathy and Clark's (1985) innovation typology in this study (Figure 1). The basic proposition is that a dominant design tends to be established following revolutionary and architectural innovations. In the present case study I classify the firm's new product and service projects according to this typology, after a careful interpretation of the case history and analysis. In general, the typology implies that the creation and renewal of industries start from architectural innovation (number one in Figure 1), after which market knowledge improves and there is a possibility to create niche innovations (number two in Figure 1). A dominant design will then be established, and after that technology and market knowledge will be entrenched in regular innovations (number three in Figure 1). Another technology shock will typically end the incremental development (revolutionary innovation, number four in Figure 1).

Henderson and Clark (1990) further specify the nature of architectural innovation, implying that it is the most difficult innovation type for incumbents. It will destroy the company's previous architectural knowledge, in other words how the product components are connected – and thereby elicits the adverse consequences of the replacement effect (Pepall et al., 2005, p. 566). As a result, it is difficult for the firm to know what skills it should keep and why.

In sum, the innovation concept (adopted here) and the Abernathy and Clark (1985) typology provide tools for analyzing companies' biases and product types and, most importantly, offer life-cycle and path-dependent perspectives on innovation.

2.1.3 Complex technological system

In general, systems can be characterized as having parts or components, which are connected by a structure of relationships and interfaces that are usually rather complex (Davies, 1996, p.1146). In this study I adopt the definition of complex technological systems as open assembled systems that "*contain complicated interface technologies to connect their closed, assembled systems*" (Rosenkopf & Tushman, 1993, p.408). These kinds of systems are typical in the telecommunications industry, in which the firms' main offerings to customers include telephone and data network products and services, for example. According to Davies (1996), the telecommunications system consists of the following components: terminal equipment, access technology, switching equipment, a transmission system, and a control component. Notwithstanding this definition, which is rather technologically oriented, telecommunications companies offer both products (i.e., the technical hardware) and *services* (related to the utilization of the hardware) *to their customers*, telecommunication companies (and the like). More specifically, the modern telecom operator typically offers managed services to its customers, in other words the delivery and management of telecom-network-based services, applications, and equipment to enterprises, residences, or other service providers. Other typical industries involving complex technological systems include those related to energy and electricity, military equipment, and airplanes (Davies, 1997; Miller, Hobday, Leroux-Demers & Olleros, 1995; Rosenkopf & Tushman, 1993).

In contrast to ordinary, simpler products and services, such complex systems or systems offerings have the following special characteristics. First, they rely on complicated interface technologies to connect their closed assembled systems[6] . Second, the system components interact and are interconnected. Third, they are often high-value-added, engineering-intensive capital goods (Davies, 1997). These special characteristics stand out when contrasted with (1) non-assembled products such as cement and glass, which have no separable components in the first place; (2) simple assembled products such as guns or skis, which are constructed from components that are mechanically fitted together in an assembly process (rather than containing complicated interface technologies); and (3) closed assembled systems that require [comparatively simple] technology linking the components (Rosenkopf & Tushman, 1993).

Despite their special nature as offerings, complex technological systems can be modeled in a somewhat similar way as other ordinary products (Christensen & Rosenbloom, 1995; Murmann & Frenken, 2006; Rosenkopf & Tushman, 1993). As implied by the name however, the component and interface structure is more diverse and complicated. Nevertheless, the analysis of products as systems and sub-systems is typical in the research on dominant designs, as is the notion that systems incorporate a hierarchical internal order.

For the purposes of this study, it is indeed useful to delineate different context-specific explanations of product and technical development in separate layers, as is evident in Davies' (1996) overview of the telecommunications system, for example. In a similar vein, Christensen and Rosenbloom (1995) and Abernathy and Utterback (1978), used hierarchical models as cases (i.e. electronics, car manufacturing, disk drive manufacturing, and corporate Management Information System [MIS] product architecture). [7]

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[6] Automobiles and watches are examples of closed assembled systems, which require linkage technology between components for assembly. Open assembled systems, in turn, require interface technologies to connect many closed assembled systems together. (Rosenkopf and Tushman, 1993)

[7] The marketing literature distinguishes between systems selling and solution selling (Mattsson, 1973; Davies, Brady and Hobday, 2007). In the case of systems selling "the seller provides, through a combination of products and services, a fulfillment of a more extended customer need than is the case in product selling" (Mattson, ibid., p. 108). Solution sellers, in turn, provide managerial and strategic advice for customers (Davies et al., 2007). I focus on solution selling in this study, but also on simpler products or services that may have a complex technological system embedded in the production process.

2.1.4 Dynamic capabilities

Dynamic capabilities are a paradigm in the research on strategic management. The concept has been used for over 20 years in discussions among authors such as Teece et al. (1997), Teece (2007), Winter (2003), Martin (2011), and Augier and Teece (2008). The key notion is that competitive advantage is gained through focusing on organizational capabilities, and managing them in parallel with the changing environment. In turn, heterogeneous resources are deployed in companies, thus forming capabilities (and dynamic capabilities).

I follow Wernerfelt (1984) and Barney (1991) in defining the concept of a resource, as follows: "*The attributes of a firm's physical, human, and organizational capital that enable it to conceive of and implement strategies that improve its efficiency and effectiveness are its strategically relevant resources*" (Barney, 1991., p.102). Tangible manifestations of resources include specialized equipment, sales units, technological skills, financial resources, brand names, and organizational processes (Barney, 1991; Eisenhardt & Martin, 2000; Wernerfelt, 1984). Capabilities, in turn, are activities, or routines (activities that are performed constantly), that use company resources and enable '*the company to make a living now*' (Winter, 2003, p.992).

In contrast to 'normal' organizational capabilities, which refer to the organization's current skills and know-how in performing technological or market tasks (e.g., providing long-distance-call services to customers), dynamic capabilities are attuned to and needed in adapting to changing environmental conditions. The concept of dynamic capabilities is rooted in evolutionary economics (e.g., Nelson & Winter, 1982), in which the focus is on the internal processes when an organization adjusts its actions to changing market conditions. The unit of analysis is the organization and its dynamic interaction with the environment.

A natural link between dynamic capabilities and the concept of dominant design is the fact that *product development* is often considered one of the most important dynamic capabilities of an organization (Danneels 2002; Eisenhardt and Martin 2000): it is through product-development processes that the organization essentially adapts its technology and offerings to changing environmental conditions, thereby leveraging, reconfiguring, and building on its existing resources and capabilities.

Dynamic capabilities are also relevant to the management of dominant designs, the emergence of which fundamentally involves dynamic shifts in the industry environment. Indeed, their emergence or consolidation, by definition, marks a shift from a turbulent era in the industry in question (an era of ferment in the dominant-design terminology) to a more stable era (an era of incremental change) (Tushmann & Murmann, 1998). In order to master this shift the firm needs to tap into its dynamic organizational capabilities. The management of path dependence is also crucial (Eisenhardt & Martin, 2000), and is related to learning processes that are specific to each company. The difficulty with learning processes is that they are idiosyncratic, and even '*out learning'* is needed when the market is very dynamic (Eisenhardt & Martin, 2000, p.1115; cf. Miller & Shamsie, 1996).

Teece et al. (1997) also emphasize that the term 'dynamic' in this context refers to the organizational capacity to renew competences so as to achieve congruence with the changing business environment. In turn, "*The term 'capabilities' emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment*" (ibid., p.515). The authors also point out that the fundamental units of analysis in the dynamic-capabilities view are the strategic positions, paths, and processes (ibid., p.527): they describe (1) positions as assets and resources; (2) paths as path dependences (i.e., past decisions and investments that influence decision-making); and (3) processes as the ways in which activities are carried out in companies.

Teece (2007) further explicates dynamic capabilities with regard to their nature, identifying three key managerial processes: "*coordination/integrating, learning, and reconfiguring*" (p.1341). He also refers to sensing (and shaping) new opportunities as a key activity, involving sub-activities such as scanning and learning from and interpreting the environment. Thus, he essentially views the foundations of dynamic capabilities and business performance as: (1) analytical systems (and individual capacities) to learn and to sense, filter, shape, and calibrate business opportunities; (2) enterprise structures, procedures, designs and incentives for seizing opportunities; and (3) the continuous alignment and realignment of specific tangible and intangible assets. I apply Teece's (2007) framework in my study, as specified later in more detail.

In sum, the dynamic capabilities perspective provides a framework for process/historical analysis in companies (see also Harreld, O'Reilly III &

Tushman, 2007), which is the key objective in this study. I use the following definition: "*A dynamic capability is the capacity of an organization to purposefully create, extend, or modify its resource base*" (Helfat et al., 2009, p.1). Specifically, I focus on the processes, positions, and paths – as defined in Teece et al. (1997) – in my historical case (Chapters 2 and 4), studying the firm's product-development projects in 1980-2010 (cf. Martin, 2011; Adner & Helfat, 2003; Hodgkinson & Healey, 2911, Teece, Pisano & Shuen, 1997). My aim is to identify the changed competitive requirements that turn into new cognitive demands for management with regard to the adaptation of a dominant design. This is manifest in decisions as to whether for example, the firm should attempt to create new dominant designs (i.e. change the industry), or adopt dominant designs achieved by others.

2.2 Emergence of dominant designs at the corporate and industry levels

My discussion starts from the first pioneering works on the dynamics of product and process innovation (Abernathy & Utterback, 1978; Utterback & Abernathy, 1975). These authors show that different innovation types exist when an industry and a company evolve, analyzing the innovations mainly from the firm's perspective. Significantly, the term dominant design is used for the first time in this discussion, in connection with the management of technology from an organizational perspective. Abernathy and Utterback (ibid.) describe the evolutionary nature of innovations in terms of the change in competitive emphasis (functional product performance or cost reduction), the source of the innovation and the dominant type, and the nature of the production process and of organizational control.

Next I consider two other seminal works (Anderson & Tushman, 1990; Tushman & Anderson, 1986) that establish the basis on which the effects of a dominant design on the industry structure are analyzed. The former article discusses technological discontinuities whereas the latter focuses specifically on dominant designs. The discussion is on the industry level, and the main questions cover issues such as the types of innovation that incumbents and entrants typically pursue, and how the industry structure changes after the dominant design has emerged. The authors also present their main argument that a dominant design emerges from technological discontinuities, although this is not always the case and describe situations in which no dominant design emerges. They further suggest that dominant designs evolve in sequential stages. I discuss more recent studies presenting the same cyclical view (e.g., Nooteboom, 2000).

The previous literature covers the major perspectives in the discussion: how a company can initiate innovations and achieve a dominant design, and how, on the industry level, the dominant design affects competition. These perspectives are nevertheless intertwined. A firm can learn from historical regularity, for example, how dominant designs were established in an industry, and attempt to manipulate the factors, influences and forces identified in their emergence (e.g., Lee et al. 1995; McGrath et al., 1992; Suarez, 2004). I briefly describe McGrath's (1992) and Suarez's (2004) models, and elaborate on my understanding of the evolution of a dominant design in the present study.

Finally, I consider the building blocks, or success factors (Suarez, 2004), in the process of acquiring, managing, and transforming one dominant design to the next one in the marketplace. The success factors are typically present at the emergence stage. I also bring three closely linked factors into the discussion, all of which are theoretically highly relevant and assume importance in the present case study: technological brokering[8] (e.g., Hargadon & Sutton, 1997), dominant logic[9] (e.g., Bettis & Prahalad, 1986; Chesbrough & Rosenbloom, 2002; Tripsas & Gavetti, 2000), and convergence[10] (e.g., Adner, 2002; Tushman & Romanelli, 1985; Yoffie, 1997).

I argue that increasing the odds of creating new dominant designs is more complicated when the company grows in size and scope and when the industry matures. This discussion leans on Reinganum (1983, 1985); Klepper (1996); Ettlie, Bridges & O'Keefe (1984), and Henderson (1993), for example. The basic premise is that an incumbent invests less than an entrant in new technologies. Moreover, according to Rosenbloom and

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[8] I adopt Hargadon and Sutton's (1997, p. 718) definition: "the transfer of ideas to industries where they have not been used before and the creation of combinations of ideas that no one in any industry has seen before".

[9] I adopt Prahalad and Bettis (1986, p.491) definition: "Dominant logic is a mind set or a world view or conceptualization of the business and the administrative tools to accomplish goals and make decisions in that business. It is stored as a shared cognitive map (or set of schemas) among the dominant coalition. It is expressed as a learned, problem-solving behavior".

[10] Different technologies provide the same functionality and services (Fransman, 2000), and customers may find that different products serve the same need (Adner, 2002).

Christensen (1994), it is more difficult for incumbents to change strategies than technologies. The main point here is that innovation needs to be viewed separately from both the 'organizational' [i.e. strategic] and the 'economic' [i.e. technological] perspectives, bearing in mind the differences between incremental and radical innovations.

The economics view refers to the classic underinvestment dilemma for monopolists (i.e. they do not invest in new technologies because old technologies have a good payoff; the aforementioned replication effect), and the organizational view to corporate incompetence, as Henderson (1993, p.249) suggests. Corporate incompetence means the failure to pursue radical innovations because incumbent inertia and 'power games' protect old business. Henderson (ibid., p.254) combines both views in a four-square matrix in which the incumbent may also successfully pursue radical innovations (see also Anderson & Tushman, 1990, p.625 and Utterback, 1996, pp. 205-206).

I will analyze the building blocks of dominant design in three steps, reflecting how such a design is created, retained, and then transformed into the next dominant design. Essentially, I derive the building blocks from Teece's (2007) widely cited framework dividing the management of dynamic capabilities into sensing, seizing and transforming activity. First, I will briefly discuss the seminal works on dominant design and how they are linked to the research on strategic management.

The main premise in the classic works on dominant designs is that innovations are patterned in and through the industry/product life cycle, in other words that technological and market development reflects the cyclical development of innovations. Closely related to this is the discussion on the tradeoffs between exploration (radically innovative and novelty-centered) and exploitation (incrementally innovative and efficiency-centered) activities, ambidextrous organizational forms, and the highly strategic nature of dominant designs in firms and industries (Anderson & Tushman, 1990; McGrath et al., 1992; Smith & Tushman, 2005). This section addresses each of these themes.

2.2.1 Patterns of innovation, the technology cycle, and exploration/exploitation (classic works on dominant designs)

In the classic works on dominant designs, Utterback and Abernathy (1975) describe an empirically grounded pattern of innovation types and the firm's or a production unit's stage of development (ibid., p.645). They identified certain characteristic profiles as the industry or firm matures.

In other words, there is a 'best way' to innovate at each stage of the life cycle, and it is beneficial if management fully understands the nature of the competition. There is a further division into product vs. process innovation, with the same life-cycle mechanisms (i.e. the locus of innovation, the most appropriate type of innovation, and the barriers to innovation [ibid. p.646-647]) at work in both.

The authors characterize the stages of the product life cycle as follows: the firm's strategies are typically (product) performance-maximizing during the initial stage, sales-maximizing in the subsequent stages, and, typically cost-minimizing in the final stages. Abernathy and Utterback (1978) later labeled these stages as the 'fluid pattern, transitional pattern, and specific pattern'.[11] The key contribution of these early studies is the notion that at each stage there are different organizational motives for exhibiting or developing a bias in favor of a specific innovation type. Moreover, the forms of resistance differ at each stage, tending to emphasize the irrelevance of the product in the fluid stage, and the fear of existing product cannibalization in the specific stage. Figure 2 depicts Utterback and Abernathy's (1975, 1978) model.

[11] The industry's and the (company's) evolution takes place in three different stages (fluid, transitional, and specific), each of which has specific characteristics:, a high degree of uncertainty and rate of change in the fluid phase; during the transitional phase, one technological implementation will typically turn into a dominant design, consequently demand will grow and the process will start to stabilize; and products turn into standards, and productivity and quality improve in the specific phase.

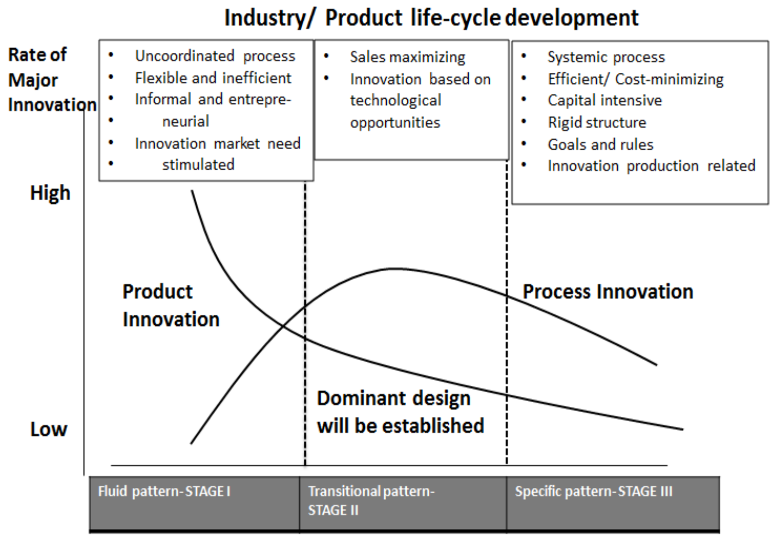

Figure 2 Innovation development in the life cycle of a dominant design (adapted from Utterback and Abernathy [1975], Abernathy and Utterback [1978])

Figure 2 traces the development of the various innovation types in the design's life cycle. The patterns of change in innovation frequency are shown on the vertical axis, and those related to the developmental stage on the horizontal axis. Product innovation is stronger than process innovation in the fluid pattern stage (I), but the situation is reversed when the life cycle reaches the specific pattern stage (III). There is an evident trade-off between product and process innovations. This is highly significant with regard to organizational capabilities, or the lack thereof, as the firm may find it has developed well-established production processes but can no longer generate product innovations. New innovations may develop in more flexible organizational units, or in other industries, thereby making the company's products obsolete. (Utterback and Abernathy, 1975)

The firm's processes are depicted as uncoordinated or non-routinized in the fluid pattern stage. These uncoordinated processes may be flexible, but the downside is that they may also be inefficient. The management style could be characterized as informal and entrepreneurial. During their move to the specific stage the processes become more systemic and rigid on the one hand, and more efficient and capital-intensive on the other. The management style could be characterized as structured, with clear goals and rules. However, there is also significant input from new technology in stage I, and the innovations are original, as opposed to stage III when they tend to be adopted from material or equipment suppliers, on license or via imitation (Utterback and Abernathy, 1975, p.651)

Utterback and Abernathy formulate seven hypotheses to test their model in their seminal article from 1975. The first two of these, which I describe in more detail below, are the most relevant for my study (1-2). First (1), the emphasis and priority given by the firm to [product] innovation as a competitive strategy will be the greatest in stage I and weaker in stages II and III (ibid. p.650). This means, for example, that if the basis of the innovation is a market need stimulated during the first stage then this effect and bias weaken later on (according to the authors [ibid.], market demand is not a source of innovation in the later stages of the life cycle). This point is significant but ignores two possibilities: there may be inputs into the innovation (such as R&D, suppliers or cost-efficient processes) other than market need (this also applies to products at the same stage in the life cycle), and the initial choice of an innovation source may affect subsequent product management and the transitions from the fluid to the transitional and specific phases. Furthermore, when the market matures the next innovation round (given that new successive dominant designs will emerge) may have the innovation sources in a different order than in the original Utterback and Abernathy (1975) model. Indeed, Utterback and Abernathy's model has been challenged: Clark (1985), Barras (1986), and Windrum (2005), for instance, suggest that process innovations may also start the next (subsequent) innovation round, bypassing product innovations altogether.

Second (2), as mentioned above, most stage-I innovations are original, whereas most of those occurring in stage III are adopted (Utterback & Abernathy, 1975, p. 651). This hypothesis raises an important question: Is it inevitable that the innovative activity of the original (innovative) firms will shift to other layers in the life cycle during the next innovation round (i.e. a new fluid stage followed by transitional and specific stages), and that the innovation will be imitation-led? I assume the other layers are embedded in the value chain[12] , hence the innovative activity can shift

[12] Porter (2001) defines the value chain as "the set of activities through which a product or service is created and delivered to customers" (ibid., p.74). The activities include logistics operations, marketing and sales, and services, for example. Furthermore, according to Porter, the Five Forces in the industry define each participant's share of the value chain (Fleisher and Bensoussan, 2003, p.106).

from the focal company to suppliers, subcontractors, adjacent industries or customers.

Tushman and Anderson (1986) introduce a second major perspective on dominant designs, and on the technology cycle – the impact "*of technological breakthroughs on environmental conditions*" (ibid., p.439). They claim that a technological change can result from pure chance, the isolated action of a technological genius, or economic demand, but eventually acknowledge that it involves isolated incidents, managing and planning. The manageable aspects include technological, market, legal, and social factors (ibid., p.444). Tushman and Anderson (ibid.) further argue that technology progresses in stages through relatively long periods of incremental change, which elaborates a particular dominant design. These periods of increasing consolidation and learning-by-doing may be punctuated by competence-destroying discontinuities (i.e. through product or process substitution), or competence-enhancing technological advancement (i.e. through the revitalization of a given product or process with complementary technologies).

Technological discontinuities (i.e., major technological shifts) typically trigger a period of technological ferment that culminates in a dominant design and, in turn, leads to the next period of incremental, competence-enhancing technological change (Tushman & Anderson, 1986. p. 444). In sum, Tushman and Anderson (ibid.) refer to three types of technological shift: 1) niche opening, which leads to the opening of a new industry sector; 2) competence-destroying discontinuities, which lead to product or process substitution; and 3) competence-enhancing discontinuities, which lead to substantial product-improvement or process innovations. A dominant design may be established following a technological shift, but this is not self-evident.

Tushman and Anderson (1986) also note that technology is the most important building block in terms of understanding how industries and organizations develop. They describe technology changes as product or process related, and as competence-destroying or competence-enhancing innovations, which is in line with the thoughts of Abernathy and Utterback (Abernathy and Utterback, 1978; Utterback & Abernathy, 1975). Tushman and Anderson (1986) suggest a research agenda and the testing of hypotheses on the industry level concerning how companies are affected by technological changes. Further possibilities have since been identified that trigger the era of ferment: new design applications, changes in customer demand, and government policy (Abernathy & Clark, 1985; Tushman & O'Reilly, 1997).

Although both incumbents and attackers can produce competence-enhancing or competence-destroying innovations, it is still proposed that existing firms benefit if the discontinuity is competence enhancing: "*A competence enhancing discontinuity builds on know-how embodied in the technology that it replaces*" (Anderson & Tushman, 1990, p. 609). Furthermore, if the company has specific technological capabilities that it can apply, it has an advantage. In contrast, competence-destroying technological change, by definition, renders its existing assets and capabilities largely obsolete.

In sum, Anderson and Tushman (1990) propose a cyclical model of technological change in their study of technological discontinuities and dominant designs. They focus more on dominant designs, thus extending earlier knowledge (Tushman & Anderson, 1986). Figure 3 below depicts their technology cycle.

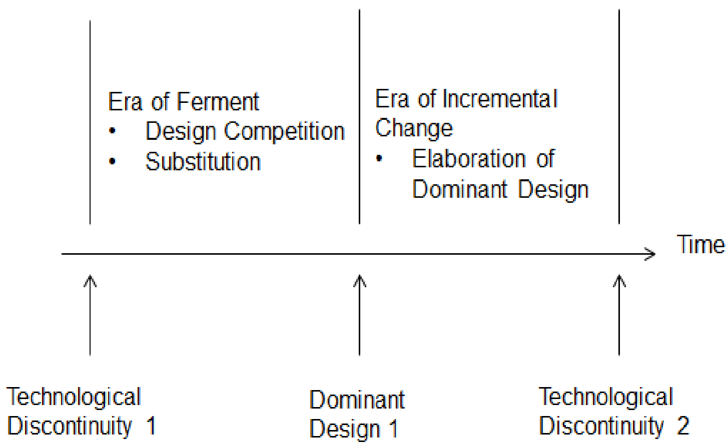

Figure 3. The technology cycle. (Anderson and Tushman, 1990, p. 606)

The analysis in the technology cycle may be on the process or product level (Figure 3). Technological discontinuities start the era of ferment, when old technologies are substituted with new (competition between technical regimes), and rival designs vie for a position in the new (chosen) technology (competition within a technological order: Anderson & Tushman, 1990, p. 612). Technological discontinuity typically results in a substantial price/performance improvement and may later evolve into a new dominant design (see also Moore, 1990, 1995, 2005). During the cycle the dominant design matures as incremental product and process refinements are implemented. It is assumed that further technological discontinuities will emerge, starting the process again. It should be noted that this is an industry-level process, and the phases appear to be more or less 'external' to the firm operating in the industry.

Several points in the above discussion are relevant to my study. First, the authors note that it is uncommon to see successive competence-enhancing discontinuities (Anderson & Tushman, 1990, p.623). In other words, competence-destroying discontinuities intertwine at some point in subsequent technology cycles. Incumbents seeking to protect their business should find out how these competence-enhancing discontinuities could be produced so as to prevent the occurrence of competence-destroying discontinuities. Second, both incumbents and newcomers utilize competence-destroying innovations, and incumbents are not necessarily in a worse position (according to Anderson & Tushman, ibid.). Third, there are situations in which a clearly dominant design does not emerge, such as when there is low customer demand, no technological competition, or a high appropriability[13] regime. The implication is that innovators can protect their innovations effectively enough (through regulation, for example) to prevent the transition of the new product or service into a dominant design. It is worth noting that, by definition, a dominant design must be a commercial success. Hence, de jure technological standards in a certain industry (specified by regulators, for example) are not necessarily dominant designs (albeit they sometimes can be) (e.g., Srinivasan et al., 2006). The Finnish telecom market provides an illustrative example of a de jure standard that did not guarantee the transition of a service into a dominant design. In the early 2000s, regulators forced telecom operators to create a new nationwide numbering system, namely the 071 prefix, as a viable substitute for corporate numbers. However, end customers did not see the need for the prefix due to the inadequate service and functionality, and the telecom operators were reluctant to develop the service given the unprofitability of the business model.

In sum, the discussion on innovation and its context (the firm's organization and capabilities) offers a perspective from which to analyze the creation of dominant designs. Complementing the concept of the technology cycle is the heuristic learning cycle and its associations with the cycles of 1) exploitation and exploration, 2) integration and disintegration, and 3) innovation and diffusion (Nooteboom, 1999, 2000). Heuristics refers to intuitive reasoning and 'guessing' how a theory or a

[13] A regime of appropriability (Teece, 1986) refers to the environmental factors, excluding the organizational and market structure, that govern an innovator's ability to capture the profits generated by the innovation.

model might work (Merriam-Webster, 2014). According to Nooteboom, the concept of learning is associated with the notion of how innovations are seen to emerge and consolidate. More specifically, he seeks to explain "*how exploration and exploitation are mutually related and build on each other*", meaning that there is a research gap in terms of explaining the transition from current practice to novel practice (Nooteboom, 2006, p. 3).

Evolution is presented as a cycle in which the end of one period is the starting point of the next. Nooteboom makes a major contribution in describing the logic of how new innovations are developed from existing ones. I describe the concept of the learning cycle in more detail below (Figure 4).

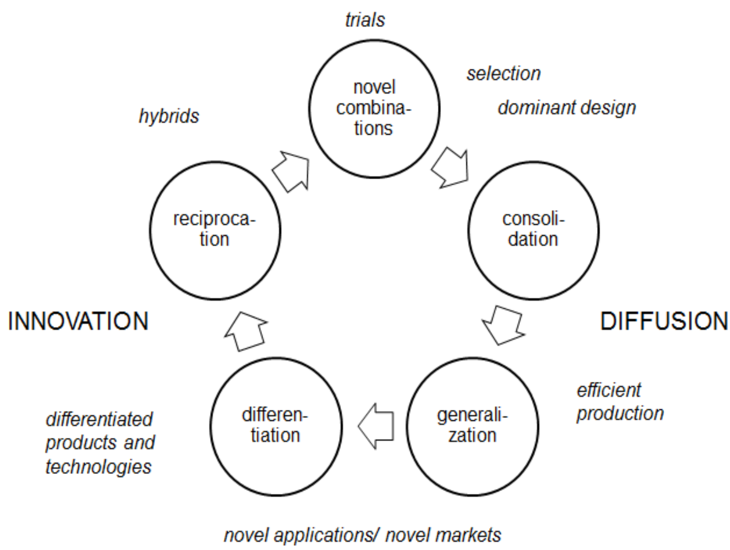

Figure 4. Nooteboom's cycle of innovation and diffusion. (Nooteboom, 2000, p.238)

Nooteboom (2000) applied the logic of learning to the cycle of innovation and diffusion as follows (see Figure 4). The processes of innovation and diffusion are polar developments. At the start, (1) reciprocation refers to the time when an old idea or practice no longer works but a new practice is not yet in place. This leads to the search for (2) novel combinations of ideas and practices, manifested in trials through hybrids, and later to (3) the consolidation of novel combinations in common knowledge. Selected innovations turn into dominant designs before consolidation, which in turn is followed by (4) generalization, referring to efficient (mass) production based on the consolidated idea or practice. Finally, (5) the related products and technologies need to be differentiated.

Nooteboom situates the cycle of innovation and diffusion in the cycle of knowledge, in which there are two kinds of tacit knowledge, tacit 1 and tacit 2 that referring to the two types of innovation logic (Nooteboom, 2000, p.187). The former (tacit 1) resides in architectural restructuring and is more fundamental in nature: knowledge cannot be made explicit because it is incomplete or non-existent. The latter (tacit 2) resides in routinization, enabled by generalization. Routinization is efficient because there is no need to challenge what the organization is doing. I see this as parallel to incumbents developing incremental innovations (based on competence-enhancing discontinuities). One can also see a link to the firm's dynamic capabilities here: when a firm is able to create new dominant designs from its existing offerings in response to new market conditions it is applying continuous learning in order to avoid technological lock-out (Gilsing & Nooteboom, 2006; Schilling, 2002; see also Fischer & Gebauer, 2010).

There is also an evident link between the learning-involving innovation cycle and the dynamics of exploration and exploitation (March, 1991). In the context of organizational learning, March describes exploration in terms of search, variation, risk-taking, experimentation, play, flexibility, discovery, and the pursuit of new knowledge. Exploitation, in turn, connotes refinement, choice, production, efficiency, selection, implementation, and the application of existing knowledge (ibid. p.71). Thus, emergent dominant designs in the above innovation cycle are akin to March's exploitation activities (occurring after periods of innovation/exploration).

Adner and Levinthal (2008) argue that exploratory actions potentially generate new business and new metrics for measuring success, but these are difficult to foresee given the bounded rationality of organizations. Therefore, management needs cognitive shifts to provide a different topology (i.e. metrics and success measures) of the competitive landscape. In this way, management may enhance the organization's ability to act exploratively. The authors effectively illustrate the idea of cognitive shifts by pointing out how 'skunk works, retrofitting, and new dimensions of performance' are (explorative) tools to use to substitute for existing success criteria, the established strategy. The ultimate target of these activities is, in fact, to overturn '*dominant organizational logic*' (ibid., p.50).

The discussion on exploration and exploitation is relevant to this study given that the aim is to analyze how a company can shift from exploitation to exploration, thereby creating new or adapting old dominant designs (the same logic articulated by Drazin et al., 2004). A closely related theme is ambidexterity, which I discuss in the next sub-section.

First, however, I will summarize the arguments put forward in this sub-section regarding the extant theory and stylized facts about the relationship between innovation and the life cycle (which constitutes the core of the discussion on dominant design). According to Windrum (2005), the reasoning behind these facts differs, e.g., in Klepper (1996) and Utterback and Abernathy (1975).

The six stylized facts about innovations and the life cycle are the following: 1) Product variants are abundant in the early life-cycle phases and then diminish; 2) New market entrants are numerous in the early phases and then diminish; 3) Product innovations are replaced with process innovations during the life cycle (or at least the product innovations become less radical and more incremental); 4) New entrants into the industry introduce dominant designs arising from competence-destroying discontinuities, whereas (older) firms whose entry preceded the discontinuity bring in dominant designs arising from competence-enhancing discontinuities (Anderson & Tushman, 1990, p. 617); 5) The numbers of producers stabilize during the life cycle; 6) Market shares stabilize and large incumbents dominate the industry during the life cycle (Anderson & Tushman, 1990; Klepper, 1996; Windrum, 2005).

2.2.2 Ambidexterity

The concept of ambidexterity is closely related to the balancing of exploitation and exploration practices in the firm. In the context of management, ambidexterity means doing contradicting things simultaneously (Smith & Tushman, 2004): it is about building management practices and organizational structures (i.e., ambidextrous organizations) to deal with different types of management problems at the same time. In the following I show how ambidexterity is linked to dominant designs in the literature, and discuss the relevance of the concept to the present study.

It is pointed out in studies on ambidexterity (e.g., Tushman & O'Reilly III, 1996; O'Reilly III & Tushman, 2004, 2008; Tushman & Smith, 2002, 2004) that companies aiming at continuing success need to implement both incremental and radical innovations, and from time to time they have to create innovations from discontinuous changes. Herein lays the link between ambidexterity (being able to do two things at once), innovation cycles, and dominant design. Ambidextrous organizations are able to rise to this challenge, being attuned to creating both incremental and radical innovations, and to sustaining different kinds of processes and cultures at the same time (Tushman & O'Reilly III, 1996, p.297). The notion of ambidexterity also strongly reflects the logic behind portfolio management. Continying this theme, O'Reilly III and Tushman (2004, p.77) distinguish between new and existing customers, and between incremental, architectural and discontinuous innovations. The company should allocate its various resources to the new explorative business units, and at the same time shield the established units from the 'distraction' of launching new businesses. The resources comprise e.g., "*cash, talents, expertise, and customers*" (O'Reilly III and Tushman, 2004, p.77)

My primary focus in the present study is on the creation of dominant designs in the focal firm, rather than on its portfolio management. Nevertheless, attempts to create and/or adapt dominant designs are inevitably made with its product and technology portfolios in mind – especially given the nature of its complex technological systems. Having such a complex system at its technological core indicates that the company's units are interdependent rather than independent, in the sense that they and the projects share certain processes, production units, sales organizations, and customer needs. This phenomenon is driven, in a sense, by technological convergence. From this perspective I see the linkage to dominant designs in the discussion on ambidexterity as somewhat deficient, or incomplete. According to Nooteboom (2000) organizations evolve from exploration to exploitation and do *not* place equal importance on both activities at the same time. Product architecture and managerial cognition are frequently overturned in the creation of dominant designs, for example, possibly affecting whole industries. Inherent in ambidexterity, in turn, is considerable effort to shield old business units from change.

My argument here is rather that an ambidextrous organization may actually inhibit the creation of individual dominant designs if the organization is cognitively split, as is often proposed (O'Reilly III & Tushman, 2008, p.195). I therefore adopt a view that a firm in the process of major change attempting to manage incremental and radical innovations at the same time (i.e. ambidextrously) may adversely affect the strategic focus on dominant design. The discussion in the next sub-section focuses on the link between dominant design and firm-level strategy in general.

2.2.3 Dominant design and company strategy

Dominant designs appear to emerge from strategic decisions on the shaping of technological progress: the fact that firms can systemically manage the factors that affect the emergence of a dominant design makes its design, creation and adoption highly strategic activities (Lee et al., 1995; McGrath et al., 1992).

Utterback and Abernathy (1975, p. 640) state in their pioneering work:

> "The essence of our argument is that characteristics of the innovative process and of a firm's innovation attempts will vary systematically with differences in the firm's environment and its strategy for competition and growth, and with the state of development of process technology used by a firm and by its competitors".

In other words, the innovative process, which I see as parallel to creating or adopting, or failing to create or adopt dominant designs, should evolve in line with the environmental conditions and the company's strategy.

The identification of an industry's life-cycle stage and its matching with the company's innovative activities are highly strategic matters, as Abernathy and Utterback (1978) point out. Illustrating the wide variety of innovation-related variables, the authors discuss the following facets in the product/industry life-cycle: the source and predominant type of innovation, the product line, the production processes, equipment, materials, plant, and organizational control (ibid., p. 154). The content and managerial challenges are assumed to change during the life cycle. The work of Abernathy and Utterback (ibid.) has much in common with that of Miles and Snow (1978) and Snow and Hrebiniak (1980). Miles and Snow (1978) provide a typology of company strategies. They stress, in particular, that the strategy types derived from the classification of major problem areas (and solutions) in management are of three types: entrepreneurial, engineering, and administrative. Entrepreneurial problems concern the choice of a product-market domain; engineering problems focus on the choice of production and distribution technologies; and administrative problems concern the selection of areas for future innovation or the rationalization of structures and processes. These dilemmas are clearly present in the creation and adoption of dominant designs.

Afuah (2001), Utterback (1996), and Christensen (1997) add further insights on strategy and environmental change. Christensen (1997), for example, having found that the types of competitive advantage change during the process of evolution, focused on which of the product's success or performance components or attributes were highly valued by the market in the following successive product launches. According to Jacobides and Winter (2005), either customer preferences or external entities (such as industry players, new entrants, and players who develop the industry's generic function [e.g., call-center management] to form a new sub-industry) guide the resource allocation. In other words, when an industry matures there is often a stage when external market inputs dictate the 'scope for strategic change'.

2.2.4 How can a company create/increase the odds of creating dominant designs?

It is evident from the above discussion that creating a dominant design is enhanced by an understanding of the industry and the company's product life cycle. These aspects are intertwined in that the firm may have an effect on the industry life cycle in terms of manipulating the industry so as to influence the factors that enhance the evolution of a dominant design (Lee et. al., 1995; McGrath et al., 1992; Suarez, 2004; Van de Ven & Poole, 1995).

According to Van de Ven and Poole (1995), (1) the units of analysis in evolution theory are multiple entities (organizations are groups of 'black boxes' on the industry level), in which variation, selection and retention mechanisms are at work, filtering out (ousting) organizations that do not adapt to the environment. On the other hand, (2) life-cycle theory concerns single entities such as organizations, and incorporates the start-up, growth, harvest, and termination phases at the level of the firm.

Variation, selection, and retention are elements that explain evolution on the company and on the industry level (Aldrich & Ruef, 2006; Durand, 2001; 2006). Campbell (1960; 1969) made a fundamental contribution to organizational theory in introducing the notion of blind variation, meaning that variation is random and external to companies. More precisely, blind in this context means unintended and unplanned. However, proponents of the dynamic capabilities view, for example, have challenged this notion, suggesting that firms can also purposefully create variation (cf. Geels, 2002, who notes that firms can even influence selection processes in an industry). Aldrich and Ruef (2006) define variation as "*change from current routines and competencies; change in organizational forms*", selection as "*differential elimination of certain types of variations*", and retention as "*selected variations are preserved,* *duplicated, or otherwise reproduced*" (p.17). What is particularly interesting is how variation, selection and retention activities are manifested on the firm and industry levels.

2.2.5 The strategic shaping of technological progress - the McGrath, MacMillan and Tushman model

McGrath et al. (1992) claim that population-level theories are in opposition to the strategic management view. According to traditional population-level theories, selection occurs at the industry level and affects individual firms – without being affected by them (e.g., Hannan & Freeman, 1989). McGrath et al., (1992, p.146), in turn, propose that a myopically purposeful firm is partly self-aware and conscious in its attempts to shape the processes of variation, selection, and retention. Lewin and Volberda (1999) coin the term "co-evolutional" when matching adaptation and selection together, defining co-evolution as "*the joint outcome of managerial intentionality, environment, and institutional effects*" (p.526). This suggests that the evolutionary processes of organizations and their environments are simultaneous and interdependent.

McGrath et al. (1992) further ask the following question, "*How do I create a dominant design in the industry for my firm*?"(ibid., p.142). This perspective extends the analytical scope of earlier studies, in which it could be determined only ex post if and how the dominant design emerged. The authors develop a framework that both captures the construct of ex-post dominant design, and allows the ex-ante strategist (manager) at the firm level to think through the linkage between the firm's technology strategy and the way it wishes to attack its markets (ibid., p.142).

Table 2 lists examples of how the management team can create dominant designs as a process incorporating the phases of variation, selection and retention.

Table 2. The influence of executive teams on dominant designs. (McGrath et al., 1992)

Variation	Selection	Retention: Prevention of diffusion
Process driving scope (Scope setting) *Search for opportunities *Screening *Evaluation *Progress reviews *Processes driving intensity (Climate setting)* *Expectation setting *Personal demonstration of support *Disproportionate resource allocation *Staffing and re-staffing *Managing disappointment and discontinuation *Internal path-clearing *Moderating internal conflict *Granting dispensation from policy	*Processes driving selection (evolutionary strategies)* *Building switching costs *Drawing off and reinforcing existing infrastructure *Reinforcing existing standards *Using clout with transaction partners *Building technology links *Processes driving selection (revolutionary strategies)* *Forging market acceptance *Negotiating coevolution *Demonstrating commitment *Negotiating standards *Negotiated environment *Exploiting clout	*Processes delaying diffusion (evolutionary strategies)* *Exploiting organization deliverables *Using specialized assets *Using co-specialized assets *Processes delaying diffusion (revolutionary strategies)* *Co-evolutionary contracting *Asserting product-class prerogative *Influencing formal standards

The actions described in Table 2 relate to how an executive team can influence the creation of dominant designs. Actions in the variation phase, for example, concern processes driving scope and processes driving intensity. Intensity refers to mediating the organization's internal competition. In the selection phase, the associated processed are divided into evolutionary and revolutionary strategies. The most beneficial strategy in the retention stage is to delay the diffusion of the dominant design in order to capitalize on the organization's assets and thereby prevent competitors from finding a match. This model is the first to expand the dominant-design theory to variation, selection and retention discussion by suggesting strategic actions of managers. I used this model when I was developing my framework for the present study (see Chapter 7.2.3).

2.2.6 An integrative framework for achieving technological dominance - the Suarez model

The previous section introduced McGrath et al.'s (1992) model depicting the firm-level strategic-management factors that facilitate the creation of dominant designs – what I call dominant-design 'building blocks'. In the following I incorporate Suarez's recent model (2004) into the framework. One advantage of his model is that it explicitly separates firm-level actions and environment-level factors, and groups these elements in theoretical domains. In other words it facilitates the more systematic study of dominant-design management in linking classic models with closely related theoretical factors from adjacent domains. Suarez's (2004) framework thus addresses the management of dominant design, incorporating the different stages and domains (Table 3).

Table 3. The success factors in the dominance process. (Suarez, 2004)

Factor type	Dominance Factor	I R&D Build Up	II Technical feasibility	III Creating the market	IV Decisive battle	V Post-Dominance
Firm	*Technological superiority		***			
	*Credibility/ complementary assets	***			***	
	*Installed base				***	***
	*Strategic maneuvering			***		
Environ-ment	*Regulation		***			
	*Network effects and switching costs				***	***
	*Regime of appropriability	***				
	*Characteristics of the technological field	***				

In brief, Suarez's model (2004), as outlined in Table 3, identifies the elements that associated with technological dominance and their overall importance in the life cycle (the asterisks in the Table 3). Phase I refers to R&D build-up, consisting of factors on the firm and environmental levels. Phase II typically involves the development of a working prototype, phase III is the market-creation stage and phase IV is when a critical mass starts to emerge in favor of the selected product. By phase V a dominant technology has been selected and competition is "*within-standard*" (Suarez, 2004, p.283).

According to Suarez (2004), technological superiority, credibility and complementary assets, installed base, and strategic maneuvering are the most important dominance factors on the firm level. Technological superiority refers to how 'good' a technology is when compared with alternatives. However, it must be acknowledged that it is not sufficient in itself. In the case of videocassettes, for example, Sony Betamax was considered technologically superior to JVC's VHS, but in the end Sony lost the standard war (cf. Shapiro & Varian, 1999). Credibility and complementary assets refer to the previous knowledge of relevant technologies (Klepper & Simons, 2000), production resources, and other supporting functions (Teece, 1986) such as sales outlets that enable diffusing of an innovation and benefiting from it. The installed base, in turn, refers to the numbers of customers for current products: in general, a larger installed base facilitates the adoption of a technology (Suarez, 2004; Schilling, 1998). Finally, strategic maneuvering refers to various actions taken and decisions made in relation to entry timing, pricing, licensing and relationships with complementors, and in promotion and public relations.

Suarez (2004) lists regulation, network effects and switching costs, an appropriability regime, and the characteristics of the technological field as the most essential environment-level success factors. Regulation refers to the attempts of legislative bodies to impose a de jure standard in order to influence the technology selection in the market. Network effects and switching costs means a user (as well as a firm) has the bigger advantage the more other users adopt the service. When the network effects are strong, switching to another service or product is costly. An appropriability regime (Teece, 1986) refers to the environmental factors, excluding the structure of the firm and the market, that govern an innovator's ability to capture the profits generated by an innovation. Finally, the characteristics of the technological field broadly refer to the amount of and relative power of each actor and the level of cooperation versus competition in the industry. Buyers may be concentrated in some industries, R&D may have a strong influence, and open-standard innovation may be appreciated, for example. (Suarez, 2004) These characteristics affect the success of the company's strategic maneuvering.

2.3 The creation of dominant design at the company level

2.3.1 Towards a synthesized framework

The following sub-sections (2.3.2–2.3.4) describe the components of Suarez's model (2004) in more detail, and incorporate the key evolutionary and managerial elements from the other frameworks discussed above (e.g., McGrath et al., 1992; Lee et al., 1995; Schilling, 1998). This synthesis yields the preliminary research framework of the present study, outlining the relevant building blocks of dominant-design management, in other words the firm- and environment-level factors that can enhance or inhibit *the adaptation process (i.e. the creation and/or adoption of a dominant design*) in a firm. The factors can be managed, invested in, and manipulated – and affect both the creation/adoption of the dominant design, and the underlying motivation. Environmental factors also act as moderators in the management process (Suarez, 2004, p. 276). I use the term 'building blocks' throughout this dissertation. Interchangeable terms include 'influences' (McGrath et al., 1992) and 'factors' or 'forces' (Lee et al., 1995; Schilling, 1998).

With regard to earlier models, I find the following aspects underemphasized in McGrath et al. (1992) and Suarez (2004). First, the focus on top management as the main (or only) actors is too narrow given that innovative ideas stem from many sources, as discussed earlier. These sources include various business units and sub-units in the firm, functional units (R&D, marketing, sales), customers and vendors, and subcontractors. Second, Suarez's (2004) model in particular does not explicitly refer to the cyclical nature of the phenomenon, although the technology cycle is integral to the traditional notion of dominant design (cf. Nooteboom, 1999, 2000). Third, the earlier frameworks do not specify the relative importance of the various dominance factors. The present research elaborates on these matters further.

I also add to the synthesized framework three building blocks that are closely linked to the evolution and management of dominant designs, but are not explicitly included in the earlier discussions: (i) convergence, (ii) dominant logic, and (iii) technological brokering (Nooteboom, 2000). Convergence (i) reflects the potential need in the initial creation process for an integrated (i.e., converged) offering, as well as an integrated company structure within which to develop the new products, because architectural knowledge is still under-developed (e.g., Christensen & Raynor, 2003). Dominant logic (ii) is commonly used as a synonym for dominant design (e.g., Nooteboom, 2000). However, I distinguish between the two, the former referring to the organization's own, internal (established) way of thinking about and commercializing a given product category, and the latter to the product design that is or becomes adopted in the industry (regardless of the focal firm's earlier dominant logics). Technological brokering (iii) refers to a global search in the search for technological discontinuities (as opposed to only a local search), which may be a key mechanism for seizing dominant designs (Hargadon & Sutton, 1997; Teece, 2007).

Finally, I include in the synthesized framework Teece's (2007) model of dynamic-capability-relevant organizational processes (see section 2.4): (1) sensing, (2) seizing, and (3) transforming (see also Augier and Teece, 2006). Although these generic concepts as such do not specifically concern the management of dominant designs, they are useful in structuring the relevant building blocks into roughly distinct managerial stages, and the processes and capabilities they require. Another reason for integrating Teece's (2007) three-fold framework into the building blocks under consideration is that it reflects the fluid, specific, and transitional stages in the classic discussion on dominant design, and some of the building blocks are the same (e.g., the notions of appropriability and complementary assets).

2.3.2 Sensing

According to McGrath et al., (1992), Teece (2007), Schilling (1998), and Suarez (2004), among others, sensing– in the context of dominant designs – refers to the source of and search for innovative ideas (Adner & Levinthal, 2008), as well as the environmental building blocks that frame this phase. Therefore, I outline both the firm- and environment-related building blocks to the extent that they appear to influence the early (i.e. fluid) stages of creation or adoption (see especially Suarez, 2004).

Typically, the *regulatory framework* and scientific progression frame the initial sensing stage. The former includes issues such as licenses governing who can operate in the market, what technologies allowed, price regulation, and regulations are covering the kind of products that can be bundled.

The source of innovation typically refers to the ideas, or managerial cognitions, on where to focus search efforts. Naturally, such sources are varied. The search may be local or global (e.g., Adner & Levinthal, 2008), for instance: local implies narrow, familiar, and competence-enhancing ideas, whereas global search is more explorative. Other sources include R&D and science, vendors in cooperation, customer needs, social and regulatory change, new technologies, competitors, standard-setting bodies, and the market (McGrath et al., 1992; Teece, 2007). Sensing market needs emphasizes the market aspect, and reflects the corporate culture or philosophy in implementing and enhancing the marketing concept (in other words, value for customers: Agarwal, Erramilli & Dev, 2003; Jaworski, Kohli & Sahay, 2000; Han, Kim & Sristava, 1998, Narver & Slater, 1990). The marketing concept, in turn, defines goals related to market share, customer focus and profitability, the achievement of which depends on identifying the needs of target markets (Agarwal et al., 2003; Kohli & Jaworski, 1990). In a broad sense, sensing market needs (market orientation literature) means learning about market developments, communicating the findings, and adapting innovations to changing market conditions (Jaworski et al., 2000).

2.3.3 Seizing

Seizing refers to the period during which a product is commercially launched (McGrath et al., 1992; Teece, 2007; Schilling, 1998; Suarez, 2004, among others).

During this phase the company starts the commercialization process from innovative ideas to product prototypes or pilot products. I have identified the following key themes in this domain on the basis of how they help in the commercialization process, and determine the nature of the commercial product and the company's role in the larger ecosystem (i.e. selecting the internal structure). The themes are 1) network externalities, 2) standards, 3) the role of complementary assets, 4) modularity management, and 5) the firm's internal structure (open vs. closed). Moreover, 6) ecosystem/partnership management, 7) innovation type and portfolio, 8) technological competences and technological brokering also belong to this phase. Finally, 9) an appropriability regime determines the innovator's ability to capture the profits an innovation generates.

1) Network Externalities are among the first macro-level factors that define the relative easiness (or difficulty) of creating a dominant design, and include the motivation for and ease in adopting such a design (even if created by others). Pepall et al. (2005, p.615) define the concept as follows: "*when the value of a product to any one consumer increases as the number of other consumers using the product increases, we say that the market for that product exhibits network externalities or effects*". Arthur (1989, 2001) describes network externalities as a building block, the aim of which is to achieve increasing returns (in technology, product, or service usage). In other words the "*increased attractiveness caused by adoption*" is central (Arthur, 2001, p.299).[14]

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[14] Other factors resulting in increasing returns include 1) learning by using (i.e., the more technology is used, the more is learned about it); 2) scale economies in production (i.e. the unit cost of a product will decrease as the production volume

Specifically, Srinisavan et al. (2006) and Baum, Korn & Kotha (1995) studied the emergence of dominant designs in new product categories, finding it more likely under conditions of weak network effects[15]. Srinisavan et al. (2004), in turn, consider the effects of network externalities in more detail, examining pioneer survival. Their main point is that "network externalities have a negative main effect on the survival duration of pioneers" (ibid., p. 41). The authors attribute this to the fact that customers do not want to commit to a product too early, preferring to wait for better products. Thus, a network externality effect may slow down the creation of dominant designs. In a similar vein, Windrum and Birchenhall (2005) note that in order for new successive dominant designs to emerge, both intrinsic and network utility must be substituted. In other words, the intrinsic utility of a new design must be so superior that it outweighs the higher network externalities of the old design ceteris paribus (ibid. p. 144). However, in the case of a technology-intensive product with network externality, when a large incumbent has knowledge and strong complementary assets, a dominant design will often emerge more quickly. In sum, the network effect is both an external condition and an internal manageable element.

2) Standards have three meanings: conventions, codes, or practices (Arthur, 2001). In any case, they tend to be technological in nature. Illustrative examples include mobile network standards (e.g., GSM, CDMA) that have evolved in life cycles and may also differ across countries. However, these conventional standards do not guarantee that related dominant designs will emerge. Second, a technology may become 'standard' (Arthur, 1989, p.305), in other words a dominant technology. I apply both of these meanings in this study. Standards often have the effect of enhancing, or speeding up, the emergence of a dominant design (Arthur, 2001, 1989; Srinisavan et al. 2004; Murmann & Frenken, 2006; Khazam & Mowery, 1994).

Standards have also been classified as de jure and de facto. Garud and Kumaraswamy (1993) study both types in the context of network industries in a case study of Sun Microsystems. Sun had a strategy of

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rises); 3) informational returns (i.e. adoption becomes more attractive if the product is well-known); and 4) technological interrelatedness, when 'sub-technologies and products' are merged and or made compatible with the dominant technology (Arthur, 2001).

[15] Srinivasan et al. (2006) further state that weak appropriability, low product radicalness, and high research-and-development intensity enhance dominant-design emergence.

connected open networks (as opposed to unconnected closed networks) and of shaping standards through sponsorship (i.e., giving rivals and firms in complementary markets easy access to technical knowledge). The current thinking is that de facto standards are more effective than de jure standards.

According to Shapiro and Varian (1999), the ability to wage a standards war depends on the following assets: control over an installed user base, intellectual property rights, the ability to innovate, first-mover advantage, manufacturing capabilities, strength in complements, and brand name and reputation. It is evident that waging a standards war (i.e. de facto a dominant-design war) demands plentiful resources.

3) Complementary assets can enhance the adoption of the initial product offering (Molina-Castillo et al., 2011). Various types of complementary assets exist, such as marketing capabilities, regulatory knowledge, and client lists (Stieglitz & Heine, 2007). What is important here is that technological innovations and discontinuities do not make the complementary assets obsolete.

Complementary assets have been linked to large incumbent organizations, enabling them to leverage innovations or to act as a buffer when products and offerings are not otherwise competitive. Stieglitz and Heine (2007) note that vertically integrated firms should have an advantage in integrating complementary assets, and that incumbents seem to have more complementary assets than newcomers. As I see it, complementarities such as the existing customer base are also important. At its simplest, a firm can cross-sell its new products or services to its existing large customer base. Another example is a robust generic billing system based on which one can develop integrative services, in other words different services with the same billing application.

4) Modularity Management is a recent notion in technology management. It refers to the degree to which the components of a system may be separated and recombined (Baldwin & Clark, 1997; Christensen & Raynor, 2003, p.128; Jacobides et al. 2006, p.1207). Baldwin and Clark (1997) put forward a view that "*modularity is a strategy for organizing complex products and processes efficiently*" (ibid., p.153). Modularity management is also linked to the question of open vs. closed organizational structures. According to Christensen and Raynor (2003) and Matthyssens and Vandenbemt (2008), when the market is capable of modular production, firms should have more open structures.

According to Baldwin and Clark (1997), modularity has enabled companies to handle complex technology by breaking up a product into subsystems. Modularity management, and thus the ability to define architectures is seen as a tool for orchestrating a value network or web (Jacobides et al., 2006). Brusoni (2005), for instance, suggests that this manifests in how networks of suppliers are coordinated in a system-integrator setting (Brusoni & Prencipe, 2001).

Modularity may have more profound effects than is at first apparent. Matthyssens and Vandenbempt (2008), for example, state that modularization will start de-systematization, which leads to commoditization in the market or industry. Both product and service elements may be modular (Baldwin & Clark, 1997; Matthyssens & Vandenbempt, 2008). I argue that a modular company has more options and degrees of freedom in terms of production. The following discussion on the firm's organizational structure further complements this discussion.

5) *The Firm's Internal Structure (Open/Closed)* explains, to some extent, how quickly products diffuse into markets. It has been argued that a closed and integrated organizational structure has drawbacks in today's markets (e.g., OVUM, 2002; see also Kenney & Pon, 2011; Fransman, 2000). According to OVUM (2002), this is partly due to a shift in managerial paradigms towards open-market thinking (such as partnerships and solution-based business substituting customer ownership and technological superiority, cf. Suarez, 2004).

Afuah (2001) in his work on dynamic boundaries wonders whether firms are better off being vertically integrated in the face of technological change, thereby bridging the discussion about competence-destroying technological change in the context of dominant design and the notion of a preferred structure when change happens. Furthermore, companies that are vertically integrated into the old technology, which it is suggested perform worse than those that are not, face constant organizational challenges (e.g., Hauser, 2006) if competence-destroying technological change is expected to emerge over and over again. Afuah (2001) also argues that in the case of technological change that is competence destroying for firms and their suppliers, firms that are integrated vertically into the new technology will perform better than those that are not. This seems to resemble the SBU (strategic business unit) model with its integrated production, R&D, product management, sales and marketing.

Christensen, Verlinden and Westerman (2002) studied modularity vs. integrated offerings as sources of competitiveness over time. They found that vertical integration was beneficial when customers did not find the products satisfactory in terms of functionality or performance, and that modularity was beneficial when they did (see also Jacobides, 2005; Kenney and Pon, 2011).

A closely related topic in the context of the firm's internal structure is that of value creation and value appropriation, and the role of industry architectures (Jacobides, Knudsen & Augier, 2006, p.1200). Key aspects of this discussion include complementary assets and capabilities and their mobility. Specifically, the open vs. closed company mode has more variations depending on how "mobile" the complementary assets are. Integration is necessary in a closed and technologically early market, and if the mobility of complementary assets is working in an open market (during the growth or mature stage), a situation may arise that is described as "*rule without assets*" (ibid.). Intel Corp. for example, used complementary assets, i.e. subcontractors, and did not need to integrate into a closed company mode. Conversely, the assets may not be mobile, but local, and have no complementarity in the production process (ibid., p.1206). Jacobides gives the example of a local factory with unskilled labor. In this case the resources and capabilities are not transferable and therefore typically should be owned.

6) Ecosystem Management concerns the linkages from a focal firm to its suppliers and producers that form a 'technological community' (Srinivasan et al., 2006): the larger the community, the greater the number of firms in the value net of the product category, and the shorter is the time to the emergence of a dominant design. What is also typical is that business in the ecosystem crosses a variety of industrial boundaries (Moore, 1993, p. 76). Ecosystems share certain characteristics, including a degree of common vision among the actors, a common platform and standards, and high interdependence. A functioning ecosystem may be more open or more closed.

The level of technological progress partly defines the ecosystem (Jacobides et al., 2006; Christensen and Raynor, 2003). The type of ecosystem (or a variation of it) that might emerge depends on the organizational type (vertically integrated or modular), and the level of technological maturity (including the degree of knowledge standardization) determines which one is the preferred option.

Cusumano, Mylonadis and Rosenbloom (1992) refer in their study on strategic maneuvering and mass-market dynamics to the triumph of VHS over Betamax video recorders: JVC won the battle through the formation of alliances, well-timed decision-making, and the strategic alignment of complementary products. Srinivasan et al. (2006, p.7) suggest that the greater the number of firms in the value net, the sooner the dominant design will emerge. Jacobides et al. (2006), in turn, discuss value creation, value appropriation, and the role of industry architectures in their study on how to benefit from innovation. They conclude that firms could benefit by managing the industry's architecture carefully so as become a 'bottleneck'.

7) Technological competences and technological brokering refer to the ability to create technologically superior products and services in-house or through networking. Teece (2007, p. 1326) uses the general term "technological competences", Suarez (2004) prefers "technological superiority" (p. 276), and Cattani (2006, p.290) opts for "technological knowledge base".

Given that technological competences may not reside in the focal firm (i.e. local search) and are therefore external to it (global search, Adner & Levinthal, 2008; Hatfield et al. 2001), the need for technological brokering, in other words the use of networking ability to leverage products and solutions to different markets, may arise: "*A technology broker introduces [these] solutions where they are not known and, in the process, creates new products that are original combinations of existing knowledge from disparate industries*" (Hargadon & Sutton, 1997, p. 716). Hargadon and Sutton stress the importance of drawing analogies between current design challenges and the designs and solutions arrived at in other industries at different times.

8) Innovation type and portfolio refer to the range of innovations that crystallize the productization process (see Chapter 2). Abernathy and Clark's (1985) typology is appropriate in this context: innovations are either competence enhancing or competence-destroying for the firm and its business units.

It should also be noted that end products may be intertwined technologically in line with a customer need. This is especially relevant in analyses of the industry life cycle. It also reflects the importance of the innovation portfolio (cf. Abernathy & Clark, 1985), meaning the product areas that share the company's production, marketing, and product-development and/or management resources. The same technological discontinuities affect these products in the innovation portfolio (Tripsas, 2008). Abernathy and Clark (1985) also refer to the different managerial and organizational skills required depending on the innovation type.

9) An Appropriability Regime (Teece, 1986) refers to the environmental factors, excluding the organizational and market structure, that govern an innovator's ability to capture the profits generated by the innovation. Teece classifies these factors as legal instruments and the nature of the technology. Legal instruments consist of patents, copyrights, and trade secrets, whereas knowledge about the nature of technology may be tacit or codified. These facets affect the imitation potential.

The appropriability regime thus helps the company to protect its investment in innovations and at the same time to promote their diffusion. It also defines how profitable the innovation is.

2.3.4 Transforming

As noted in McGrath et al., (1992), Nooteboom (2000), Suarez (2004), and Teece (2007), among others, transforming in the context of dominant designs refers to the building blocks that trigger the transition to subsequent dominant designs, as well as to the environmental blocks that frame this phase. The building blocks outlined below, according to the literature, affect the transition stages of the creation and adoption process (as well as the fluid stage in subsequent dominant designs).

I have identified customer preferences and market change (e.g., Tushman & O'Reilly, 1996), and technological change (Tushman & Anderson, 1986) as the environmental building blocks. On the company level, but closely intertwined with the environmental level, I see the dominant logic and convergence as the defining concepts in the transforming phase. It should be noted that transition could be incremental or radical, meaning that discontinuities either enhance or destroy competence (Tushman & Anderson, 1986; Tushman & O'Reilly, 1996). Dominant designs emanate from both incremental and radical innovations.

Customer preferences and market change: as companies (and industries) evolve, grow and mature the key managerial challenges, or 'dominant problems' may change (Greiner, 1972; Kazanjian, 1988; 1989). Thus, at the mature stage of the product category or industry, and thereby the transforming phase of the dominant design, the dominant problems are different than in the introductory or sensing stage (cf. Utterback & Abernathy, 1975). Customer needs are well articulated in the mature stage as the dominant design has emerged to the market, which incumbent or large established firms typically control. For these reasons, incumbent firms, which tend to be familiar with the current (dominant design) products and customers' related preferences, typically focus even more sharply on current customers and serving their incremental needs, away from architectural and revolutionary innovations (which they may have pursued at the introductory life-cycle phase). (Christensen & Bower, 1996; Christensen & Rosenbloom, 1995; Henderson & Clark, 1990; Henderson, 1993; Reinganum, 1985, 1983) This reflects the discussion earlier in this Chapter concerning the sources of investment and R&D incentives for incumbents fearing new entrants (Abernathy & Clark, 1985; Henderson, ibid.). The transformation to subsequent dominant designs, which are based on either incremental or radical innovations, nevertheless requires the capability to sense the needs of emerging and not only current customers (Anderson & Tushman, 1986).

Technological change refers to technological discontinuities that are either competence enhancing or destroying to incumbents and entrants (e.g., Tushman & Anderson, 1986) and start the fluid industry-life-cycle stage. Christensen and Rosenbloom (1995) and Christensen and Bower (1996) explain the circumstances in which entrants have an advantage over incumbent firms when they start the productization of emergent technology: entrants lead in developing and adopting technologies that address user needs in different, emerging value networks. Christensen and Bower (1996) found that new entrants initially had inferior technology, which as it matured invaded the incumbents' market. Incumbents, in turn, had difficulty matching the technology because they did not invest in it during the initial stage, and did not see how it could better serve current customers' needs (Henderson & Clark, 1990).

Tripsas (2008) asks the question: "*What factors cause a mature industry to re-enter a period of technological turbulence*?" and develops a model of technological evolution that incorporates both technological trajectories and the new concept of preference trajectories, which are cycles of incremental and discontinuous change in preferences. Preference discontinuities turn out to play an important role in triggering technological transitions in an industry. Tripsas (ibid.) illustrates the model by means of an historical study of the typesetting industry, which underwent three major technological transitions[16] . Each of these changes was driven by preference discontinuities, which complement the discussion on the limits of technology, and a supply-side emphasis: preference discontinuities in one particular industry (i.e. a demand-side emphasis) enable new radical technologies to enter the incumbent industry.

I adopt Prahalad and Bettis' (1986, p.491) definition of *dominant logic* as follows:

[16] The transitions were: 1) From hot metal to analog phototypesetters, 2) from analog to CRT phototypesetters, and 3) from CRT to laser image setters.

"Dominant logic is a mind set or a world view or conceptualization of the business and the administrative tools to accomplish goals and make decisions in that business. It is stored as a shared cognitive map (or set of schemas) among the dominant coalition [i.e. the top management group]. It is expressed as a learned, problem-solving behavior".

The source and origins of dominant logic can be varied. Huff (1982) studied the influence of industry on strategy reformulation, which may include shifting to new or subsequent industry and product-category life cycles or dominant logics. She also discusses the potential influences of strategic concepts[17] (i.e. dominant logics) on deliberate strategy formulation. Single organizations, industry groups, and other industries are potential sources of strategic concepts, which tend to overlap. However, although there is potential in unique strategies, in practice the concepts are shared (ibid., p.127). All in all, the dominant logic is important, as it filters out ideas that are the source of innovation (see also Henderson and Clark, 1990).

In essence, dominant logic reflects the process of filtering out ideas and innovations worth pursuing, a process closely comparable to managerial cognition (see Adner and Helfat, 2003; Bettis and Prahalad, 1986; Bettis and Prahalad, 1995; Leonard-Barton, 1992; Tripsas and Gavetti, 2000; and Tikkanen et al., 2005). In general, these authors propose that the conceptual basis of a dominant logic is the reinforcement of an established world-view derived from past market success, conventional wisdom, past experience and a possibly analogous solution to new situations, and cognitive bias regarding available vs. adequate information.

The tasks of management are therefore to revise multiple dominant logics: to apply the dominant logic to the business in focus, assign business to an appropriate 'sector', and add to a variety of dominant logics when the new business is dissimilar from existing business. At any rate, altering the dominant logic challenges managers to change their world-view. In later research, Bettis & Prahalad (1995) highlight the feedback loop that gives organizational learning some input into dynamic organizational intelligence, in other words organizational learning influences strategies, systems, values, expectations, and reinforced behaviors, which in turn shape the dominant logic (ibid., p.7).

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[17] Huff (1982) finds out that strategic concepts are born with shared beliefs, observations and theories.

Convergence means putting together, or uniting and mixing, technical and regulatory boundaries (OECD, 1992; Yoffie, 1997). The main point is that the technologies serve the same customer need (Fransman, 2000), and customers find that different products serve the same need (Adner, 2002). In other words, as the technology converges, previously separate technologies are able to produce a multitude of services. For example, data technology can now be used to produce a voice application, which previously required proprietary telecommunications technology. Furthermore, which is relevant to this study, convergence is understood to lead to 'horizontal' (as opposed to vertical) management, which does not protect profit margins to the same extent (Hacklin et al., 2009, p.731; Yoffie, 1997, p.17). I interpret horizontal here to mean that different players can carry out functions that were previously the preserve of players with end-to-end responsibility for operations (Internet players, for example, can provide voice services that were earlier provided only by telecom verticals). There is a clear trade-off here between a vertical and an open horizontal management mode.

Adner (2002), in turn, presents a demand-based view on the emergence of competition in his analysis of disruptive technologies. He identifies four different competitive settings in which to examine the demand-based view of technology competition (ibid., p.670): (a) competitive isolation, wherein technologies are separate throughout their life-cycle; (b) competitive convergence, wherein they serve the same customer segments (Fai & Tunzelmann, 2001; Fransman, 2000); and (c) disruption (see also Christensen, 1997; Anderson & Tushman, 1990), wherein new technology displaces the old. In sum, segment preferences matter, and offer a demand-side customer view on convergence. According to Teece's (2007) more recent view on convergence in the transforming phase, one should develop integration and coordination skills and manage strategic fit so that asset combinations are value enhancing for companies and customers.

Finally, Tushman and Romanelli (1985, p. 178) define convergence as a "*process of incremental and interdependent change activities and decisions which work to achieve a greater consistency of internal activities with a strategic orientation, and which operate to impede radical or discontinuous change*". In their view, strategic reorientation and recreation bring about product evolution inside the company, as well as changes in strategy, power, structure and control. They point out that convergence occurs after the dominant design has emerged (see also Kaplan & Tripsas, 2008, p. 798), however, whereas in my view it is a potential management tool or building block facilitating the creation of a dominant design.

2.3.5 Overall shifting across changes – Evolution

Rounding up the discussion on the three phases of dominant-design adaptation (sensing, seizing, and transforming) I now consider the overall process from an *evolutionary* perspective.

Basically, evolution is about change, but the concept goes beyond a simple product or industry life cycle. Something more permanent emerges or changes, such as the competitiveness of the product attributes or "*the basis of competition*" (Christensen, 1997). Indeed, according to Christensen (ibid.), customers value different product attributes or families of attributes and the valuation criteria change in the process of evolution.

Evolution is also about adaptation to the environment. As a concept it originates in biology, wherein species are assumed to adapt to the environment in the long term. In the present study, evolution may even incorporate what appears to be revolution: progressive evolution may give way to dramatic and sudden change. This is apparent in the theory of dominant design (especially the punctuated models; see Chapter 3.2.1) in the case of competence-disrupting discontinuity.

In my view, evolution is associated to variation, selection and retention processes. Resources are limited, and competition is inherent (Aldrich & Ruef, 2006). In the current research, evolution is found and is of significance in the elements: 1) complex technological systems, 2) innovations, 3) dynamic capabilities, and 4) dominant design and strategy. In the case of 1) complex systems, technological evolution is actualized through the interdependent evolution of subsystems. Murmann and Frenken (2006) conceptualize products as complex artifacts that evolve in the form of a nested hierarchy of technology cycles. The complex-system model of dominant design explains why artifacts evolve as a nested hierarchy of technology cycles, and why multiple causes can contribute to the emergence of a dominant design, in other words technological change. Of significance to 2) innovations (a factor of variation, Aldrich & Ruef, ibid.), is the type of innovation and how it changes in successive dominant designs. Of significance to 3) dynamic capabilities, is the change in resources and competences. Finally, with regard to 4) dominant design and strategy, the important questions include how change in the firm's strategizing affects the creation or adoption of dominant designs, and how the different players' roles in the industry change.

Specifically, the present study examines the process through which the firm adapts dominant designs, in other words their potential creation, modification and/or adoption (Durand, 2006). On the industry level I focus on the inputs into dominant design (e.g., new technologies, legislative regulation, changing customer preferences), and how the roles of these factors haves changed over time. Thus, in analyzing the company's strategizing I incorporate an analysis of how it and the industry have changed.

In line with the above discussion, I adopt the following definition of evolution, which is general enough to incorporate the company level and the industry level, and the intertwining of the two:

"Evolution is a series of identifiable events causally linked together, which concern one or several entities at different levels of analysis that may or may not alter their essential characteristics, and may or may not proceed toward an anticipated ending" (Durand, 2006, p.16).

Van de Ven and Poole (1995) and Langley (1991) also discuss this view of evolution in some detail. Van de Ven and Poole (1995) focus on organizational development and the change process (as opposed to variance theories[18] , see Langley, 1991, p. 693). Theoretical approaches to change processes concentrate on why and how things evolve over time, enabling change to be studied on different levels of analysis (e.g., Langley, 1991). As pointed out above, the following two levels of change or evolution are relevant to the present study: 1) evolution on the industry level, depicting the variety of industry players as a 'black box' of variation, selection, and retention logic, and 2) life-cycle analysis[19] , which examines how and why individual units and companies change. I merge these

[18] Variance theories refer to models in which strategic change or the outcome factor is explained in terms of the influence of the different attributes (e.g., the. environment, leadership, and decision processes). The model is in the form of a mathematical function. I adopt variance theory in a certain form or spirit, as I attach numerical values to individual product areas, and consequently to various building blocks, which together affect the potential emergence of dominant designs.

[19] Van de Ven and Poole (1995) use the term life cycle to explain the development of a single entity: the start-up, growth, harvesting and terminating stages. Other authors (e.g., Anderson and Tushman, 1986) associate the life-cycle concept with industry-level analysis.

viewpoints, reflecting Durand's view (2006) that the borderlines of the levels need not be mutually exclusive.

2.3.6 Product and industry life-cycle relations

Product life-cycle (e.g. Cox, 1967) and industry life-cycle (e.g. Klepper, 1997) theories are closely related. The industry life-cycle was originally developed by the product life-cycle (e.g. Vernon, 1966; Klepper, 1996, 1997).

Industry life-cycle studies concentrate on explaining the evolution of industries. Evolution is characterized by four industry life-cycle phases, which are introduction, growth, maturity and decline (Klepper, 1996, 1997). The phases have clear profiles concerning market volumes, the maturity of technology, consumers articulated preferences, product architecture, and the number of players in the industry. Technological, legislative regulation and consumer preferences development drive the transition in the evolution of the industry, and also the possible transition of old industries to a new introduction stage. Klepper (1996) finds that "*technologically progressive industries evolve from birth to maturity*" and "*this evolutionary pattern has come to be known as the product life-cycle (PLC)"* (ibid., p.562)

Cox (1967) notes that the concept of the product life-cycle describes the evolution of a product, as measured by its sales over time. The product life-cycle stages are used in product marketing planning, e.g. in the amount of promotion and advertising. Like the Cox (ibid.) model, Vernon (1966) pioneers the product life-cycle research. Vernon identifies facets with management and conditions in the environment concerning product life-cycles: inputs, production process, communication of the product features between producers and end customers, price elasticity of demand, competitive situation and so forth. What is interesting, product life-cycle (new product, maturing product, standardized product) is used to explain international investment and trade patterns. This indicates product life-cycle as being inseparable or even a synonym with industry life-cycle.

Indeed, in the seminal work of Abernathy and Utterback (1978) the unit of analysis is called a *productive unit*. This captures both industry level and product (corporate) level, integrating the product and industry life-cycle. In Utterback and Abernathy (1975) model, the economics view at industry level, the management and engineering view at company level, and organization theory and behavior view at company level are integrated. In the similar vein, Anderson and Tushman (1990) note that dominant design is the key event in the evolution of an industry. The logic is here, that dominant design is associated both with the product life-cycle and the industry life-cycle. Also in a later overview (e.g. Peltoniemi, 2011) product life-cycle and industry life-cycle are not separated as distinct concepts.

However, as the product life-cycle and industry life-cycle are closely related, it is possible to separate facets concerning product level and industry level. This is evident also based on Klepper's (1997) findings that some industry life-cycles are not identical to the predicted development based on the product life-cycle. Entry, exit, market structure, market shares, and volumes are associated to industry level (e.g. Utterback, 1996; Klepper, 1996, 1997). In turn, facets such as changes in the nature and source of innovation, production processes, and company's competitive emphasis are associated to product life-cycle level.

In this research I separate the product life-cycle and industry life-cycle as follows. I am studying how new innovations (product life-cycle) are done 1) during industry life-cycle stages, and 2) at the start of the new industry life-cycle. I am interested in the changing context in new product and service innovations in life-cycles, especially when I have identified new industry or sub-industry introduction stage. The industry life-cycle (and sub-industry life-cycle)[20] set the conditions for innovative activity and organizational action. I also refer to the previous Chapter 3.5 (Overall shifting across changes- Evolution). The evolution of innovative activities and industry sets the context for studying dominant designs in this study. Put it in another way, 'the next waves of innovation' meaning successive innovations is of strong interest (Utterback, 1996), that capture the evolutionary logic.

[20] In this work industry life-cycle refers to 1) a telecommunications industry, and 2) ICT industry. In turn, these industries retain subindustries. In telecommunications, these subindustries are for example mobile communications, data communications, Internet and fixed voice. In the Appendix 13 there are shown to where subindustries the cases belong. Telecom industry and sub-industry classifications are found for example in Communications Outlook (OECD, 2007; 2009).

2.3.7 The Research Framework

In the following I outline the research framework of the focal study (Figures 5 and 6), which crystallize the theoretical discussion in Chapter 2. The framework has two distinct parts: the first covers events and evolution on the industry and firm levels (Figure 5), whereas the second focuses on the strategic process within the company or its business units (Figure 6).

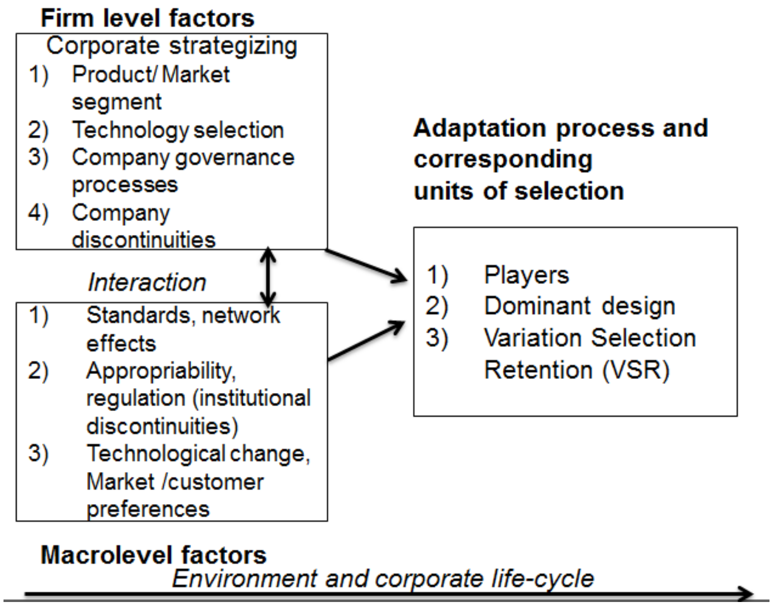

Figure 5. A theoretical framework describing the emergence of a dominant design on the corporate and industry levels

As Figure 5 shows, the emergence of a dominant design on the corporate and industry levels involves firm-level factors, macro-level factors, adaptation and corresponding units of selection, and the environment and corporate life cycle. The firm-level and macro-level factors are in interaction, the end result of which is the adaptation process (i.e., the creation or adoption of the dominant design). As an outcome, the firm- and macro-level factors and the consequent adaptation change in a life-cycle type of evolutionary process (Environment and corporate life-cycle).

The firm-level factors could be broadly described as corporate strategizing, which I address along with company discontinuities. Specifically, I use Abernathy and Utterback's (1978) and Miles and Snow's (1978) typology (items 1-3): 1) product/market segment, 2) technology selection, and 3) company governance processes (see Chapter 3.2.3 Dominant design and strategy). The typology explicitly addresses the fit of the firm's strategic choices with the environment – which is relevant to my research as I wish to explore the intertwining firm-level and macro-level environmental factors. Company discontinuities (i.e., major strategic changes) are also positioned in the framework, representing major changes in managerial cognition (or dominant logic), or in other major developments such as mergers.

In terms of macro-level factors, items 1-3 represent the building blocks and theoretical views of how a dominant design emerges. The building blocks may involve standards, network effects, regulation (institutional discontinuities), appropriability, technological change, and market/customer preferences. The intertwinement of firm-level and macro-level factors means, for example, that a company may benefit from or try to influence legislative regulation.

The end result of this interaction is the overall adaptation (i.e. evolutionary) process. The following units are selected on the market level: dominant players, and dominant designs widely adopted on a grand scale such as the Internet and mobility (i.e. mobile phones as de facto communication devices). Processes of Variation, Selection, and Retention (VSR) also influence overall adaptation. The arrow in Figure 5 signifies environmental and corporate change.

The second part of the framework describes how dominant designs are adapted within the company and its business units (Figure 6).

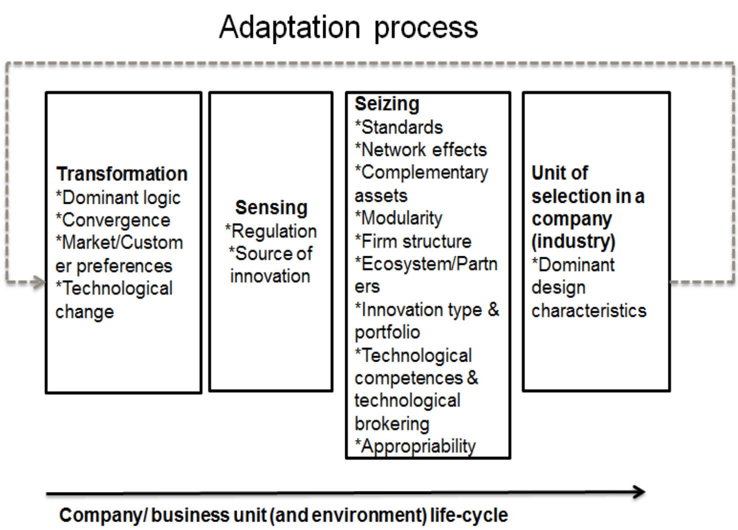

Figure 6. The creation of a dominant design on the company level

Figure 6 classifies the building blocks of dominant design in terms of transformation, sensing, and seizing phases. The end result is the design that the company has created or adopted, as well as its characteristics. Although the elements are on the company/business-unit level, they also intertwine somewhat with the industry-level elements (here market/customer preferences, technological change, appropriability, regulation, standards, and network effects). I discuss transformation first in the empirical part, given that dominant designs emerge as a cycle and there is typically earlier knowledge and a technological basis (e.g., Poole & Van de Ven, 2004, p.381; O'Reilly III & Tushman, 2008, p.202; Tripsas, 2008).

Specifically, in the transformation phase a certain (old) dominant design has an effect on the mindset of the company's executives, typically resulting in a rather strong idea – a dominant logic – of how business is being and should be done. This dominant logic may have to be managed or changed (even abandoned) by the company in order to start the productization of new innovative ideas and, possibly, the rejection of old dominant designs. At the same time, changes in customer preferences and technology may be taking place on the industry level.

The source of innovation in the sensing phase tends come from outside the focal company. Among the environmental conditions, legislative regulation are particularly important. Finally, the seizing phase is the laborious productization period. The most relevant building blocks to be managed are complementary assets, modularity, firm structure, ecosystem creation and partner management, the innovation portfolio, technological competence, and technological brokering. Among the environmental conditions, standards, network effects and the appropriability regime are among the most important.

The end result (and unit of selection) of one cycle of these phases is the dominant design, and its nature and characteristics. It should be noted that unsuccessful innovations do not turn out to be dominant designs.

2.4 The evolutionary context- industry and company history

In this chapter, the empirical case history will be structured as follows. I will go through the history of the industry and case company applying the theoretical framework, the emergence of the dominant design at industry and corporate levels, as presented in Figure 5 in this Chapter.

I have organized the history into periods, but there is a certain discontinuity between them that stems from the environmental conditions (technology, regulation, competition, customers, and markets) and the case company's structural changes and strategic decisions.

The history of the industry and the case company is organized as follows. First, I describe the development of the telecom industry and Sonera from 1980 to 2010 including a general description of the broader telecom landscape. I then review the history of the market in Finland, the performance trends observable in the case company and finally depict the organizational history of Sonera. I then proceed to outline the historical eras and finally summarize these in Chapter 2.5.8. In Appendix 1 and 2, a detailed chronological history of environment's key events and Sonera's strategic decisions are presented.

2.4.1 General- Telecom industry, Finland and Sonera

Telecommunications is an important area of technology and has been at the heart of the most recent waves of technological (and subsequent societal) change. Indeed, after the eras of electricity and steel (1890s–1940s) and steam power and railways (1840s–1890s), the mass adoption of telecommunications (1940–1990) has been a key driver of technological change (Fransman, 2001; Freeman & Soete, 1997, p. 19).

Finland has been very progressive in the technological development of telecommunications. As early as the 1990s, the penetration rates of telecommunication services were high, partly due to the strong role of Finnish industry leaders such as Nokia and Sonera—the case company under study. In the area of mobile business the diffusion of mobile phones in Finland was also at a world record level: in 1999 Finland was ranked first in terms of the mobile penetration rate in western European countries, and mobile phone penetration had developed from 3% in 1988 to 63% in 1999 to 91% in 2003 to 96% in 2004 (Sonera Annual report, 1999, p.60; Telecom Statistics).

Sonera has a history in Finland spanning more than 200 years (MINTC, 2003; Turpeinen, 1996). It is thus a robust example of a telecommunications operator, and one that has experienced multiple industry changes and contributed to the changes in its industry. Especially in the 1990s, Sonera produced novel product and service categories (DataNet[21], FastNet[22], MobiCentrex[23], Privatel[24], premium rate service numbers[25], Corporate number CID[26]) successful products and services (VPN[27], Vipgate[28]), and world-class operating processes (e.g., GSM[29] network planning that manifested to 50% EBITDA rates). Sonera was a top operator in the world and vendors and other operators in the world used Sonera as a 'tele laboratory' (e.g. Siemens and AT&T). In addition, Sonera incorporated and developed all the tele technologies at that time (e.g. SS7[30], ATM[31], First international GPRS[32]/UMTS[33] roaming and connectivity service (GRX), VoIP (Voice over Internet Protocol), WLAN (Wireless Local Area Network), IMS (IP Multimedia System) and more generally interfaces between data, PSTN[34] and mobile networks. Sonera also had symbiotic relationship with Nokia, and its own

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[21] DataNet combines a customer's local area networks (LANs) in different locations into one single managed network entity, a VPN.

[22] With the help of FastNet, the customer could integrate their different offices into a joint network, which was controllable by network management. The network operated at transmission layer.

[23] Sonera MobiCentrex was a PBX Attendant [Switchboard operator] service that was implemented in the mobile phone network in such a way that the customer receives it as a service

[24] Privatel service integrates a company's mobile phones into the company's fixed telephone network and numbering.

[25] Premium service numbers make it possible for service providers (tele lawyers or hotlines provider) to do business in the telecom network.

[26] The service made it possible for B2B company customers to have one national (telephone) number.

[27] VPN created virtual networks to voice communication, also enabling a numbering solution to a company beyond the PSTN numbering.

[28] Vipgate was a new service concept, it was formed to design and create the comprehensive communications solution to companies, who had many sites. The concept included incoming traffic, internal traffic and outgoing traffic.

[29] Global System for Mobile communications

[30] Signaling System No. 7, a set of telephone signaling protocols.

[31] Asynchronous Transfer Mode. A multiplexing and routing technology for high-speed digitalcommunications that permits data, text, voice, video and multimedia signals to be transmitted simultaneously between

network access points at speeds of up to 155 Mbps or more.

[32] General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication systems.

[33] Universal Mobile Telecommunications Service

[34] Public Switched Telephone Network. A term for all the publicly available, interconnected telco networks.

technologically talented professionals and Professors (to name a few, Matti Makkonen, Esa Kerttula, Arto Karila, Olli Martikainen, Juha Heinänen, Mika Uusitalo).

Broadly stated, the telecommunications industry incorporates carrier services (i.e., landline and mobile technologies to carry voice and data), end-user communications equipment, Private Branch eXchange (PBX) and key systems, circuit switching equipment, cellular mobile radio infrastructure, and transmission and other network equipment (EITO, 2007, p. 249). From 2007 onwards, the telecommunications industry has increasingly merged with the Information Technology (IT) industry (including e.g., data processing equipment, data communications equipment, software and services) to form the ICT industry (EITO, 2007). This development is often referred to as industry and technological convergence.

The telecommunications industry offers infrastructure, products, and services. The offerings have a layered systemic nature (for example, the widely used Open Systems Interconnection [OSI] is an effort to standardize computer networking), and the offerings are provided to end-customers through a network of different players, that is, a value web (e.g., network and end device vendors, network and service operators, content creators; see, for example, TeliaSonera Annual report, 2007, p.13; TeliaSonera Investor Day, 2009; Suarez, 2004, p.272). The tasks of a telecommunications operator like Sonera have been network capacity planning and investment and prioritization of traffic. These tasks have been carried out by means of purchasing and developing the hardware and software in network and customer premises.

In Finland market history, next, I review the usage of telecom industry services.

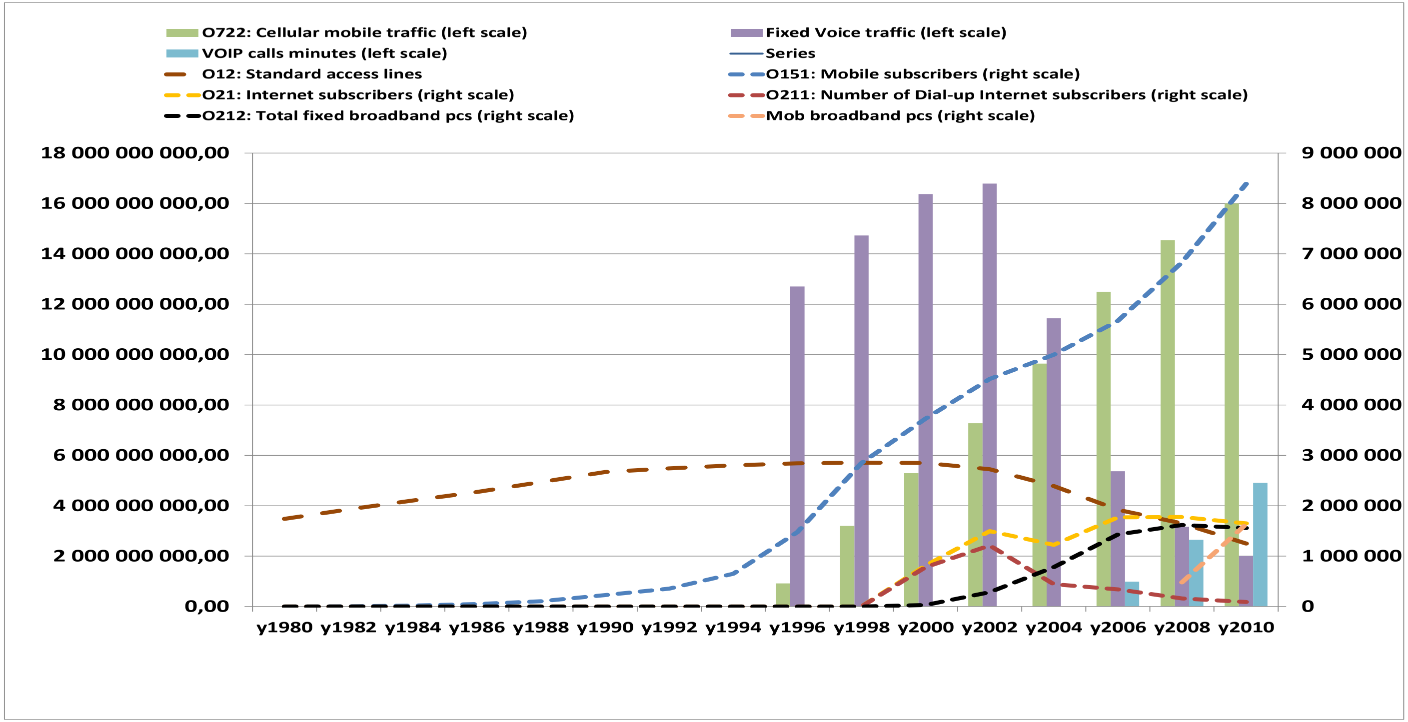

Figure 7. Telecom industry services usage 1980–2010 in Finland. (OECD statistics, modified).

Figure 7 summarizes the usage of telecom industry services. The right axis depicts the number of subscriptions, and the left scale the number of service usage minutes. In 1997, mobile subscriptions overtook fixed subscriptions and later in 2004, the minutes used on mobiles was also higher than those on fixed subscriptions. Fixed broadband (i.e., a communication service that delivers communication channels with a bandwidth of 1.5Mbit/s or more) and currently mobile broadband have been, and remain, the growth areas. In early 2000, fixed broadband started to grow, continuing the emerging Internet usage in the late 1990s with a new technology (replacing the dial-up Internet usage, i.e., internet in a Public Switched Telephone Network [PSTN] telephone network). Yet, it took almost ten years, before mobile and Internet broadband truly converged; this is shown in the emerging growth of mobile broadband. Mobile data traffic is increasing at a rapid rate and will continue to do so with the advent of 4G/LTE[35] mobile technology and ongoing developments in mobile smartphones (e.g., Apple's iPhone). Voice over Internet Protocol (VoIP) call minutes also present the new growth, representing the unified communications[36] (often carried out with Cloud Computing[37] technology) dominant design era. VoIP minutes substitute the traffic originated from ISDN or standard access lines (also in Martikainen, 2006b).

The Finnish telecom operator field has throughout its history had three almost equal players. This is unique in the world, as there have been local monopolies, and not one monopoly in all business arenas (e.g., MINTC, 2003). The players are the case company Sonera, Elisa (formerly HPY, Helsinki Telephone Association), and the Finnet Association. Elisa was earlier part of the Finnet Association before separating in 2001.

Traditionally, the number of fixed voice subscriptions was split into three. In 1998, Sonera had 33% of the subscriptions. These subscriptions were in rural, sparsely populated areas and at the time Sonera had only 16% market share in fixed landline business in its competitor's core geographical area, Southern Finland (Annual report, 1994, pp.12-13, Telecom Statistics, 1998). Sonera's competitors have benefitted from their geographical location in the

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[35] Fourth Generation Mobile Technology, Long Term Evolution is a standard for wireless communication of high-speed data for mobile phones and data terminals.

[36] Unified Communications (and Collaboration), UC is the name given to the attempt by enterprises to bring all their disparate modes of communications together in a managed way, with one client by software communications applications (Gartner).

[37] Cloud Computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet).

big cities that gave access to the population and businesses during the history of telecoms. In the 1980s–1990s, the arrangement was that Sonera was a united national entity, but the local operators had actual monopolies in their areas. Before commercial competition started (after the founding of Datatie in 1985, a privately owned company), Sonera had monopolies in the mobile phone business, the trunk and international call business, and telex operations.

Lately, new types of competitors have been emerging in the telecommunications sector. Traditionally, the access business and related carrier services formed telecom operators' core business. More recently, Internet players such as Google started to target the access business, and consequently to affect the profitable traditional carrier services (also in OECD, 2007, p. 23). A second trend was that hardware players, such as Apple, Nokia, and Cisco, were entering the applications business, the same field where operators have an interest (TeliaSonera Investor day, 2009). These new types of competitors are also currently the top spenders in R&D investment terms, surpassing telecom operators (OECD, 2007, 2008). This industry evolution had consequences also to Sonera: it was no more innovating and introducing products and services first in the world.

In terms of *Sonera performance trends*, Figure 11 presents the product portfolio development at Sonera, which also reflects the trends discussed earlier at industry level. Sonera's revenues have stagnated and its profitability decreased despite the streamlined mode of the company (number of personnel). Figure 8 presents the product portfolio development at Sonera, which also reflects the trends discussed earlier at industry level.

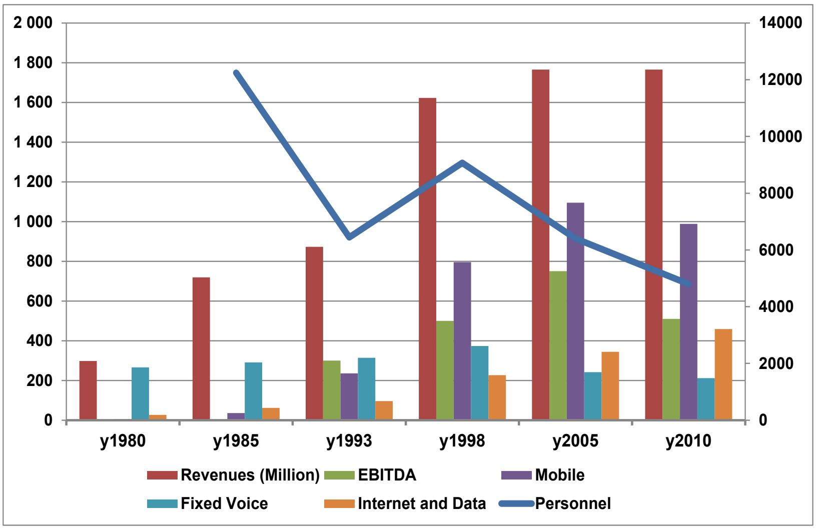

Figure 8. Sonera revenue breakdown, EBITDA and personnel 1980–2010, Finland. (Annual report, 1998, TeliaSonera investor material, 2005, internal reports, Lukkonen, 2004). (Personnel, right scale, Revenues and EBITDA, million euro left scale)

Sonera's turnover increased sharply in the 1990s, but has stagnated since then (see Figure 8). Most notably, there was an increasingly strong role for mobile services, a decline in fixed voice, and a gradually increasing share of Internet and Data (i.e., the business area where data technology and data communication is used). The latter includes the growth of Unified Communications and Cloud Computing.

In terms of *organizational history of Sonera*, Table 4 shows the dominant organization types at Sonera in 1985–2010, classified by whether the organization was primarily structured in Strategic Business Units (SBUs), or functional areas (F). The organization charts are shown in Appendix 3.

Table 4. Organization types in Sonera 1985–2010.

Year	85-86	87-00	2001-05	2006-07	2008	2009-10
SBU		*		*		*
Functional	*		*		*	*

In 1984, Sonera was organized by geographical numbering areas (Lukkonen, 2004, p. 52). This organization type had no product or profit and loss structure (SBU) and consequently Sonera's Chief Director was tasked with solving the product group division in tele-operations and with responsibility for profit and loss. Consequently, the central administration was terminated and the telecom, telecommunications technical department, and radio departments were closed. Gradually, profit center thinking was introduced into Sonera. However, the culture was for a long time production-oriented (functional areas based), as the actual products were productized only at the beginning of the 1990s.

Subsequently, in 1987 the organization was changed to reflect profit centers. In 1988, a Corporate Networks unit was founded, in order to attack competitors' areas with B2B products. Later, in 1990, new business units (business services, mobile communications, and basic networks) were created along with regional units (Turpeinen, 1996, p. 363). In 1991, Sonera's regional business organization was reorganized: from ten regional profit and loss units to six national units. The reason for the reorganization was cost-cutting and the need for more efficient units (Annual report, 1991). In 1994, customer segments were added to product area management. In 1995, the SBU form of organizing was enhanced with the introduction of a separation between the network operator and service provider interfaces. The split also enhanced customer needs-based thinking in productization (while the earlier focus was largely on producing basic carrier services (e.g., traffic) as much as possible in separate technological organizational units).

In 1998, Sonera was listed on the stock exchange. In the same year, a Sonera Solutions unit was established (i.e., a single organization for B2B products, except mobile services). This reflected the desire to provide complete and integrated offerings and product bundles instead of individual products for the business segment.

In 2000, Sonera was divided into two separate and large SBUs: *Mobile & Media* and *Telecom*, but the split decision was overturned in 2001, when a convergent corporate model was established (see Appendix 3). This was an organization type that created a uniform customer interface ('One Sonera') across unit boundaries (Annual report, 2001, p.8). However, an expert from the time observes:

"The SBU way of organizing Sonera has been the only model, where the management of one entity could be done in the smart way, because also the commercial product management had a big role. One time Sonera had a model where the sales had the idea that they were "a business responsible entity." That meant they bypassed product management [One Sonera, Appendix 3, 2001 organization structure]. This proved to be wrong and didn't work in practice" (Informant 2, Quote 1).

After the merger with Telia in 2002, there was a shift to technology-based product management. R&D resources were downsized, and the company communicated its fast follower strategy (cf. Markides and Geroski, 2005). Customer service resources were increased (Annual Reports, 2003-2008). The organization had two corporate functions: (1) Marketing, Products and Services and (2) Networks and Technology. Profit centers were based on geography, not on business units.

The merger enhanced the functional organization further, an example of this was the Focused Service Portfolio (FSP) project undertaken in 2004. It was a Group policy to migrate and end selected products based on technology meaning that SBUs played a minor role. Finland Country management felt the product streamlining criteria were wrongly based on technology, instead of on the customer need. Consequently, there were few resources to create new offerings, because of the time-consuming FSP project. In 2007, Integrated Enterprise Services (IES), a TeliaSonera headquarters unit focused on B2B customers was founded. The aim was to strengthen the position in the B2B segment and create a truly converged ICT offering and, thereby, new growth (Annual report, 2006). The founding of IES again marked the shift towards an SBU-based organization (where there was one organization for all B2B products). But there was once again a change back to a functional organization in 2008, when the IES organization was abandoned. Strong country organizations, especially in Sweden, did not want to provide resources and power to this IES organization. At the same time, the R&D and sales functions were centralized in Sweden.

In 2009–2010, the business was organized into business areas, but the concentration of activities at headquarters and in Sweden continued, and Finland's independence has been reduced further.

Experienced interviewees explained the major trends in Sonera's organization in the following way.

"I think in management there has been big change when we merged Sonera and Telia. Starting from the 1980s, we have had profit and loss accountable units irrespective of the organizations, where sales, R&D, and production have been somehow under our control. Then the first mistake—the One Sonera organization restructuring [2001]—was made…That meant, for example, on a fixed voice business we didn't speak of this kind of "Decision Point" [DP] joke. We had a real customer need, and it was said during the 1990s that the best way was to sell directly to customers. That way the organization starts to do real work; that was enough of "this sort of DP-process!" On the contrary, currently in TeliaSonera we have portfolio management and managerial layers, and you have no commanding control from product to customers. This new management culture leads to all the energy going into the prioritization of projects, DP processes and reallocating of resources". (Informant 5, Quote 1)

"We had no timetables in the 1990s and products were just started in management groups and we had no formal procedures, things were just invented and implemented" (Informant 58, Quote 1).

2.5 The evolutionary context - historical eras

In this section, I review the historical eras that emerged from the periodization of the data. I first discuss the critical events in the environment (regulation, technology, competition, customers, and market) (see Appendix 2). After that, I review strategic actions of Sonera (Appendix 1), namely the structural changes to the company, and strategic decisions concerning technologies, products, and investments. By investigating Sonera's actions, I also preliminarily discuss the changes in the cognitive mindset of the company's management in different eras.

2.5.1 The era of telecom monopolies (1980–1986)

Telecommunications is a regulated industry. The legislative regulative bodies have traditionally addressed a variety of issues, and continue to do so. However, the regulatory issues have also changed dramatically during the period under scrutiny (from 1980 to 2010). Pressure to change legislative regulation was a key theme in the era of telecom monopolies (from 1980 to 1986).

Regulation and Technology. In 1919, a telegraph law was enacted granting the Government a monopoly over the provision of telegraph services. This law was very unclear, and became more so as services such as teletext, videotext, telefax, and data communications emerged subsequently. Sonera was of the opinion that provision of these services should be a monopoly. On the other hand, Sonera did not have permission to operate data business in competitors' areas. Consequently, the period between 1970 and 1986 was time of local and national monopolies granted by legislation in Finland (Häikiö, 1995; Turpeinen, 1996; Nyström, 2008; Mäenpää& Luukkainen, 1994). The monopolies concerned data communications, mobile traffic, and fixed voice (i.e., local calls, national calls, and international calls).

Fundamental progress was made in technology development in all sectors: fixed voice and data, mobile technologies, and even ICT. In fixed voice, signaling protocols between switches (i.e., Signaling System No. 7 known as SS7) were developed in 1980, in order to create rich call-related services. Accordingly, a new service area emerged in the industry: value-added voice services and manifesting this development, American Telephone and Telegraph Company (AT&T) implemented toll-free service numbers in the USA in 1982. A closely related technology, Direct In Dialing (DID), was also developed in 1983 in the USA. This was used in the emerging Call Center and Toll-Free service number business.

In data technology, X.25[38] was an emerging standard protocol for data communications (1977), which replaced circuit switched data transfer. However, as early as 1982, the Transmission Control Protocol (TCP) and Internet Protocol (IP) (TCP/IP a foundation of the ICT era) as an emerging standard was seen as a challenger. In March 1982, the US Department of Defense declared it as the standard for military computer networking (Fransman, 2001, 2002a, 2002b). However, though the development was rapid in data technologies, a significant amount of traffic and infrastructure was in fixed voice networks. In order to rationalize the usage of voice and data infrastructure, multiplexer (MUX)[39] technology emerged, and Sonera (at that time Posts and Telecommunications of Finland), also pressed by competitors such as Elisa (at that time HPY), was active in MUX technology. The local telecom firms in Finland also started to have their own MUX-networks, and Sonera felt it was losing the battle with them. Consequently, Sonera needed to get the MUX-network ready, and eventually did so in 1981. In MUX technology, the fixed data lines' usage was rationalized using telephone networks, while broadband trunk lines were used with time-divisioning techniques to separate caller lines.

In mobile technology, Nordic Mobile Telephone Service (NMT-450 MHz) (1982) was a standard developed by Nordic incumbent operators. Sonera had an active role in this development. NMT-450 was an automatic network, contrary to the earlier Radio Car Phone [ARP 150 MHz] manual network. In 1986, the NMT-900 MHz standard was in use, complementing the earlier standard. An important point in the development of the NMT-900 standard occurred when Sonera ordered an NMT-900 switching center from Nokia. Sonera had previously ignored the Nokia option, although the firm had competency in fixed DX200-switches. This also meant competition in the

[38] An ITU-T standard protocol suite for packet switched wide area network (WAN) communication. (Wikipedia).

[39] Multiplexer, In telecommunications multiplexing is a method by which multiple analogue message signals or digital data streams are combined into one signal over a shared medium.

vendor business of Finland (earlier Ericsson, a Swedish vendor, had a monopoly in Finland), and for many years the relations between Sonera and Nokia were symbiotic.

A reform bill affecting the telecommunications legislation was presented to the Finnish parliament in 1984. Among its important elements were proposals to allow the operation of new tele services by third parties, to liberalize end-user terminals or end-devices[40], to enforce a separation of authoritative regulation and telecommunications operations by Posts and Telegraphs of Finland (later Sonera), and to create an interconnection obligation to transfer traffic among operators. The interconnection obligation was important to Sonera and local telecoms; the local telecoms could transfer traffic more widely, and Sonera would also gain access to local monopolies and their customers. However, the legislative proposal was unclear and did not address the most important question at the time, namely the license to run data business. Consequently, Sonera's competitor Elisa (at that time HPY) founded, de facto illegally, the Datatie Company, in order to embark on data transmission business and later landline trunk call business (Häikiö, 1995).

Competition, Customers, and Market. During the era in question, competition was increasing in the telecommunications sector. One manifestation of this was the digitalization of the telecom network switches and the usage of fiber cables in 1985, which made local telecom operators (e.g., Finnet Association) more competitive. A time and data usage based business model was used in the market, and this was profitable for telecom players. Nevertheless, the telecom services were proprietary and no adjacent industries were then entering the market to compete.

Customers and the market also reflected the development in data and mobile technology. In 1984, new trends emerged: microcomputers (for example Nokia MikroMikko, IBM PC), a new networking need in data services (where the purpose was to connect separate networks, such as corporate networks), networked personal data processing, and decentralized data processing (Hewlett-Packard, in Ficom, 2005). In addition, the mobile phones started also to diffuse to the B2B segment in Finland in 1985.

Sonera's structural changes and strategic decisions. In the era of telecom monopolies, it was still possible for Sonera to develop, investigate, and invest

[40] It was a common practice that telecom operators bundled the end-device with services (e.g., in Helsinki, Elisa had Ericsson's end devices) and end-devices were a monopoly business and restricted competition.

in some technologies (e.g., videotex[41] and service numbers) and standards in a somewhat secure way, initially without competition. In addition, the firm had ample time to start transforming the state-owned entity into a real business. A manifestation of this was the decision to transform the Regional Tele districts into profit centers in Sonera in 1985. The most severe threat to Sonera was the advent of data competition.

Pekka Tarjanne was appointed Director General of Posts and Telegraphs of Finland in 1977 (later becoming Secretary General of the International Telecommunications Union [ITU] in 1989). He wanted Sonera to help develop Finland into an information society. The previous Director General, Oiva Saloila commented that during Tarjanne's period, the relations with the private telephone operators were, however, worse than ever. The deteriorating relationship culminated in the so-called tele wars, over the division of work between Sonera and local telecom operators (Turpeinen, 1996). Kurt Nordman, the CEO of Elisa (then HPY), commented that "*the attempt of Posts and Telegraphs of Finland to stop HPY's business in data communications, was also a stimulus to Elisa to start its journey to a business organization from bureaucracy and establishment*" (Häikiö, 1995, p. 50).

Even when Sonera was a public sector organization, it had strong ambitions. For example in 1981, a separate telephone laboratory was founded: the Telecom Research Center. Sonera played an important role in national-level R&D through the Telecom Research Centre and later through other 'tele-laboratories' for mobile, fixed voice, and data communications areas. It also explored new technology-based businesses, for instance, Videotex, a system that provided interactive content and displayed it on a television set. Experimentation was encouraged by the legislative regulators having a liberal attitude to competition between manufacturers in Finland (foreign manufacturers were allowed to operate in Finland), which also created a lively telecommunications ecosystem in the country. A characteristic of the market in Finland is the ample number of different signaling protocols between telecom networks and technologies. Consequently, vendors and telecom operators need to develop hardware, software, and services capable of working in this heterogeneous environment. More specifically, "*If it [the telecom service] works in Finland with tens of operators, then it is safe for worldwide deliveries*" (Telecommunications Policy, 2003, p. 14).

[41] Videotex is any system that provides interactive content and displays it on a television. (Wikipedia)

Sonera had decided to start building its own data transfer network in February 1975, thus also restraining private telecom companies from building their own networks and limiting overcapacity. Sonera had also progressed on other fronts. It adopted the digital DX200 switch in Korppoo town, in 1980. This was important in terms of digitalization, as it gradually made new services possible in the telecommunication network. Furthermore, Sonera continued the planning of Integrated-Services for Digital Network (ISDN) in 1985, which made available new data services on circuit switched technology in telephone networks. In addition, in the same year, Sonera started to digitalize local switching centers on a greater scale, which permitted new services and the rationalization of operations (Turpeinen, 1996).

Sonera was also a pioneer in mobile technologies and services, developing the NMT 450 standard in 1982 and the NMT 900 standard in 1986 together with other Nordic telecom operators. Sonera subsequently built these networks in Finland. In the area of mobile business development, Sonera took part in the design work on the Global System for Mobile communications (GSM), a new digital mobile system, and made the decision to transition to GSM in 1983.

2.5.2 The era of the liberalization of telecommunications and data business (1987-1992)

A new telecommunications law was implemented in Finland in 1987, and after that, competitive licenses to operate telecommunication businesses were granted in stages (MINTC, 2003). The opening up of competition had its roots in Datatie (the aforementioned company established by Elisa/HPY) and in Yritysverkot (Sonera's subsidiary for the corporate sector) and eventually in the birth of Radiolinja in 1992, which was the new subsidiary of Elisa in mobile communications. Datatie and Yritysverkot were first granted country-wide licenses in 1988. Due to the competitive pressures in 1987–1992, Sonera was able to sow the seeds of its later major successes.

Regulation and Technology. In technology development, breakthroughs were made in all sectors: fixed voice, data communications, and mobile communication. In 1988, the Comite Consultatif International des Radiocommunications (CCITT, a telecom standard making body) had defined the ISDN protocol. ISDN was a digital standard for carrying data and voice simultaneously. In line with this, Sonera productized the 2 Mbit Voice access in 1987. This was a more efficient digital subscriber connection line to customer premises. Over and beyond the progress in the fixed voice area, there was new technology emerging in data transmission technology, namely routing[42]. In 1988, a new routing technology was jointly manufactured by CISCO and Sonera. The third breakthrough was in the mobile communications area, as the digital mobile technology GSM was implemented in Sonera's new network in Finland in 1992. In the GSM period, the interest of the top management in R&D was evident; Sonera was involved in high-profile GSM standardizing committees. GSM was the first mobile network technology to introduce competition to the mobile business. Earlier, in NMT periods, the business was operated only by 'backbone operators'.[43]

In legislative regulation, one further event was important. After the telecommunications law came into force in 1987, the selling of end-terminals was liberalized in 1988, as part of the policy of reregulation and liberalization. The development of services was easier when the operator obtained a hold on the sales of end-terminals. Therefore, Sonera started its own import of end-terminals (consisting of NMT phones, videotex end-terminals, and PBXs) in 1990.

Competition, Customers, and Market. Competition started gradually between telecom operators in the data business. A byproduct of competition soon emerged, in the mobile communications business. With the advent of the new GSM mobile technology, HPY's General Director Kurt Nordman began the process of establishing a new operator in the Finnish market in 1988. The new operator was also financed by Finland's private banks, insurance companies, and franchising groups (Häikiö, 1995, p. 103). Despite Sonera trying to block Radiolinja's mobile operator license for GSM in 1989 (on the grounds that local telecom operators would gain too strong a position), Radiolinja was granted the license and entered the mobile communications market in 1992 with a new GSM network. GSM was thus the first technology to open up competition in mobile communications.

In the *customers and market* areas, there was a need to develop the call center business in 1989. The business was important due to growing customer businesses and consequently the need to network company sites with telecom services and infrastructure.

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[42] Routing is a process of selecting the best paths in a network (Wikipedia)

[43] Backbone operator refers to i) Backbone network, and ii) Bit pipe. i) is associated to the part of a network used as the primary path for transporting traffic between network segments (distinct from the access portions of the network) and ii) to a way of expressing a telecom company offers only capacity, not value-added services.

Sonera's structural changes and strategic decisions. In summary, in the era of liberalization of telecommunications and data business (1987–1992), Sonera was active in all areas: reorganizations and internal processes, technology development, and investments.

To start with, the period from 1987 to 1992 was active in terms of internal management, and early signs of scaling up operations and economies of scale were seen. In the early 1990s, a more customer-oriented working mode started to emerge. This appeared in the form of, for instance, solution sales (tailored services to large companies), IP design (Internet Protocol architecture planning), and close relations to top companies in service development and piloting of new services[44] , and roadmap plans. This customer-oriented working mode, or these best practices, were used and diffused to nearly every SBU in Sonera in the 1990s. The new entrepreneurial SBU product units were created along with a new marketing concept TeleGate, in which the products for the TOP 3000 segment (the 3000 largest companies in Finland) were combined, especially for datacom and B2B fixed voice and value added services (see Appendix 3, organization charts). In addition to new SBUs, a Service Development Unit was founded in 1991 to design and develop the firm's B2B services and complex systems management. A key Sonera employee recalls that time:

"Innovation was definitely a key point in the late 1980s, the time was right for alternative offerings. If we remember the early 1990s and the fixed customer network, we could quite easily create this kind of total offering, where we could integrate all customer services through one platform. The benefit was the manageability of the whole value chain—voice and data—and the model was also cost effective. Elisa's rented copper lines were expensive; we replaced this model" (Informant 16, Quote 1).

At that time, however, a threat was also perceived, that there would possibly be a total collapse of Sonera's business, potentially caused by its losing the data business and trunk business. Consequently, a project labelled "Star Wars" was announced in Sonera (Informant 55). Star Wars was a reference to the epic American movie, and its themes of fighting against an evil empire (in this case, the competitor Elisa). The target was to attack the local

[44] An example of piloting appeared in 1989, when Sonera created an internal corporate network, combining the proprietary "IBM-network" and the emerging IP-network. This was an important project for the future, because it created resources and knowledge in the company that could be employed to productize corporate networks for customers in the future; for example the world's largest ATM network was built in 1996 for the Finnish National Insurance Establishment [KELA].

telephone companies with the best possible technology. The most important competitor, Elisa, chose a different path: obtaining private financing to buy state-of-the-art products from Nokia. Sonera used companies like Cisco in order to attack its competitors, which used closed and expensive telecom products. In Sonera's business model, the target was to offer effective and fast data connections with the expensive local access playing a minor role in the whole offering. Sonera's business model was seen as a managed service concept targeted at the system integrator market:

"The system integrator market was born at the turn of the 1980s and 1990s when Personal Computers [PCs] diffused. PCs were the trigger to plan and reorganize the business. System integrators were not present during mainframes and stupid terminals, because there was not actually anything to be integrated" (Informant 36, Quote 1).

In Finland, Sonera also equipped itself to compete with local telecom companies in the fixed voice communications market. One tool it employed to do so was a new corporate subscription model. The decision to productize this model was made in 1987. It was the first attempt in the voice area to attack competitors' areas. The operative way to attack competitors' switches was progressive. With 2 Mbit technology (and also due to liberalization), it was possible to enter the competitors' corporate segment, first in the region of the capital, Helsinki, and then other competitor areas (e.g., other major cities in Finland, Tampere and Turku). A key manager at Sonera recalls:

"In the mid-1980s, I got the job to create sales organizations at Sonera, which I did and which took form in different settings. One was linked to regulation at that time; we got permission to offer company subscriptions in competitors' areas, and offered company subscriptions in former local telecoms areas and it was a really a revolutionary thing. The local telecoms held that against us for years. With those company subscriptions, we attracted companies to a "kind of total solution. The subscription was based on the "corporate subscription bypass phenomenon." This meant we could bypass competitors' expensive local access lines and offer Sonera's comprehensive services to competitors' customers. Consequently we moved into a positive spiral: The market fed us and if we think of innovations and organization's operative capability, this era was actually a fundamental prerequisite for Sonera being an innovative company. These events happened in the early 1990s; in the late 1990s the situation changed" (Informant 20).

Furthermore, on the technology side, Sonera invested in a trunk network of optical cables in 1987. It actually started using these in competitors' areas as well, after a decision to invest 158 million Finn marks into the area around

Helsinki 1992–1996. In 1991, the company also invested in an Intelligent Network (IN), and in this way, the physical infrastructure and management layer of telephone networks could be separated. The adoption and nurturing of IN technology was seen to be very important from the perspective of economies of scale and the possibility of creating new services from software.

2.5.3 The era of intense competition and growth in mobile business (1993-1998)

A typical feature of this era was the emerging technological convergence with mobile and Internet technology. This was seen as the growth driver for the future, along with mobile business, and was envisioned as having an effect on a global scale. In addition, the liberalization of the market continued in Finland, which intensified competition and brought pressure to find more flexible and cost-efficient production methods.

Regulation and Technology. In terms of legislative regulation, the liberalization of the Finnish market continued apace. In 1994, national and international long distance telephone calls were fully deregulated. The legislative regulator also required that geographical numbering areas should be harmonized into larger entities in 1995, and operators were obliged to lease network capacity to other operators in 1996. The abandoning of the numbering areas meant that Sonera could compete as a national player. The obligation for operators to lease network capacity, in turn, offered more opportunities for local area competition for Sonera. In line with this, in 1996 a new divisional split was implemented in Sonera, at the request of the legislative regulator. Specifically, the basic network business area was split into a network operator (NO) business division and voice service operator (SO) division. A similar split was carried out for mobile business. One interviewee (Informant 12) described this as important, because there could now be two earning logics: standard bulk-based volume business (network) and a new customer-based service operator model; earlier there was merely one vertical product organization.

Another key event in 1994 was the granting of the first licenses to service providers. This marked the first time a new kind of competitor entered the telecom sector. At first, there were quite exotic players entering the market, for example Telivo (a spinoff of the state-owned power company Imatran Voima [IVO]), using the power grid as a backbone network platform. They started offering limited fixed, national long distance and international services in 1993, and mobile services in 1998. (Telecom Policy, 11). However, the most visible in the market were the new Internet Service Providers

(ISPs); the first commercial, consumer-focused mass market ISPs were launched (Eunet, Scifi) (Suhonen, 2002, p. 141).

In technology itself, there was development in fixed voice, mobile, and data communications, as well as a new event: the emergence of Internet technology. In fixed voice and later also in mobile, Intelligent Networks (IN) were used and developed actively in Sonera. The related standards were documented in the International Telecommunication Union (ITU). In the mobile communications business, Intelligent Networks were also used and new services such as Short Messaging Service (SMS) were possible due to newly introduced digital mobile communications technologies (especially GSM). With the help of IN technology, adapted and developed from Bell Laboratories (formerly a R&D unit of AT&T in the USA), the physical infrastructure and management layer of telephone networks could be separated. This subsequently enabled the management of volume mass-produced products, and the technology diffused to many other product areas in Sonera (e.g., Vipgate, service numbers, value added mobile products in B2B segment). In general, before the new technology such as IN, the telecom industry was seen as a closed or vertical system (e.g., Yoffie, 1997, p.18). An expert from Sonera's mobile business explains this in the following way:

"On the consumer and corporate side, this mobile environment has progressed in evolutionary way from a closed ecosystem to an open platform enabling system; if we look at the old telecommunications environment, there you must define all products as a network feature" (Informant 37).

A head of R&D in Sonera at that time also explained the importance of IN. However, the situation was not so black and white, as another mobile expert in Sonera explains:

"I saw that the services are software and we must develop the software competence in our company in order to develop products and services instead of only bulk traffic in network. The first IN solution, enabling service creation, we made with Nokia Data which became later ICL. In 1996, we succeeded in everything; we had IN and Telecommunications Management Network [TMN] and interfaces to GSM, we were the first operator in Europe who owned all the interfaces with computers, mobile networks, and telecom networks". "And actually the bit pipe is good for an operator in this oligopolistic situation if we don't spoil the pricing" (Informant 7, 37)

In this era of emerging, intense competition, and growth of the communications mobile business, the cost structure also changed dramatically. Further, for the first time there was productization within the company. Before that, functional and regional units merely produced bulk traffic under the constraints of the Finnish state budget. Gradually, a closed, dedicated production infrastructure was opened up and products were easier to manufacture. In the data business, for example, the new routing technology (Cisco in 1988) was a manifestation of this:

"This telecom infrastructure is somewhat more complicated than the computer, but there has been the same development in the telecom production machine as in computers. If we begin in 1985, then the telephone exchange was mainly dedicated technology, it was the world's largest computer planned to be a telephone exchange. These datacom datacenters were built by a couple of telephone exchange vendors, big dedicated mills, which cost some 10 million Finn mark a piece. Then in parallel came Nokia, the first to start building telephone exchanges on top of a computer. You could buy this hardware from a store, dispersed automatic data processing to a telephone network. Cisco in particular has been a forerunner in data networks, which started to bring miraculous cheap hardware and dispersed routing to the network. This is seen in our whole infrastructure, there the infra changed at the same time as Cisco's routers etcetera appeared. The production costs have been going down dramatically, it is totally different when you are developing software to serve readymade standard hardware. The new capabilities have been created in the doing of these first products, FastNet, Privatel, Corporate number service and these have not been known as a concept either, because earlier you could just move information from place A to place B". (Informant 5, Quote 2)

In 1994, Cordless Telephony [CT2-CT3] technology was a pre-stage of mobility in PBX and later DECT (Digital Enhanced Cordless Telecommunications)[45] system, meaning that wireless calls were planned to run with a cordless telephony standard. However, CT2-CT3 and DECT were not a success due to limited mobility and functionality but caused a boom in the PBX business area. Actually, in Finland NMT and GSM standards overrode CT2-CT3 and DECT. A similar kind of embryonic development was in Voice over Internet Protocol (VoIP) technology in 1995, a sign of later convergence of voice transmission and data networks. In turn, the Internet technologies in 1996—Hypertext Markup Language (HTML), Hypertext Transfer Protocol (HTTP), and Uniform Resource Locator (URL)—were an immediate success that created a new business, a pressure on the current Videotex business, and to the whole vertical telecom infrastructure. They also foreshadowed the later period of IT hype (1999–2000).

In mobile technology, the 3G-UMTS (a third-generation mobile technology) standard introduced in 1997 represented efforts to integrate

[45] DECT is used primarily in home and small office systems, but is also available in many PBX systems for medium and large businesses

mobile and the Internet. In the same year, another working technology introduced was the GSM Wireless Application Protocol (WAP) standard. It was a technical standard for accessing information over a mobile wireless network; it was built on GSM technology in order to create telecom operator-led convergence between mobile and the Internet.

Competition, Customers, and Market. In the competition, over and above the development of service providers, Finnet International received a license to start an international calls business in 1993. HPY (Elisa) entered the Internet business with the Kolumbus brand in 1994. Elisa's operations were privatized in 1994, and in 1996, the Finnet alliance (local landline telecom operators) was established. In 1997, Elisa entered the market with new GSM 1800 technology enabling wireless Cityphone. In 1998, Radiolinja and FinnetCom became subsidiaries of Elisa. In the market arena, fueled by the technological developments of the Internet, a boom occurred, and was accompanied by the founding of Netscape (US internet company; web browser). In the same vein, in Finland, a mobility boom started to emerge in 1995, with the advent of GSM applications for the consumer segment.

Sonera's structural changes and strategic decisions. At Sonera, Aulis Salin was appointed as the Managing Director in 1993. Organizational restructuring, new ways of segmenting markets, the seeking of growth, technology development, and new services were the most important aims in this period.

Aulis Salin had clear visions about the elements important for markets and thereby for Sonera in the future. Specifically, looking towards the turn of the millennium, the following were seen as key elements: flexible billing, reachability of customers, customer satisfaction and the quality of services. In addition, telecommunications was a key element of companies business, substantial resources for marketing were needed, and Sonera needed to be growth oriented and aggressive (Turpeinen, 1996, p. 13).

In 1996, organizational changes were made: seven divisions, and sales and marketing units were introduced, and network and service layers were separated in Sonera. Earlier in 1994 there had already been a renewed focus on segmentation: it was now done in four key areas: the industry, public administration, banking, and trading sector.

Three issues stand out as the most important for Sonera in this period: Further attacks on competitors' geographical and business areas, R&D investments in the emerging mobile and media sector, and seeking new growth through globalization.

In 1993, Sonera decided to invest in the local network covering the competitor's major cities. This was a counterattack on the activities and concentration of forces of the main competitors, Elisa and Finnet Group.

In the growth of the mobile business, starting from 1994, Sonera benefited from its assets. These assets were identified as follows: marketing power; a broad customer base; good profitability; a wide outlet network (delivery chain policy); strategic and operative network planning supporting a cost-efficient network, building and management; well managed network modernization; competitive network coverage and quality; CAPEX-management; cellular planning; and roaming contracts.

In 1997, Sonera's R&D investments were directed toward mobile communications and multimedia, IN technology, software-based management, and information systems. In retrospect, these investments were not very productive, but did give rise to some (rather marginal) new services, such as a GSM Postcard, and ordering Coca-Cola by phone (Informants 6, 45, 22). Top management, consultants, and financial backers were the source of activity, which led to product and service development.

One example of seeking global growth was the early investments abroad. These included a minority share of Turkish telecom operator, Turckell. Here, Sonera's target was to become a Turkish GSM operator, and in 1993, the firm offered to build a GSM network in Turkey (Turckell). The decision was difficult, as Sonera was a state-owned company and the investment was seen as risky. In addition, there was also pressure on the Finnish mobile business sparked by aggressive competition with Elisa (Radiolinja) (Marttila, 2002). While Sonera's investment in Turkey proved successful, at that time it had even more opportunities to grow and leverage its technological excellence. In 1994, Cisco Communications was investing in VoIP technology, but, in that time, the VoIP technology needed to be integrated into PBX's with the SS7 signaling technology. Sonera was an expert at this, and Cisco wanted to buy Sonera's knowledge and cooperate, but Sonera's top management team was reluctant at that time. In the same vein, Nokia wanted Sonera to develop the maintenance and management of Nokia's IN networks and switches. Sonera also turned that opportunity down.

However, the focus was clear: it was internationalization. To that end, Sonera even started two subsidiaries in Germany for data services and electronic payment in 1997. Global mobile Internet was also a focus, although still embryonic.

2.5.4 The era of IT hype - the convergence of mobile and Internet business (1998-2000)

This period was characterized by minor developments in technology and legislative regulation. Technologies introduced in the earlier eras were now used effectively in order to grow profitably. Sonera's technological expertise sparked over confidence among the top management, which sanctioned investment in 3G/UMTS and mobile portals such as Zed[46] . In turn, there was activity in the Finnish competitive landscape. Even more importantly, Sonera undertook international activity on many geographical fronts and product and technology areas. The stock market valuation of telecom operators and Internet service providers skyrocketed in this period, and Sonera was no exception. Consequently, Sonera's top management took big business risks and totally changed its strategy and organization (see Vesterinen, 2009, p.138).

Regulation and Technology. In technology, the mobile General Packet Radio Service (GPRS) standard was introduced in 2000 to substitute for UMTS technology, because UMTS was not yet running operatively. GPRS is a packet based mobile data service, which enhances the mobile data transmission speed. In the regulation area, minor mobile communications technologies (Autonet, ARP and paging service) were deregulated from license obligations. In addition, global telecommunications were fully deregulated in 1998.

Competition, Customers, and Market. In competition terms, in 1998, global and local mobile service operators entered the Finnish market and Elisa abandoned the Finnet Group in 1999 to gain freedom to pursue market opportunities. In 2000, Sonera was a market leader in Finland in all major businesses, and number two in local landline voice.

The stock market valuations of the companies operating in the telecommunications market were soaring, as investors anticipated extraordinary business growth from the new IT and mobile services. Sonera was a case in point. In November 1998, Sonera's share price was EUR 17, and by March 2000 had climbed to EUR 97. The HEX general index at the same time period was not as volatile as Sonera's share price development (Annual report, 2000, p.79). One informant recalled that in Sonera's internal meeting

[46] Sonera Zed, a global wireless portal, which links a mobile phone with Internet services, was launched in 1999. By means of the Zed mobile portal, the customer could personalize the mobile phone menu that is loaded on his or her phone, and pick the desired services from a selection predetermined for the phone (Sonera Annual report, 1999, p.58).

for personnel, the Head of Communication presented PowerPoint slides showing how valuable Sonera was, stating that with Sonera's market valuation one could buy six British Airways companies.

In 1998, the name of the case company was changed from Telecom Finland Ltd to Sonera Ltd, before the company was taken public in the same year. The rationale for going public was to permit larger operations globally that would enhance the credibility of the company. At that time, the Finnish Government sold 22% of its Sonera shares. As the Managing Director, Kaj-Erik Relander, stated in 2000, the duty of management was to increase the value of the company, and this was no longer possible as a national state business.

In order to go public, Sonera needed a story to be sold to international investors. To put it briefly, Sonera pinpointed that it was concentrating on a customer focus, R&D, and the business opportunities resulting from the convergence of telecommunications and information technology (Annual report, 1998; Relander, Sonera international growth strategy, 1999). What was new compared to the earlier, approach was the statement that Sonera would also focus on the system integrator market. As a result, Sonera was sold to investors as a "*global and profitable first-mover in mobile world*" (Marttila, 2002, p. 70), with promises that Sonera's services like the Zed "*will be the Yahoo! of the mobile world*" (Yahoo being the most successful Internet portal of the time).

Sonera's structural changes and strategic decisions. The period 1998-1999 was a very active time with regard to strategy: the top management group was analyzing industry maps, opportunity domains, different scenarios, Sonera's current and future competences, and discontinuities (Sonera strategy versions, Project Reason; Scenarios, 1999, Appendix 10, 11). The following discontinuities were taken as examples, thereby creating a new basis for competition analysis: new types of competitors and from a different industry would enter, the barriers to entry would disappear, cost structures would change, owning the customer versus access to the customer would become a key question, channel management would be important, and branded services marketing would grow in importance. A related development plan was developed for the company, whereby Sonera would have a leading role, but with a different emphasis than it had had earlier (Appendix 11). Specific targets for the global projects were to "*identify and prioritize a limited number of business areas, where Sonera can reach a global market leader position.*" In this regard, the Annual report 1999 states:

"In the spring of 1999, Sonera Corporation's Board of Directors sharpened the Group's strategy toward an emphasis on achieving growth within global service operations. Sonera estimates that over the next three years it will spend a total of EUR 500 million on developing new services. As part of the implementation of its strategy, as of January 1, 2000, Sonera has also introduced a new business organization in which the businesses of mobile communications, media communications and new services comprise the new Mobile and Media business area, whereas the fixed network businesses and other operations comprise the Telecom business area."

Overall, ambition was high in Sonera: The earnings from new service businesses were zero in 1998, while the target set in 1999 for 2005 was EUR 2000 million, including such services as Zed which was a mobile portal. In turn, the Mobile business was seen to be worth EUR 1000 million even in 1998, but EUR 7000 million was targeted for 2005. This target was to be achieved by acquisitions, expansion, and creating partnerships. In addition, the fixed network operator businesses were worth EUR 1000 million in 1998 and the target was EUR 2000 million in 2005, to be achieved by being more effective, through restructuring or divesting.

The top management team and the consultant firm Strategos analyzed Sonera's competencies and identified groups that would be valuable in the new industry domain (EMT [Enterprise Management Team] Project Reason, Sonera 1999). The groups identified were skills and knowledge, technologies and systems, culture and values, processes and structure, and strategic assets. In addition to the old components, new critical components (shown in italics in figure 12), were also seen as new core competencies and new success products to be developed (shown in a lighter shade in the figure). On top of the previous customer value proposition (rapid, reputable, and responsive) a new one was created. This was termed *Smart Partner*, which meant 1) a global reach (focus on services and solutions for selected industries globally); 2) life and business management services (services and solutions adding value to the lives of end users/ consumers, a new earnings logic producing strong margins and increasing returns); and 3) increasing connectivity (gaining access to a much larger set of service customers; customers who increasingly rely on Sonera's services and solutions).

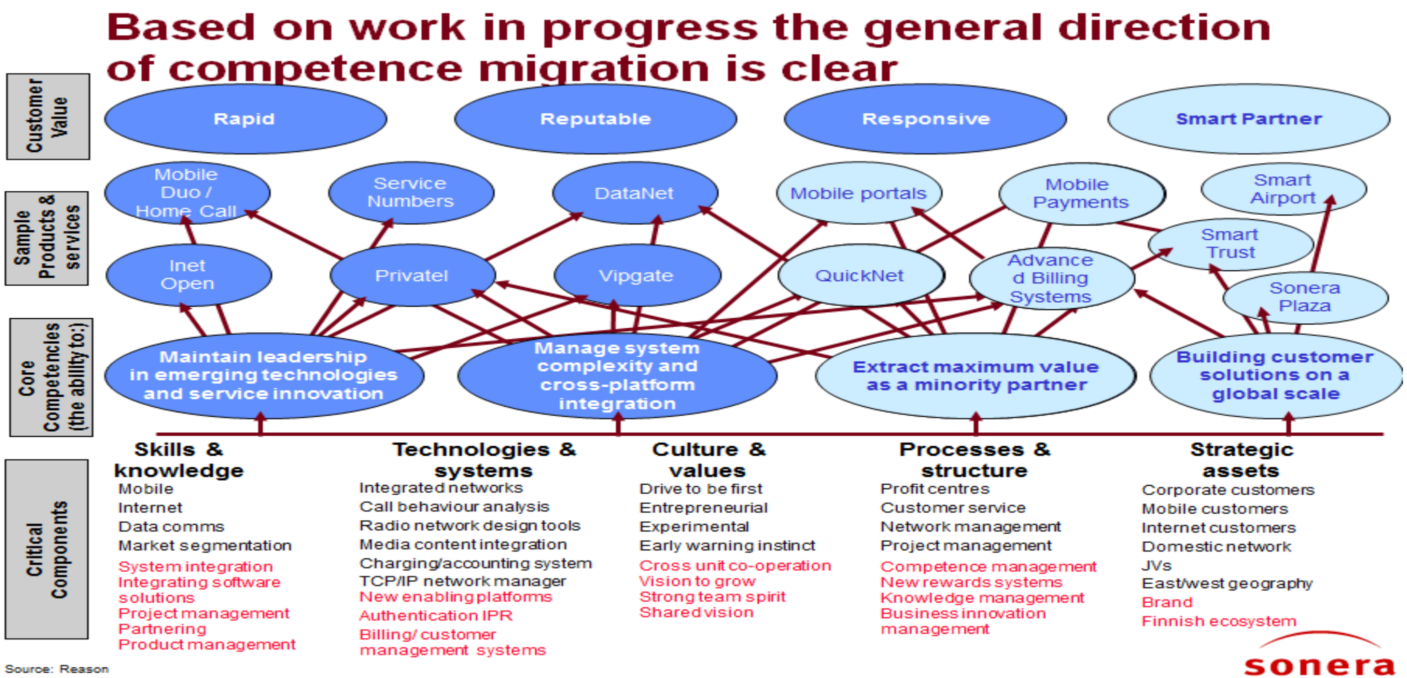

Figure9. Sonera's_competences_in_the_2000s_identified_by_EMT_1999.

Figure 9 hence depicts the critical components that were considered important at the time the product portfolio was created. These components were bundled into four core competences (the old ones being to maintain leadership in emerging technologies and to manage system complexity; the new ones being to extract maximum value as a minority partner and to build customer solutions on a global scale). The four core competencies were seen as having the potential to create successful products in the new mobile world, the target segment of the company. That message was manifested when the company was sold to investors. The new core competencies were seen as preconditions needed to create the new products and the new strategy the company pursued (shown as the light shade in Figure 9). The top management saw radically new kinds of knowledge demands in the future.

The past competences were not seen as sufficiently aligned with creating a new market (also in Vesterinen, 2009, p.139), and challenges were identified even regarding the maintenance of the old core competences. In the internal analysis, it was stated that

> "lessons from the failure to fully exploit leading technical solutions commercially suggest that [former] "gurus" [technology experts in Sonera especially in the data business] cannot mix technical and business leadership" and further that "Sonera therefore cannot sustain the former 'guru' core competence of data communications and must switch to the collective core competence of mobile". (Sonera strategy versions,1999b).

There was a need to change the skill profile throughout the life-cycle, which comprised the phases of imagine, test, launch, and grow. In the imagine phase, technical dominance was seen to be Sonera's strength, and in the growth-phase, business dominance was seen as Sonera's weakness.

The industrial and growth market logic in the new strategy that Sonera adopted is seen in the management visions in 2000 presented in Figure 10. They envision the official target of the company: becoming a market maker and a winner in the 3G mobile communications business. The stock price development made global acquisitions feasible and for the firm to enact its distinctive and global footprint visions. According to the interviews, the most important growth logic was to increase the stock price, and the focus was on calculating multiples.[47] This exercise was done

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[47] An equity valuation multiple refers to the price-to-earnings ratio. It is defined as market price per share divided by annual earnings per share. In Sonera, the target was to have a price-to-earnings ratio as high as possible.

in “the goat” division, mobile and media, and also in “the sheep” division, telecom, where artificial businesses were put, that were thought to be lucrative in the eyes of investors (also in Vesterinen, 2009, p.150).

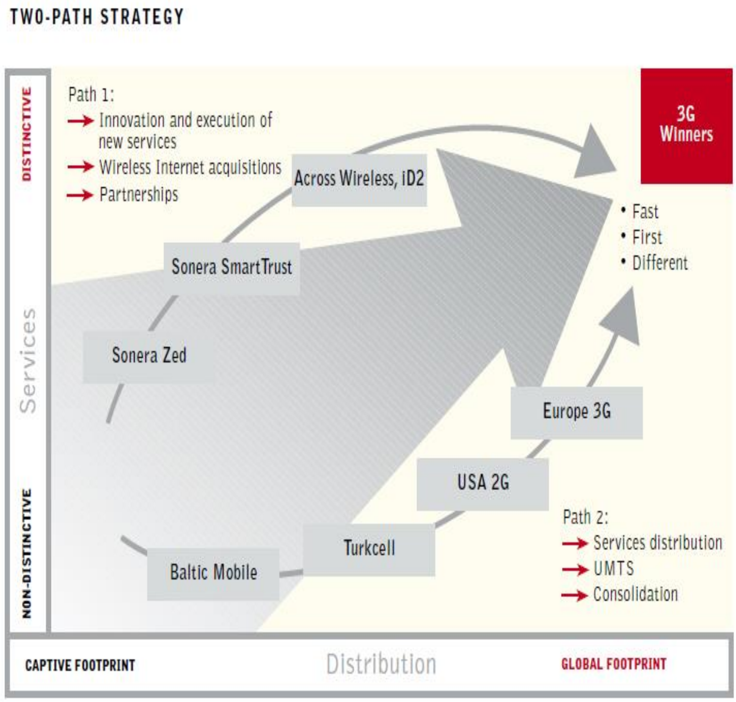

Figure 10. Sonera’s two-path strategy (Annual report, 2000, p. 4).

As is apparent in Figure 10, global acquisitions and industrial growth logic were seen as a dual path strategy. Both services and distribution are pictured in the strategy, on vertical and horizontal axes accordingly. The global presence aimed at industry consolidation, services distribution, and UMTS licenses. The operative steps were demonstrated in terms of success in Baltic mobile, Turkcell, the US 2G [Second Generation Digital Mobile Technologies, e.g., GSM], and finally in European 3G. A value-added differentiation strategy was pursued, with the help of innovation and the execution of new services, wireless Internet acquisitions, and partnerships; manifesting itself in the branded services of Sonera Zed [Portal for mobile and Internet], Sonera SmartTrust and Across Wireless and iD2.

The strategy and thoughts that emerged from that time are evident from the interviews with staff. In the 1990s, the firm sought a new value-added role arising from systems integration and convergence. The then head of R&D remembers the situation:

"I remember 1996 when new people were coming to Head Office, and the discussion started around the fact that we now have this technology competence others do not have which we can use as a tool for increasing value to customers and valuation for Sonera. The talks went so that we should be a global service developer and vendor and it also turned out that way. And then came these Smart Trust and Zed, Zed being a service platform; thousands of people were employed but it could never be managed." (Informant 7)

The following figure 11 shows the "New Internet" vision Sonera had.

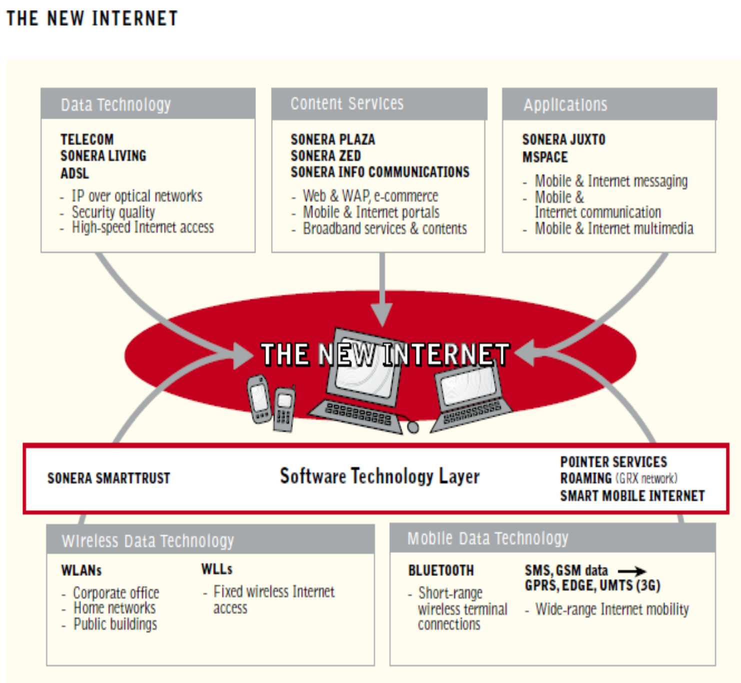

Figure 11. The new Internet. (Annual report, 2000, p.13.)

The integration of mobile communications and data transfer was presented in Sonera as a future megatrend—the new Internet—with the telecom operator orchestrating the development and content (See Figure 14). The vision of the new Internet featured Sonera as the market maker. In hindsight, only mobile data technology in the new Internet through the technological path from GSM (including services such as SMS) to GPRS and UMTS (3G) proved successful for Sonera, and mostly only in the

Finnish market. The content services (such as Zed) and applications did not evolve into a viable business led by operators and, in turn, the wireless data technology came to be dominated by US-based operators.

The ICT boom of the late 1990s (see e.g., Fransman, 2004) divided the Sonera into two areas: the traditional telecom area and a global new mobile and media area (Informants 6 and 55 among others). The new organizational structure came into effect in 1999. There were investments in the mobile and media areas and the product innovations were led by investors' attention, a search for technological convergence and attempts to profit from convergence. Below, an interviewee comments on the era from the viewpoint of the traditional organization and the difficulties of the industry accepting the mobility trend:

"Sonera's situation changed when the management group in 1998 got the task of privatizing Sonera. When the team realized the mobility message would be accepted in the market, they started to behave in a quite dictatorial way. For example, in the sales unit, we had rules that when you go to customers you must not talk about anything else but mobility. Then we had a customer meeting with UPM-Kymmene (a Finnish forestry company), and when we entered the workshop the customer warned us right from the start; "If you mention the word mobility, you can leave right away!" However, the stories by the Top Management Group about mobility were reasonably sensible, but the problem was the stories didn't have any reality and knowledge in Sonera, it was more important to grow the value of the company than use the current core capabilities to progress internationalization. Without this industrial capital logic, the internationalization of the company would have been perfectly possible" (Informant 45).

Sonera's actions focused more on market making than developing technology (Sonera's core asset in NMT-GSM period). The Zed-product at Sonera illustrates this:

"The director of Zed gave a presentation to the company management group in which he emphasized the need to continue with the capital market leveraging tactic. The most important topic in this tactic was 'eyeballs' in the consumer market, which would determine the value of providers, while the market would determine the value of each customer. These would then create pressure and leverage for operators to make deals with Zed (Laaksonen, 2007, p.136)".

The activities in Sonera and in the market proceeded very quickly between 1998 and 2000. First, Sonera was listed on the NASDAQ stock exchange in 1999. That same year, Sonera acquired many companies in the USA and also partners for its planned big businesses (Zed, SmartTrust, and Plaza Internet Portal). Sonera also took part in UMTS auctions in Europe. In addition, in 1999 Sonera sold its Primatel subsidiary, which was seen to represent an old core competence area, fieldwork and maintenance activities. Sonera also envisioned entering the broadcasting industry, as it planned to buy 34% of Digita in 1999, a subsidiary of the Finnish Broadcasting Company.

The culmination of the aforementioned actions in the year 2000 was a new departure for Sonera, the decision to begin developing and offering new services for other operators and service providers. In fact, this meant that Sonera was willing to sell all its networks, whether mobile or fixed, if it had a buyer and if there was a sufficiently competent operator from whom Sonera could buy capacity. This was a total different idea than any mooted before.

At the same time, these activities raised the sentiment in the (stock) market very high and Sonera was rushing to meet the expectations loaded onto its market capitalization value. The expectations came from investors and banking firms. To meet these expectations, Sonera saw it needed to be at the forefront of European mobile leadership. In particular, Sonera saw that the need for scale was driving mobile consolidation in an increasingly global industry and that the initial positioning for 3G broadband had started. In 2000, 3G/UMTS license auctions were organized in Europe, and Sonera considered it must participate to create new mobile Internet services. Consequently Sonera purchased 3G network licenses (more specifically, UMTS frequency bands) from Germany and Italy, for a significant price of EUR 4 300 million, three times Sonera's turnover at the time.

However, the sentiment also plummeted rapidly in markets after a while. One consequence was that the vast investments Sonera made in UMTS licenses as part of its new strategy proved to be worthless, because the new mobile Internet ecosystem was not established in time and, for example, the 3G mobile phones did not come to the market in time. For this reason, Sonera even considered making its own 3G phones through a subcontractor. In summary, in the boom period, Sonera oversaw the largest investment failure seen in Finnish economic history, the EUR 4300 billion investments in buying a UMTS operating license from the German government. The investment proved to be worthless, and Sonera's own capital diminished almost totally.

2.5.5 The era of the IT sector bust (2001)

Typical features of the IT bust period were that market sentiment was low, customer investments decreasing, and cost cutting programs were being introduced in the case company and across the whole telecom industry sector. The great expectations of Sonera's new business model during the IT boom period did not materialize. Consequently, the strategy of the company changed to focus on internal processes and downgrading businesses, as it absorbed huge losses, especially costs arising from the pursuit of 3G/UMTS licenses in Germany.

Regulation and Technology. In the environmental conditions, there was only one significant event. On the national regulatory front, a third mobile network operator, DNA, was granted a license in 2001. This caused an overcapacity in the bust market and subsequent price wars brought further instability to the mobile communications market. The incumbents, especially Sonera, objected to the regulatory authorities that the unbalanced mobile termination fees[48] were a direct income transfer to DNA. In addition, in 2001, the new Communications Market Act was being prepared. Its target was to regulate converging networks and services equally regardless of the underlying technology.

Competition, Customers and Market. Instability characterized the telecommunications and information technology industry in 2001, and UMTS license auctions caused many telecoms firms in Europe to become deeply indebted. The situation was worsened by the lack of GPRS terminals, UMTS services, and related technology. Consequently, equipment manufacturers, operators, and service providers all faced profitability and sales challenges (Sonera, Annual report, 2001).

Sonera's structural changes and strategic decisions. In 2001, Sonera appointed a new CEO, Harri Koponen, who followed a temporary CEO, Aimo Eloholma, who had stepped in after Kaj-Erik Relander had been fired. Sonera focused on internal management and on scaling down its operations in 2001–2002. The first task undertaken was an organizational restructuring: One Sonera (see Appendix 3, Organization Units), which also meant that the role of many product/service areas was downgraded, and the Service Businesses were radically downsized. The business areas affected included Zed, Smart Trust, Juxto, Plaza, and Sonera Service Media. Some of these areas had barely begun to trade,

[48] Operators pay fees to other operators when their traffic is carried in competitors' networks. A legislative regulator can set those fees to operators in order to subvent smaller players.

including some embryonic services, such as a speech recognition service named ‘Sonera Say It’.

In addition to downgrading the service businesses, Sonera sold assets to cover its 3G losses, and focused on projects that could exploit its domestic customer solutions. The goal was to be a Finnish 3G operator. However, the company still believed wireless Internet was on its way (Annual report, 2001). Consequently, in an EMT strategy study conducted somewhat later in 2002, there were signs of Sonera’s new major ambitions. These included MyLife (converged mobile and home communications solutions for the consumer segment), ICT (mobility-enabling services and process solutions for the business segment) and East (Mobile and business communications in high growth markets).

Sonera did not totally abandon the knowledge and capabilities in network R&D, which it had come close to outsourcing in the boom of the late 1990s. Sonera had begun carrying telephone traffic via its new IP-based backbone network and there was a plan to make a network migration to Ethernet-IP based transmission, this would have meant abandoning the previous ATM[49] -solution (2001).

Despite the rehabilitation programme, Sonera desperately needed new capital to cover its 3G losses, and in 2001 it made an offering, where each pair of existing shares entitled their holders to subscribe to one new share at a price of 2.70 euro. This price contrasted with the stock at the height of the IT boom, when a single share was listed at 97 euros. The new capital raised was, however, not enough, and the next step in Sonera’s history was its merger with Telia.

2.5.6 The era of streamlining and cost cutting (2002-2005)

This era was marked by typical business and cultural merger conflicts. This led to difficult discussions on how to organize the newly founded TeliaSonera Company. In addition, in Finland, Sonera faced a challenging market situation, as vendors and low-price mobile operators entered the market.

Regulation and Technology. In technology development, the telecom market started to see the true nature of the ICT market. As early as 2003,

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[49] Asynchronous Transfer Mode (ATM). A multiplexing and routing technology for high-speed digital communications that permits data, text, voice, video and multimedia signals to be transmitted simultaneously between network access points at speeds of up to 155 Mbps or more.

Skype [software and a company] had emerged onto the market as an IP voice provider, threatening telecom operators' PSTN (Public Switched Telephone Network) network earnings. In a similar vein, Cisco Systems entered the IP-PBX (Internet Protocol Private Branch Exchange) market in 2004. The same year Microsoft and Nortel declared a strategic alliance governing work on an IP/ PBX communication server. These activities led to vendors entering the PBX market, and they were seeking a share of the telecom operators' value-added services.

In Finland, a regulatory decision was made in 2003 about mobile number portability. A customer could now change its operator and keep the old mobile number. This lowered the switching costs and set the churn in Finland to record-high levels when customers switched operators in search of lower prices. This also led more newcomers to enter the mobile sector like the firm ACN in 2003. The mobile market was overheated and consequently the price level plummeted.

Competition, Customers, and Market. Regarding competition, virtual mobile service providers[50] had entered the market, meaning that one could enter the market with minimal investments, and the result was overcapacity. The situation grew even worse for Sonera in 2004, as Saunalahti—one of the largest of these players—stopped licensing and using Sonera's network. Consequently, a price war erupted between virtual service providers and incumbents.

In the customers and markets fields, there were two kinds of events from the telecom operator's view. First, a full mobility trend emerged in companies in 2004, and the usage of mobile data started to increase. This was, in principle, a positive development for Sonera. Second, tight SLAs (Service Level Agreements) and ITIL (Information Technology Infrastructure Library, a way of organizing buying behavior) practices entered the telecommunications sector. These events put pressure on Sonera to formalize processes and IT development.

In March 2002, Telia and Sonera announced they were to merge. Tapio Hintikka, a Finn, would be the chair of the board; and Anders Igel, a Swede, the new CEO. The Swedish government would own 45% of the new company, while the Finnish government would own 19%.

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[50] A virtual mobile service provider that does not own the wireless network infrastructure over which it provides services to its customers. It enters into a business agreement with a mobile network operator to obtain bulk access to network services at wholesale rates, then sets retail prices independently. It may use its own customer service, billing support systems, marketing and sales personnel. (Wikipedia, accessed 23.5.2014)

Sonera's structural changes and strategic decisions. When Anders Igel became CEO, he stated in the Annual report (2003) that Sonera's 3G investments made a huge loss, but also that Telia's past investments in international network capacity services had been a mistake. This statement marked the focus of the company for a long time: the era of streamlining and cost cutting. The same annual report stated that profitability would be achieved through synergy benefits and by increasing cost efficiency. However, industry analysts (OVUM: TeliaSonera merger analysis, 2003) were of a different opinion, suggesting that synergy gains would flow from size advantages (i.e., more efficient buying bargaining power), not business advantages (i.e., creating new innovative services). It soon became very apparent to the Finnish organization how different Sweden and Finland were, and business synergies were difficult to identify. In particular, mobility was highly diffused to Finnish consumers and especially to the business segment, which was not the case in Sweden. Thus, there was no common culture and understanding about different countries spearhead services and if and how to develop those.

"Sweden is lagging at least ten years behind Finland, and the situation is even worse now when all decisions are made in Sweden and the R&D function in mobility is in Sweden. Also, the Swedish decision process and culture is much slower than we have in Finland. In addition, our competitor, Elisa, has all its resources and decision processes in Finland and does not have to send a proposal to 50 boards as we now have to at Sonera. For these reasons, we have lost for example Rovaniemi city, Sonera's own traditional business heartland, where we should have all the resources and telephone networks. Whereas Elisa has no infrastructure there, not even a single copper line, but despite that they win the bidding contest and their solution was 'all mobile' to the municipality. Mobility is overlooked in TeliaSonera and we have an "only over my dead body" attitude in Sweden, you need to have the permission to offer these kinds of all mobile solutions. Furthermore, then we have an internal battle if the solution is fixed or mobile silo's property, and if we are offering this kind of integrated solution, that means if we get one euro from the customer, it is then split between divisions inside Sonera." (Informant 58)

The merger with Telia in 2002 brought changes in management models. Telia changed the models to multilayered matrix organizations, technological silo management, and new emphasis was placed on what kind of R&D to pursue. What was also new, the strong role of central management in running local businesses, both considering Finland and Sweden. The important point is that the Finnish organization thought that B2B specific business needs were not understood and appreciated by the Swedish organization, which was seen as treating B2B products and customer needs the same as consumer products. In contrast, the Finnish organization had produced converged, service integrator type of customized solutions for the B2B market—which was also a source of pride for Sonera's Finns.

"In Finland, all telecom operators have a managed service layer…I recall as a case example, DataNet. The idea was the so-called active hardware was no longer bought by the customer, instead it was offered as a service. In Finland, system integrators (IT players) don't have this layer, while telecom operators have. Whereas, on the other hand in Swedish markets, IT players offer that service, an example was TietoEnator which sold the voice services to the city of Stockholm. If this happened in Finland, somebody would get fired at Sonera, whereas in Sweden it would mean a celebration, because IT players provide that service. In Finland telecom operators have targeted the next layer in the value chain and in Sweden they haven't, and that job has been done by system integrators [such as TietoEnator] case by case." (Informant 32)

In 2002, TeliaSonera declared itself a *fast-follower*, in practice this meant TeliaSonera would choose only large established vendors, would reduce its own R&D activities, and would focus on customer service and becoming a service company. This was a new focus, and Sonera Finland tried to implement it. However, at the same time, managers at Sonera Finland also attempted to adopt new technologies as soon as possible (i.e., to be a first-mover), in contravention of the new group policy (discussed later in cases and in the analysis section). A key person in Finland comments in retrospect on that period 1980–2010:

"We could now be right in this standard global way of working, no risk taking. On the other hand, we have no opportunity to acquire big fortunes as we could earlier when we had a risk taking attitude. Now we are playing the big operator game, which could be a 100% right way of acting" (Informant 20)

The fast-follower strategy pursued from 2003 to 2005 was evident in many decisions. In 2003, Anders Igel commented that the Nordic areas and the Baltic States were TeliaSonera's home market and the plan was to defend that home market. In 2004, a part of R&D activity was transferred from in-house development to cooperation with customers, suppliers, universities, and research institutions. Such decisions led Tapio Hintikka to resign as chairman of the board in 2004. The disputes at top management level between Sweden and Finland also began in this period.

Hintikka criticized Igel for being too cautious and went on to say, *"I thought I was in business, but I ended up in Swedish politics*." In particular, the slow decision making around TeliaSonera's investments in Turkcell in Turkey, and in Russia, stymied growth. "*TeliaSonera would have majority shares in Turkcell and MegaFon, if it had acted faster*" commented Hintikka.

One important event was also, in line with the fast-follower strategy, that Sonera defended its market share by introducing a cheap mobile service provider of its own, Tele Finland, in 2004. Because of activities in the Finnish mobile market, Sonera suffered a 20% price erosion. In the annual report of 2005, Anders Igel singled out Finland as one country that exemplified failures in business management out of the 13 different markets TeliaSonera operated in.

In the early years following the merger between Telia and Sonera a joint organization and headquarters unit was established. This operated above the country organizations and especially the strong broadband organization in Sweden. Harri Koponen was the Head of the joint Marketing, Products, and Services (MPS) unit. Koponen tried to create a common product offering, a new telecom firm to replace the former organizations ('*bit pipes*') marked by their silo constructions (fixed voice, fixed data, mobile). His vision was to introduce a new customer-driven telecom operator (convergence), based on horizontal customer-oriented operations.

According to the interviewees, the plan to create a new telecoms operator by the MPS organization actually progressed. However, Koponen wanted the change to happen in Sweden in six months, whereas in reality it would have taken much longer, and as much as 10 years according to one informant (Informant 55). This was claimed to be the reason why Igel fired Koponen, officially stating "*the attitude to business strategies and Government's corporate governance principles has not been consistent*" (also referring to Sonera's Turkcell affairs, which were led by Koponen).

2.5.7 The era of convergence – ICT (2006-2010)

The most notable characteristic of this period was the strong growth in mobile data usage in the market. In addition, new ways of producing, bundling and buying telecom services, Cloud Computing, Unified Communications and ITIL standards (Information Technology Infrastructure Library, a set of practices for IT service management) emerged. These events posed a challenge to telecom operators' business models. Internally, Sonera made changes to its organization, and to its R&D policies.

Regulation and Technology. In the field of regulation, the market had already been opened up to competition, but now in the era of convergence, competition and technology adoption assumed a role in the evolution of the industry.

The technology development focused on ICT. In 2007, Apple (a US-based technology company) introduced the iPhone[51], an intelligent mobile phone particularly suited for mobile data and internet usage. The main event in legislative regulation in Finland at the time was the lifting of a ban regarding the bundling of mobile subscriptions and mobile handsets in 2006. This increased the sales of Apple iPhones, sold in a bundle with a mobile subscription. To continue, in 2007, the LTE/4G standard was introduced. This meant that higher data speeds and mobile voice would be also carried in the data network alone. This posed a threat to circuit mobile network earnings (namely GSM), as the traffic would be transferred to the IP network (LTE/4G).

The technology used in the B2B segment also made rapid progress. Most importantly, computing power had progressed so that telecom services could be provided by IT and Internet players. Internet players, such as Google, introduced Google Wave—a software framework for real-time collaborative editing online—in 2009. It represents an offering to Unified Communications made by players other than traditional telecom operators, and bypassed the latter. In turn, according to Gartner (2011), "*while clearly maturing, cloud computing continues to be one of the most hyped subjects in IT today*". Cloud computing means consuming and/ or delivering services from the cloud, manifesting to technologies as SaaS (Software as a Service), PaaS (Platform as a Service), and IaaS (Infrastructure as a Service) (ibid. p.3), where services are provided virtually. [52]

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[51] Apple iPhone marked a true convergence period in seamless, easy to use mobile Internet services, which increased mobile data usage significantly. Sonera licensed the usage of the iPhone and retained proprietary rights as the sole licensor of iPhone in Finland for a limited time.

[52] This is basically what telecom operators had done earlier with Virtual Private Network (VPN) services, but the difference is that now the customer companies are offering more and more services and infrastructures to be managed by others, and not necessarily by telecom operators any more. There are currently many standards on which to offer services. The operator is, however, still dependent on

Competition, Customers, and Market. In the market field, service offerings were typically service packets and bundles, meaning that many types of products and services were sold together and with a fixed price, often based on euros/month to consumers or euros/user in the B2B segment. However, these packets and bundles were not profitable for telecom operators, who preferred simpler time and volume-based billing. The situation was worsened by the fact that services were becoming more complex, consequently requiring sales, marketing, and customer service investments. In addition, SaaS/UC service providers began entering the telecom market, which further threatened their business model by making it possible to make content with control gateways in the network, for example, with players like Google. Therefore, while B2B voice (fixed voice) was still seen as important in the client companies, there would be less willingness to pay for it.

The foundation in this latest era is convergence; both in networks and in the end customer offering (e.g., the business segment and the consumer segment). The attraction of IP was seen to lie on the convergence side, as services could be offered more freely and without taking a stance on hardware and the network layer as such, as an expert from Sonera stated:

"Technology disruption is one way to look at industry development. The disruptions work through competencies, one area which could traditionally make large changes is that some technological innovation makes the change in a value network. For example, with IP voice, you can produce an IP service over mobile data without having a mobile center or base stations on your property. The roles are also changing in that way, the investment based business is surprised when some service provider buys and needs only some usage center, for example, buying Amazon usage center time and running some application there, which performs the same operation as a telecom operator does" (Informant 29, Quote 1)

In 2007, it was clear that operators were not driving the market (the opposite idea was prevalent in the hype of the late 1990s) as Sonera communicated that

"mobile handset browsers and increasing functionality are driving content services, handsets are also more capable of using different networks: e.g. GSM, GPRS, EDGE, 3G, WLAN [wireless local area network]"... Furthermore, it was stated that "also the value chain has more players than telecom operators" and

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turnover and is facing a competitor capitalizing on market hype and investor capital.

"technology drivers are IP telephony and higher network speeds in mobile, increased capacity of devices." (Annual report, 2007).

Sonera's structural changes and strategic decisions. In 2007, Sonera made a proprietary agreement with Apple and bundled the Apple iPhone and Sonera's 3G services. The success of the Apple iPhone demonstrated the ability to build customer intimacy, ease of use and a rich ecosystem. Customer Average Revenue per User (ARPU) and profitability were higher than in competing solutions, meaning that Sonera earned more in mobile data usage per customer when Apple's iPhones were used, contrary for example to Nokia's smartphones. Horizontal services such as Google and Skype became feasible because of the IP-based network (Martikainen, 2006b). Sonera also identified this opportunity, when it licensed the iPhone. This period saw network hardware vendors' role diminish, and end device and application builder's roles increase. The importance was not found in the technology alone; but in a way of doing business and in the customer centric design. This transition to a new kind of service usage went noticed, and consequently Sonera created a partnership with Apple to resell their iPhones, in order to boost mobile data usage.

Internally the iPhone way of working gave the organization further inspiration to develop new products and services: Now it targeted (once again) developing easy-to-use services, even in B2B.

"In our own B2B segment, in the internal investigation of our own processes, we noticed that we are competitive technologically, but we have a knowledge gap in key customer service processes. IT has slowed down the competence creation in customer service. IT influences customer intimacy; we have even currently for example 26 self-service portals." (Informant 16, Quote 2)

Finally, in 2010 the business service portfolio was further developed with an emphasis on cloud-based functions and a convergent offering. In addition, an important change from previous vendor policy was to choose Telepo, a new kind of agile vendor, to provide Unified Communications (UC) in 2007. The firm also came to view partner management as more important than it had previously:

"In UC, innovation and good partners are important. For example, we cooperate with Microsoft and IBM. In this area, we also develop our own technology on the SME side; UC will bring big vendors into play, we must know what they are offering and have good relations and cooperation. We could say that Microsoft has their contacts with customers and possibly some sort of dominant design, but they don't have the network and connections, they always need a partner. Who wins the game is the player who can influence the customer with a good partner network. Thus, the winning player could be Google, too" (Informant 16, Quote 5)

Convergence management in general was seen as a tool for creating dominant designs[53] and it was recognized that "*the company that leads the convergence can shape the market in a desirable way*." This sentiment appeared in an internal strategy plan in 2009. Operators would have faced a challenge if an IT player had defined the dominant design with convergence, and consequently taken the customer interface for themselves. One tactic used to counter this scenario was to have an aggressive migration from the operators (leading the convergence, Appendix 8.) In addition, a more tangible example of convergence management was seen, the challenge in management was seen to have mobile services included in the convergent offerings (see Appendix 4).

At the same time, owing to globalization and IP technology development and IP services applications, TeliaSonera radically increased the utilization of open platforms from vendors, third parties, and software oriented solutions; the solutions were demanded by market, partners, and end users. The intention was to obtain early proof of the viability of new concepts and reduce time to market. In addition, in order to gain expertise in ICT, the Finnish-managed hosting services company, Crescom was also acquired (2007).

Moreover, in R&D, to reduce risk and ensure easy-to-use services, a proactive engagement of end users in all R&D phases became mandatory (2008). In company M&A policy, the goal was for TeliaSonera to participate in European telecommunications market consolidation—a move motivated by the desire for economies of scale and growth (2006). In the same vein, distribution of additional capital to shareholders through an extraordinary dividend and an increase in the ordinary dividend (2006) was implemented.

On the organizational front, the company made mixed decisions as it had on the technology front. In 2007, Lars Nyberg was appointed CEO. The Integrated Enterprise Services organization was established in order to construct the leading Nordic and Baltic IT and telecom system integrator in 2006, but that model was discontinued as a separate business area in 2008. The number of Finns in the management group was reduced to just one. The company had downsized its own R&D operation. In turn, Cygate, a leading supplier of secure and managed IP

[53] Managers used the term 'dominant design' literally in strategy plans.

network solutions and system integration in the Nordic market was acquired in 2006. Focus areas were communicated that included the migration of Swedish fixed voice customers; participation in growing markets to improve cash flow; improvement of the B2B sales process; becoming a world-class service company; and the reduction of costs (2006). R&D and sales functions were centralized to Sweden in 2007.

2.5.8 Summary of historical analysis: The telecom industry and TeliaSonera 1980–2010

Telecommunications is a high technology industry, but the intensity of the R&D in the sector, especially that conducted by telecom operators, has diminished in the period under scrutiny. New entrants from different industries and from a different area of the value chain (e.g., vendors in the areas of hardware, the Internet, and applications, such as Apple, Google and Microsoft) have taken a stronger role. The competitive situation in Finland has changed from one dominated by telecom operators to a new landscape where IT and Internet players want a share of value-added services, both in the consumer and B2B segments. Thus, by 2010, the telecommunications industry was experiencing negative organic growth compared to the 1995–2000s period, when the growth in the mobile and internet business areas, in particular, were strong.

The major technological, regulatory, market, company critical events, and company strategy are summarized in Table 5. The empty cells represent areas where no major relevant issues that affect the context of this study emerged.

Table 5. Discontinuities and dominant designs in industry and the Sonera Corporation: a case study.

Time	Technological critical events	Regulative and market critical events	Company critical events	Company strategy
1982 - 1986	Networking idea, TCP/IP as a standard (1982); Nokia in Mobile-PBX (NMT-900) (1986)	Data Competition (Datatie founded) 1985	First profit & loss and sales units in Sonera.	Defending national and local geographical assets (local and national networks); R&D focus.
1987 - 1992	Analog to Digital/ ISDN/ 2Mbit Voice Access (1987); GSM (1992); Cisco enters to routing technology (1988)	Liberalization starts (1987); Radiolinja enters the mobile business (1992)	Focus to be a company; First profit centers (1987)	Equip one to compete with innovations (own or locally adopted)
1993 - 1998	IN(1993); Microcomputers, HTML, HTTP, URL, Netscape (1996); UMTS (3G) standard (1997)	Trunk calls competition (1994); Option to buy access/ Abandoning of numbering areas (1995); NO /SO split (1996)	TSF gone public (1997); 3G auctions (1998); three large SBUs emerge	Quality, technological excellence and early commercial thinking/ SBU way of working
1999 - 2000		3G auctions, the market value of operators-inflated expectations	Global SP mindset (99-01)	Lifting the market capitalization value high/ M&A's to insource knowledge; network independent services; industry creation with convergence
2001		3rd mobile network operator (DNA) (2001)		Portfolio cleaning/ Networks core assets; Focusing to be a local 3G Finnish operator
2002 - 2005	IP-PBX (2004)	Mobile number portability (2003)	TSF-TS merger (2002); R&D downsizing (2002); different managerial cognition in FIN/SWE	Process excellence, functional management and customer service; Portfolio mgt.; Service Orientation
2006 - 2010	All-IP(2007);iPhone (2007);Consumeri-zation (Skype, Google Wave) 200309;SaaS(2010) 4G (LTE)	3G handset bundling (2006); US vs. Europe mobile ecosystem wars	IES organization (2007); IES organization was closed down (2008)	Partner mgt. importance; Customer experience/ Easiness of use/ Service and product adoption from third parties to boost network usage, bit-pipe production

3. Methodology

3.1 The case study as a research method

According to Stake (2003;, see also Easton 2002, p.118), it is essential by definition to investigate particular phenomena as integrated systems in case studies, given the multifaceted nature and specific character of a case organization that is subjected to many forces. Gibbert, Ruigrok and Wicki (2008, p. 1466) also stress the need to study phenomena in their real-life contexts. The main aim of this study is to provide an empirically grounded framework illustrating how companies adapt to dominant designs, thereby enhancing understanding of the interdependency between the industry and the company level (including both the corporate and the SBU level).

Case studies typically address how and why questions (Yin, 2003, p.5). The broad research questions of this study concern how dominant designs are adapted to on the company level in complex technological systems during the life-cycle evolution of the industry (in a potentially successful way). These questions are addressed through the construction of a framework (i.e. the research framework) for adapting to dominant designs, and its application in a longitudinal case study carried out within the Sonera Corporation.

The aim is to explore possible causal descriptions (Easton, 2002) and "in fact, getting closer to constructs and being able to illustrate causal relationships more directly are among the key advantages of case research vis-à-vis large-sample empirical work" (Siggelkow, 2007, p.22). However, such causal descriptions must be understood as possible (or at the best, likely) relationships that arise from an in-depth description of the evolution and adaptation of the multiple dominant designs that under investigation in the case company. Still, this description should still enable theory development, i.e., the building of a dominant design adaptation framework. Case studies, as such, do not provide conclusive, fully generalizable, or 'quantitatively objective' evidence of the precise causalities.

Indeed, case studies can be used for descriptive purposes (the case histories in this study), to test theory (in this case in terms of how well dominant design and related concepts reflect the development of the telecom and ICT industry, and the case company's attempts to adapt to dominant designs), and to generate theory (this study further develops earlier dominant-design models). "*Cases are chosen for theoretical, not statistical, reasons*" according to Eisenhardt (1989), citing Glaser and Strauss (1967). The theoretical logic behind the choice of the telecommunications company Sonera as the case company (or the case in general) relied on the following reasons. Telecommunications and the ICT industry (represented by Sonera) are theoretically interesting in that they are 1) high-technology based (an implicit assumption in much of the literature on dominant design) with 2) a hierarchical systemic model (interdependent components forming an integrated whole), and 3) manifest identifiable technology cycles. The case company Sonera and the time period of the study (1980-2010) allowed in-depth investigation of all these facets. Moreover, Sonera has introduced new technologies, and has adapted technologies created by others, thereby allowing the study of a fuller spectrum of dominant-design process (i.e., creation, modification and adoption/copying).

The theoretical logic and reasons for case selection are described in the following section (3.2). The individual cases form a life-cycle continuum: in other words, I study and analyze product areas and their new releases and versions over time, including their interrelationships. Methodologically, "*the fact that subcases were not independent increased their individual contribution to the total case*" (Dubois & Gadde, 2002., p. 558). The majority of the cases in the present study are indeed interdependent: the businesses of the case company in the voice, mobile communications (described in the empirical history of the industry and the case company), and Datacom areas are studied in order to find out how dominant design management changes as the industry evolves.

3.2 Case selection

I used theoretical sampling (Eisenhardt, 1989; Suddaby, 2006, p.638) in choosing the individual cases within the company. As Eisenhardt and Graebner (2007) state, "*Theoretical sampling simply means that cases are selected because they are particularly suitable for illuminating and extending relationships and logic among constructs*" (p.27). I investigate the relationships between the building blocks of dominant design identified in my research framework, and therefore selected cases that would shed light on these constructs and their relationships (theoretical frameworks in chapter 2).

The selected cases represent product-development projects within the complex technological systems of the case company Sonera. In addition, Sonera's corporate level strategizing and management are included in the case study. They all relate to the ICT and telecommunications industry, which is a traditional and frequently studied area in the research on dominant designs (Suarez, 2004). It is worth pointing out that not all the case projects led to the successful adaptation (i.e. creation, modification, copying/adopting) of a dominant design: some of them did, some turned out to be dominant designs later on, and some failed. Yet, selecting a variety of cases along these (adaptation) dimensions was theoretically purposeful given that the theoretical focus of this study is on not only the creation of dominant designs but more broadly on their adaptation process, which includes both in-house creation, modification and the adoption/copying of designs created by other players.

The seven cases ultimately selected for analysis (Table 4) represent substantial variation along the theoretical dimensions and constructs under study (see the theoretical framework in Ch 2). For instance, the Vipgate concept and the Cid company number service represent the *era of incremental change and elaboration in the development of dominant designs*. On the other hand, Sonera's Communications Solution is an example of *technological discontinuity*, but at the same time it represents the *elaboration of many earlier dominant designs in combination*. The cases also differ on the company level in terms of how the building blocks are used. These details are discussed more fully in the case histories, and in the analysis and discussion sections.

An additional reason for selecting the specific product-development projects was that they formed continuums regarding the customer needs addressed. Consequently, it was possible to study the extent to which the longitudinal changes in the industry facilitated the creation and adoption of individual dominant designs. Such an analysis would not have been possible if the cases had been totally independent of each other. Moreover, many of the projects were flagship projects in their time, which meant that they consumed substantial amounts of management time and resources (almost all of them attracted top-management [CEO] interest). This is also reflected in the fact that they eventually came to constitute 79-85 percent of the case company's turnover (in 1994-2000). I discuss mobile business on the general level, although pointing to the role of GSM, Zed and iPhone cases in the industry and Sonera's history. Table 6 below shows the selected cases.

Table 6. Selected cases

Cases (including the sub-cases)
*Service numbers (Call Center Toll Free, Premium) *Vipgate (VPN, Privatel, Cid Company number, Vipgate Concept) *DataNet *FastNet *Mobile business (GSM, Zed, iPhone) *B2B Mobile (MCX, Sonera Communication Solution) *Unified Communications *Sonera Company business case

Table 6 lists the cases selected for and analyzed in the present study. Service Numbers & Telematics Services was the first product/service concept at the case company to offer value-added services beyond basic telecommunications traffic. The Vipgate concept as a whole defined the offering structure to the large business segment, in the fixed voice and integrated value-added business area. DataNet and FastNet were counterparts to Vipgate, but in data business. The Mobile business as a whole, in the Finnish market, currently makes the biggest and most significant contribution to the case company's Finnish operations. B2B Mobile represented specific offerings related to the value-added services that the business segment needed. Unified Communications brought together many earlier offerings and, it is proposed, also started a whole new dominant design cycle.

3.3 Data collection

3.3.1 Interviews

I started the data collection by studying the history of the telecom industry globally and in Finland (histories, annual reports, previous studies; see the empirical Bibliography). I kept the theoretical literature on industry life cycles (technology discontinuities, regulation, and usage patterns of products, their related volumes and values) in mind while reading and interpreting the data.

During the first interview stage I went through the case details (products, product areas, key organizational events, key industry discontinuities in technology, regulation and customer preferences) with the interviewees. The first questions (Appendix 14, Interview Questions) related to the facets of dominant design in different life-cycle stages, as well as to how the products/services had been developed within the company.

The interview process (starting in 2009 and ending in 2013) comprised three stages, with between one and three interviews per interviewee. The first stage focused on the industry, customer and technology trends in the time period 1980-2010. The first interview was a consultative discussion about what study objects (mainly products) to include in the analysis in order to get the best grip on the B2B Communication business and its evolution (there was also talk about the whole business including B2C and operator segments and overall corporate strategic choices).

The second interview stage focused on the theme of dominant design and the implications and emergence of the concept from a product perspective. The objective in the final stage was to obtain direct answers to the questions: “How do you understand a dominant design?” and “How should one create a dominant design?”

Almost all the interviews were tape-recorded (73 were taped and 8 were not taped), and notes were taken. I informed the interviewees beforehand about the themes and questions (see Appendix 14). The interview procedure was semi-structured (Kvale & Brinkman, 2009). Not all the questions were discussed, and there was ad hoc improvisation depending on what themes were more fruitful and proved to be ‘in the comfort zone’ of the informants.

More focused questions needing clarification arose during and at the end of the interview process, which were dealt with by e-mail (26 emails). I also returned to themes that seemed to need more clarification or corroboration.

All the transcripts (59 in all, 81 interviews) were sent to the respective informants, who gave their views and made factual corrections if needed. Informants 22 and 7 requested caution when publishing sensitive facts and in conveying some strong opinions they had expressed, and informants 4 and 5 made small factual corrections to the text. The other informants verified that the transcripts were accurate.

In addition, the complete case descriptions (the history of the industry as well as all the product /service information) and the related analyses were sent to informants 12, 10, 55, and 6, who were ‘Senior Vice President-level’ individuals with profit and loss responsibility in their business areas. We went through the industry and case analyses in separate discussion meetings, and the informants accepted my interpretations.

Separate product/service-area analyses were also corroborated. The analyses of the mobile case went to ‘Senior Vice President-level’ individuals [informants 22 and 31], who also had profit and loss responsibility in the mobile business as a whole, and in the production networks. The case description and analyses were accepted, although informant 31 also wanted to discuss Unified Communications (UC) in relation to the mobile business. In fact, this increased the robustness of my analysis of, indicating the central role of UC found in this study (see Chapter 4). In the case of TeleSampo, informants 51 and 52 verified that my analysis was correct. Beyond these product areas I corroborated extensively [case description and analysis] with informants 2 and 24 in Vipgate and Unified Communications. The former informant had a long business career in the Vipgate, Mobile and Unified Communications business areas, whereas the latter was the best expert in Sonera on production and network issues (Sonera’s network layer and technologies).

3.3.2 Supportive archival materials

Archival data complementing the interview data included business plans, strategy reviews (on different organizational levels and in different organizations), product-development pre-studies, sales material (products, concepts, concept development), memos about strategy processes, data on turnover and costs, consultant studies (also on the industry level on various topics), product plans, technology reviews, business white papers, electronic mail material, official investor material, and participant observation. The archival data is listed in the Bibliography.

Table 7 below lists the supportive archival materials and indicates how they were used in drawing the main conclusions and tracing events in the case history.

Table 7. Data sources and their usage

Theoretical concept	Theme	Inter-views email, Parti-cipant obser vation	Investor material Comp history, Annual reports, strategy papers	Consultant and other studies, statistics	Product and service descript -tions
Historical eras	Hype	*	*	*	
	Streamlining	*			
	Convergence	*	*		*
Company strategizing	Defending	*	*		*
	Equip to face competition	*	*		
	Quality, tech excellence	*			*
	High market capitalization	*	*	*	
	Portfolio cleaning	*			
	Process mgt.	*			
	Customer experience	*			
	Fast follower	*		*	
Technologi-cal change	Networking idea	*		*	
	All-IP	*		*	
DD emergence	Industry level, cases	*		*	*
ILC stage	Generic	*		*	
Company governance	Generic	*	*		
Transfor-ming, sensing, seizing	Generic	*			*
Innovation type	Generic	*			*

The table 7 lists the theoretical concepts of my case (see the theoretical framework in Chapter 2), and elaborates on them in the 'Theme' column. For example, with regard to historical eras I wanted to point out the importance of accurately reporting the source of information for my arguments. On the other hand, the 'monopoly' theme does not need an explicit explanation given that the era is well documented in the secondary sources (industry histories, for example). Consequently, 'Generic' as a theme indicates that I draw conclusions from all the facets in that theoretical concept, such as on all innovation types. The other four columns list the type of empirical material: an asterisk (*) in the participant observation column means that I was personally involved in operative business in the related area.

3.4 Data analysis

3.4.1 Preliminary analysis: temporal bracketing of the historical eras

Langley (1999) describes temporal bracketing as a strategy (pp. 703-704), which I used in the initial analysis of the case company's history (i.e. its evolution as a whole). Temporal bracketing is a way of structuring the description of events into phases. It enhances sense making in that processes are "stable or linear" within the phases, but on the other hand, discontinuities divide the history into phases that can be examined in relation to each other. In other words, it allows the constitution of comparative units of analysis for the exploration and replication of theoretical ideas. (ibid., pp. 703-704)

In my case description, evolutionary context of the industry and company, (Chapter 2) I structured the major events in the case company's history, vis-à-vis the industry so as to identify separate historical eras, and to make sense of the events as well as regimes of action within them. Regimes of action (e.g., Geels, 2002, 2004) here refer to 'the rules of the game' guided by regulation and technology. Having conducted this initial analysis I was able later to observe patterns in the evolution of dominant designs on the company and industry levels.

I used temporal bracketing, as defined above, in analyzing actions and change in the focal company, Sonera. The historical eras thus identified also overlap, and some of the effects persist when the new periods commence. I completed the periodization by studying the major strategic decisions in the company together with discontinuities on the industry level, which constitute a prerequisite in the adaptation of dominant designs.

Having completed the periodization I corroborated it during the writing process as follows. I allocated the case products/services to the periods and analyzed the building blocks as well as their importance in the process of adapting the dominant design and in the industry's evolution (e.g., the significance of regulation and standards in each period). I also showed the periodization to the interviewees in the second and third stages of the process. The outcome of this preliminary analysis was a picture of the overall change in management processes, mindset, and industry power positions, as well of other issues in the research framework (Chapter 2, Figures 5 and 6). I mapped the concrete actions of the focal company onto the theoretical framework (i.e., the big picture) as emerging company mindsets.

Across the periods I identified a total of 161 strategic decisions in the material. I also included the related industry's key events in areas such as regulation, technology, competition, customers and markets, and appropriability (shown in Appendix 2 in chronological order). Strategic decisions were conceptualized in a similar vein as in Athreye, Kale and Ramani (2009), referring to a significant resource allocation, investment, or structural change (related to adopting, modifying or creating dominant designs). To this end I looked for concrete words and depiction of events in the interview and other material regarding the major product-development areas in my study, such as discover, incentives, establish, partnership, develop, acquire, license, invest, piloting, and communicate (see case selection).

In verifying the analysis of the temporally bracketed eras I consulted the industry reports on developments in business volume, usage data, and product/service pricing over time (Abernathy & Utterback, 1978; Malerba et al., 1999), as well as reports on the key competitors' market shares. The main information sources I used here were company histories (Turpeinen, 1996; Lukkonen, 2004; Häikiö, 1995), annual reports from 1985-2010, and the interview transcripts.

Table 8 shows a sample excerpt from the preliminary analysis based on temporal bracketing: it positions (1) the industry's key events including the facets of regulation, technology, competition, customers and markets, and appropriability (Appendix 2) and (2) Sonera's strategic decisions (Appendix 1) in each typologized era.

Table 8. An extract from the preliminary analysis based on temporal bracketing

Eras	Year	Decision	Description	Regulation Technology	Competition, Customers & Market	Appropriability
Monopoly	1977	Pekka Tarjanne DG in Posts and Telegraph Office	Telecom war began in this era, which was fed by Tarjanne.	X.25 standard in industry		Time-based/ data-usage based BM profitable
Monopoly	1982	Sonera starts to develop a Videotex system.	Value added data business starts to develop.	TCP/IP as a standard; AT&T implemented toll free service number.		
Liberalization	1989	The decision to apply for a license to offer regional services in competitors' areas.	Sonera's counterattack, when local telecoms applied for a mobile business license	Telecommunications law (1987)		
Competition & growth of mobile business	1996	Sonera took part in the implementation of the world's largest ATM network with IBM.	Sonera gained competetive advantage on the national level.	HTML, HTTP, URL, Netscape	Internet boom in the market	
IT Hype	1998	Sonera is listed on the Helsinki stock exchange	Sonera participates in larger operations.		Mobile services operators enter the market.	
Convergence	2007	Sonera introduces exclusive iPhone sales contract.	Role of partners increasing.	iPhone; Intelligent mobile phone capacity increases.	Large local telecom companies abandon Finnet.	B2B Voice a major application, but nobody wants to pay for it.

Notably, the eras eventually identified from the temporal bracketing are also visible in the example shown in Table 8:

- The era of telecom monopolies (1980-1986)
- The era of the liberalization of telecommunications and data business (1987-1992)

- The era of intense competition and growth in mobile business (1993-1998)
- The era of IT hype - the convergence of mobile and Internet business (1999-2000)
- The era of IT bust (2001)
- The era of streamlining and cost cutting (2002-2005)
- The era of convergence – ICT (2006-2010)

The discontinuities at the frontiers of the eras include changes in legislative regulation, new technologies and appropriability regimes, as well as in Sonera's strategic decisions and the regimes of action on the industry level. Appendix 1 and 2 detail the temporal bracketing events, which were placed periodically at eras.

3.4.2 Data analysis: the abductivist approach

I adopted an abductivist approach (Dubois & Gadde, 2002; Kovacs & Spens, 2005) in this research in order to link the theoretical framework and development on the one hand, and the further analysis of the empirical data on the other. Dubois and Gadde (2002) broadly refer to the abductivist approach as one in which the empirical world (i.e., the chosen cases), previous theory, and the framework of the study are intertwined with the processes of matching, direction and redirection. In other words there is constant iteration between the data sources, the data analysis, and the initial theoretical framework, and in some cases a total (theoretical) redirection if new evidence and data are present.

My target was theory development regarding the constructs in the theoretical framework and their relationships (e.g., dominant designs follow each other) in a longitudinal setting. I further classify this study as one of theory refinement (case-specific) (Keating, 1995), which further justifies the abductivist view: "Systematic combining builds more on the refinement of existing theories than on inventing new ones" (Dubois & Gadde, 2002, p.559). Nevertheless, testable propositions are often presented as an outcome of the final analysis in cases of theory refinement.

Below I describe the abductivist research process as a whole. I started by asking how one could create a dominant design in a company, bearing in mind the industry conditions. I included constructs from classical studies (e.g., Anderson & Tushman, 1990; Tushman & Anderson, 1986; Utterback & Abernathy, 1975) in the initial framework, supplemented with more recent models incorporating factors relevant to the management of dominant designs (e.g. Suarez, 2004).

The first and second interview rounds yielded inductive findings about the cases: how innovations came into being in the company; whether or not they were dominant designs, and why; how they related to the industry life-cycle and the company's historical eras; and whether they were developed in-house or adopted and modified from the innovations of other players in the market.

The following general themes emerged during the first reorientation of the initial theoretical framework based on the interviews and other materials: convergence, dominant logic, and technological brokering (as major sources of innovation). It also seemed as if the variables that determine successful innovation strategies were no longer associated with "fluid pattern"[54] facets in the creation of subsequent dominant designs. In contrast, new dominant designs were created in accordance with the industry-life-cycle view of "specific pattern" facets such as cost reduction, and an organizational emphasis on structure, goals and rules, bypassing entrepreneurship (Abernathy & Utterback, 1978). According to the traditional view (ibid.), new dominant designs start from the product (fluid pattern) rather than the process (specific pattern) stage of innovation. However, my initial findings indicated that many of them were rooted in the latter stage. Moreover, according to my initial empirical findings, the sources of innovation are more fine-grained than implied in the traditional assumption that dominant designs are rooted in the insights and decisions of (top) management (e.g., McGrath et. al., 1992).

During the third interview round I elaborated on the reoriented focus and articulated my initial findings to the informants. As a result I came to a conclusion that individual dominant designs are not pursued very systematically based on a clear strategy or roadmap, for example. On the contrary, ad-hoc problem solving was more prevalent, as was the management of a varied product portfolio (instead of following a clear, unified strategic direction). This further meant that the case products were mutually interdependent in terms of technology and commercial potential. The varied sources of innovation (and dominant designs) mentioned above were also reflected in the further stages of interviews and data analyses. During the later stages I also brought in Teece's (2007) framework of sensing, seizing, and transforming phases given its

[54] Fluid pattern facets are discussed in the theoretical section, Figure 2.

relevance in identifying and classifying the preliminary building blocks of dominant designs.

The final reorientation of the theoretical focus concerned the shifts or transformations between subsequent generations of dominant designs. At this stage I concentrated more strongly on the theoretical discussion about changing customer preferences and the role of technological progression in enabling more players to come up with dominant designs. I also reframed Teece's model (2007), making it more relevant to their evolution by starting (rather than ending) with the "transforming" phase. Likewise, I distinguished between sensing/seizing and transforming environmental conditions in their management. Thus, in a sense I returned to the classic discussion on dominant design in this last reorientation phase, although armed with new abductive findings concerning how subsequent dominant designs are created and what role the varying sources of innovation play therein. This shed light on the extent to which innovative activities are product or process led, and on whether they actually evolve in this [product/process] pattern (Utterback & Abernathy, 1975; Abernathy & Utterback, 1978), and if so, why. I also concluded that products seemed to constitute a converged portfolio in Sonera and in the telecom industry, meaning that they share the same (technological) production and process platforms, and tend to be marketed as solutions and systems (instead of individual products as was the case in the 1980s and earlier).

However, although abductivist reorientation was significant during the research, the reporting of the case and the findings is presented in a more traditional, linear and chronological way (see e.g., Järvensivu, 2007; Moisander & Valtonen, 2006, p. 174).

3.4.3 Data analysis in practice

Table 9 summarizes the actions and steps that I undertook in the data analysis, as well as the rationale behind them and the outcomes. I describe this in more detail in the following text.

Table 9. Analytical strategy and tactics

	Action	End result	Rationale
Step I	Reading the interview and archival data, organizing the data and transcripts into 1) interview themes, 2) dominant design building blocks, and 3) products/ services	Mind maps, matrices	Data is easier to analyze, patterns, commonalities are seen
Step II	Industry and case history narrative, dominant design existence, temporal bracketing strategy	Dominant design fact tables, Case narrative and Industry history (historical eras- evolution of empirical context).	Initial narratives (also to be discussed with the interviewees in the further rounds)
Step III	Inductive findings, conclusions, explanations and trends in the creation of dominant designs	Two matrices analyzing how dominant designs were created in Sonera	Dominant design creation profiles are identified, a necessary step in order to fix the analytical framework
Step IV	Teece's (2007) framework used to match and reorganize the building blocks of dominant designs as sensing, seizing and transforming	Framework for the adaptation of dominant designs (consisting of propositions)	First answers to the research questions, linking them to the dominant design discussion
Step V	Elaborating on critical questions regarding change in dominant design , the VSR model and the role of complex technological systems in the DD adaptation process	Five separate analyses: Source of innovation change in time, exploitation and exploration interchange, dominant design innovation type (Abernathy & Clark, 1985), VSR (Variation Selection Retention) change in time- in Sonera and the industry, the networked systemic innovation path	Crystallizing the answers to critical questions about dominant design change and how one company can create subsequent dominant designs and the role of technological complex systems on this (i.e. convergence of technologies and customer demand); elaborating theoretical contribution

The table 9 classifies the analytical phases in five steps. The steps build on each other and are explicitly linked to the empirical data and the theoretical framework (see Chapter 2, including the key constructs). However, by means of abductive logic I moved iteratively back and forth in these steps in the course of the analysis, and complemented earlier analysis when I gained a more thorough understanding of the cases. I explain these steps in more detail below.

Overall, the data analysis and the drawing of conclusions follow Miles and Huberman's (1994) steps: summarizing and packaging the data (here, first organizing the interview transcripts according to products and dominant-design building blocks), repackaging and aggregating, and finally developing propositions for constructing an explanatory framework. The framework is the dominant-design-management model (see Figure 23 in Chapter 4).

Step 1. I started the analysis by reading the interview transcripts several times in order to become thoroughly familiar with the data. First I read them separately, and then in comparison with others, identifying common themes, as well as product areas (and dominant designs) that were linked in the same themes. Next I linked the empirical material (interview notes and transcripts, the material shown in the interviews and supportive archival materials) in order to find support, complementary information, or counteracting factors with regard to what other interviewees had said. The grand aim was to give meaning to the data in terms of the evolutionary processes related to the creation, modification and adoption/copying of dominant designs. Pettigrew (1990, p.269) puts this point well: *"Causation of change is neither linear nor singular [...]. Look for continuity and change, patterns and idiosyncrasies, the actions of individuals and groups, the role of contexts and structures*." This is reflected in my study in the many factors combined (on the company intertwined with the industry level) that shed light on how dominant designs are created and adopted.

In drawing and verifying my conclusions I used the following tactics (adopted from Miles & Huberman, 1994): 1) noting change patterns and themes in the industry and how innovations had been created during its evolution; 2) finding out what building blocks were critical (and in what way) at different times; and 3) clustering the interview material and archival data according to the constructs of the theoretical framework. I coded all the transcripts and the related empirical material not only by product area (dominant design cases), but also according to these partly emergent theoretical themes (constituting a 71-page document).

Table 10. Example of emergent themes and product areas coding

Theme	Product area	Quote
Complementarities	Vipgate	The competitor did not have such a large operator at that time [1992], but had local telephone companies, and Elisa were forced to build the concept of nationwide one-stop shopping from bits and pieces. This explains 'the process thinking': the competitors had to engage in much more cooperation among the different actors and client companies.
Complementarities	Vipgate	The background to the VipGate concept is the fact that we [Sonera] used an intelligent network, IN, to produce services. In 1995, competition was fragmented, and local telecom companies did not have the resources to provide intelligent network services.
Modularity	Unified Communications	Transformation to the packet-switched transmission opens up the market, and there is no longer such a closed situation. This is evident in the arrival of new entrants, which in turn opens up the industry even more.
Modularity	Unified Communications	Hybrid solutions will require different levels of efficiency and capacity in the processes that manage the complete customer view, in other words knowing how one client uses the services. Sonera has historically promoted strong product-based thinking, and the organization had its own information system for every product. Now you have to have total-solution-based thinking for a certain subset of products.
Dominant logic	IP Voice (Mobile)	On the other hand, as Finland is a mobile [communications, speech in GSM network] land it has kind of slowed down this mobile IP voice breakthrough, when circuit-switched voice [GSM] is used in the mobile, and in the way that no one except the traditional telecom operators can offer it.

Table 10 gives examples of interview extracts and how I coded them by theme and case product (or product area). Thus I became familiar with the data and gained an understanding of the role of each building block (in the framework of dominant-design adaptation). For instance, Vipgate used complementary assets to its benefit, but this was not necessarily the situation with other products, as the overall role of complementarities had changed in the industry.

Step 2. I then split the industry history into different eras and case histories with the help of the rich interview material. Here I took into account where the product-development projects were situated in the company's product/service offering portfolio, and of the goals and resources in these projects. My aim was to tell a dynamic and holistic story of transformation, discussing events in the past and present, to describe the context and the action, and to identify many causes of change (Pettigrew, 1990, p.269). I checked the various relevant factors in developing the dominant designs in all cases (including validation of their existence, in other words producing evidence that a dominant design had indeed been created). I also crosschecked the cases to find common themes and differing factors.

I used the sensing, seizing, and transforming framework when I described the cases. The building blocks that trigger the transition to subsequent dominant designs are of interest in the transforming phase. Examples of such a trigger include poor company performance, a new technological or regulative event, and the early diffusion of some service in the market. It should also be borne in mind that the transforming phase is a situation wherein the company strategy and cognition (top management team, R&D, SBU, and sales management) must change. The focus in the sensing phase is on the source of innovative ideas, although it also requires action to generate ideas for and ways of changing products and services. With regard to seizing I looked at the resources, organizational structures and processes the case company used in its productization. The sensing and seizing phases also had their environmental building blocks, which I analyzed in the light of the dominant-design-adaptation process.

Step 3. In order to get an overview of the cases and how they might differ in relation to the industry life cycle and sources of innovation, I prepared matrices analyzing the innovation types in the company. The general dimensions in the matrices are the stage of the industry life cycle; the closed, semi-closed or open industry structure; and if the innovations were created endogenously (by the case company) or exogenously (by external players in the industry). They made me think about whether there were some common patterns in the success factors and trends in terms of how innovation types evolve in the industry life cycle. For instance, is a certain type (cf. Abernathy and Clark's [1985] typology and the endogenous/exogenous distinction) inferior, and if so, why? What are the key antecedents of success in innovations? I also proceeded inductively, thinking in a more fine-grained manner of the interplay between R&D and top management, the customers' role, and the company's competences in creating dominant designs.

Step 4. Next I assigned the building blocks of dominant design to the sensing, seizing, and transforming phases in accordance with Teece's (2007) dynamic capabilities framework. Within the sensing phase I first described the source of the innovation, which I scrutinized in more detail in the analysis. Moving on to the seizing phase, I described the role of the company's complementary assets and how modularity and the firm's structure enabled or hindered the creation of dominant designs. The end result was the realization of an innovation in the market (a product or service) that could be considered a success or a failure, in other words a dominant design or not. The design could then 1) vanish / be terminated, 2) be retained, or 3) modified in the transforming phase in order to 4) create a totally new dominant design for a new regime incorporating competence-disrupting technology. What also assumed significance here in terms of potentially determining whether there would be new dominant designs in the next sensing phase were the managers' current dominant logic (of how business should be done), as well as their views on technological and business convergence. Thus, I also analyzed the disappearance vs. retention of old dominant designs and convergence.

In this step I further assigned numerical values (Eisenhardt, 1989, p.543; Larsson, 1993; Mintzberg, Raisinghani & Theoret, 1976) to illustrate the importance of the different variables to each case (see Appendix 12 for details of the coding). The reasons for assigning numerical values were to cross-check the cases, find longitudinal evolutionary trends, and to identify the role of the building blocks in the adaptation of dominant designs, and how they related to each other. It was also then possible to identify further similarities, differences, and patterns across the cases – in a more systematic way than by relying only on verbal explanations.

Step 5. In order to find more robust answers to the research questions I conducted five further analyses that are also implicit in the theoretical frameworks (albeit not referring to explicit building blocks). These analyses shed light on (1) the changes in the sources of innovation that occurred over time, (2) signs of collapse in current dominant designs (Nooteboom, 2000; Gilsing & Nooteboom, 2006), (3) the type of innovations pursued over the life-cycle (Abernathy and Clark, 1985), (4) in broad terms, company- and industry-level variation in selection and retention activities with respect to dominant designs, (Durand, 2001, 2006; McGrath et. al. 1992), and (5) the analysis of a networked innovation path, i.e. the simultaneous effects in technology, regulation and capabilities in dominant design creation.

3.4.4 Outcomes of the analyses: The structure of the case findings

In sum, the case narrative and findings (including the theoretical propositions) emerged as follows. In Chapter 2 I described the company's historical eras vis-à-vis the industry, using the theoretical framework describing the emergence of dominant designs on the industry and corporate levels (Figure 5 in Chapter 2). This analysis assessed the critical events: legislative regulative issues, changes in technological and market/customer preferences, and how these affected corporate strategizing and the competitive situation in the process of adapting a dominant design. The outcome factors in this narrative were players in the industry, and selected dominant designs in the case company and the industry.

Chapter 4 describes and the historical cases pertaining to different products (or product-development projects) within Sonera. I have structured the case narratives according to the framework for creating dominant designs on the company level (Figure 6 in Chapter 2), depicting the transforming, sensing, and seizing activities related to each case. Each one was affected by Sonera-level strategizing during the historical era, and they also influenced Sonera as a whole.

Chapter 4 further analyzes and interprets the case histories in conjunction with developing propositions derived from the research questions (Chapter 1) vis-à-vis earlier theories and literature. The propositions are based on the abductive empirical findings concerning how (the source of innovation, the relations between the building blocks) and why (regulative, technological, and customer needs) dominant designs were emerging on the company and industry levels. They also relate to the appropriability discussion: who are creating dominant designs, what capabilities are appreciated in the market, and what links the sources of innovation to the industry life cycle. The framework covering the management of dominant design adaptation summarizes the findings of the propositions and refines existing frameworks.

3.5 Reliability and validity

In the following I assess the overall reliability and validity of the present study in terms of methodology and philosophical assumptions. Gibbert et al. (2008) outline criteria for a rigorous case study, including its internal, construct, and external validity, and its reliability.

Internal validity requires acceptable causal arguments and logical reasoning in order to defend the research conclusions. This is achieved here through the construction of relevant theoretical frameworks for dominant designs.

I have attempted to adhere to this principle in my study, especially in constructing two separate frameworks: one for the industry and corporate level, and the other for the business-unit level. I have also put effort into locating the evolution and events in terms of how and when the levels of analysis were intertwined.

In an instrumental case study such[55] as this, "*because the critical issues are more likely to be known in advance and follow disciplinary expectations, such a design can take greater advantage of already developed instruments and preconceived coding schemes*" (Stake 2003, p. 8). Thus, the fact that many constructs and components have been validated in earlier studies on dominant design-related matters strengthens the internal validity of the present case. At the same time, I avoided making generalizations too early. To this end, the interviews, empirical material, feedback from the transcriptions, and conclusions were reflected upon throughout the whole research process as the analytical stage proceeded for as long as necessary (see the five analytical steps in the previous section). According to Yin (2009, p.41), such explanation building improves the internal validity of the research.

Construct validity relates to the data-collection phase, referring to "*the extent to which a study investigates what it claims to investigate*" (Gibbert et al., 2008. p. 1466), and to "*identifying correct operational measures for the concepts being studied*" (Yin, 2009, p.40). From this perspective, it is useful to have many sources of data and to be able to build a chain of evidence within and across them. I sought construct validity by carefully checking the case objects (i.e. the cases and the corporate strategy), and the theoretical constructs and the related empirical material linked to them, choosing a variety of interviewees with different backgrounds (from senior managers to functional R&D experts, for example), and using my own work experience (akin to participant observation) in the company. The case histories were also peer-reviewed by the informants, thereby double-checking the validity of the theoretical constructs and the interpretations in the case context.

Thus, my data sources added robustness through the triangulation process of using multiple data sources and cross-validating

[55] According to Stake (2003), a case study is instrumental "if a case is examined mainly to provide insight into an issue or to redraw a generalization" (p. 4).

them:"*Triangulation has been generally considered a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation*" (Stake, 2003, 15). The triangulation tools used in this study were as follows: multiple interviews about products, top management expressing their views on products and providing industry-level views, rich empirical data collection, and structured and open-ended interviews. In total, there were 81 interviews and 20 follow-up questions through email. Many organizational units were embodied: SBUs, R&D organization, and top management.

External validity requires that theories generated are also generalizable to other settings. In qualitative case studies such as the present one it typically refers to analytical rather than statistical generalization (Gibbert et al., 2008). To enhance the analytical generalizability I focused on details within the case-study context (interviews, strategy material) and took a nested approach (different case studies within one organization). Moreover, I considered both successful and failed cases. In addition, I analyzed a total of 17 cases as well as the seven eras of corporate history. Eisenhardt (1989) considers between four and 10 cases a good starting point from which to develop analytical generalization, which was exceeded in this study.

Given the context, the findings of the present study are likely to be applicable and analytically generalizable to other business contexts that feature intertwining technological products and services, are capital-intensive, and have a complex, systemic business nature. The case period is also of sufficient length, enabling observation of the different roles of the company in the development of dominant designs: at times it was a pioneer, and at times a challenger. This aspect also widens the analytical generalizability.

Elaborating on the theme of external validity, Eisenhardt and Graebner (2007) further ask, "*How can there be rich description of all cases and at the same time robust theory testing and formulation*?" (p. 29), also proposing a solution: "*develop a theory in sections or by distinct propositions in such a way that each is supported by empirical evidence*". To this end, the case histories constitute rich descriptions, and propositions are formulated based on empirical evidence in the analysis section.

Finally, the *reliability* of the case study refers to transparency in the data collection and analysis. In other words, the empirical procedures should be apparent and understandable to other researchers (Gibbert et al., 2008; Yin, 2009). I sought to achieve such transparency by carefully documenting and explaining the data-collection and analysis procedures

(Chapter 3). I also followed the same procedures in all the cases, at different time periods. Moreover, I created a case-study database.

In terms of transparency, real products and businesses were studied using real names. Thus, the case company and the set of dominant designs analyzed could also be assumed to be valuable as an identifiable case example in its own right (Siggelkow, 2007, p.20). In addition, corroboration is reflected in the fact that the respondents commented on the conclusions and answered various follow-up questions.

4. Analysis

In this chapter, the empirical case history (products and services) and an analysis of the nature of dominant designs and their evolution is gone through in the following way. In this chapter, the empirical case history will be structured as follows. I will go through the cases by applying the theoretical framework of dominant design creation *within the company, at the level of business units* and their products and services (see Figure 6 in Chapter 2). This empirical case history complements the industry and corporate level empirical account of Chapter 2 (which applied the theoretical framework regarding dominant design emergence at *industry and corporate levels*; see Figure 5 in Chapter 2). However, the historical descriptions at these two levels of analysis are naturally interlinked, as both theoretical frameworks share some facets (Figure 5 and 6).

As outlined in the framework (Figure 6), each case is described in this chapter according to Teece's (2007) framework of the modes of dynamic capabilities (sensing, seizing, transforming). Furthermore, as in the framework, the cases are structured through the relevant "building blocks" of dominant design management, that is, the firm and environment-level factors that can enhance or inhibit dominant design adaptation process (i.e., dominant design creation and/or adoption) at a firm (also in Schilling, 1998). More specifically, the building blocks comprise the following dimensions: managerial and organizational processes, capabilities, environmental changes and conditions (e.g., technological change and appropriability), resources, and finally innovations.

Thus, the case history is organized as follows. First, I describe the background of the product/service central to the case. Second, the transformation from the previous product generation is described. Third, I proceed to examine the processes of sensing ideas, and fourth, I describe the seizing phase activities and environmental conditions and the resulting dominant design characteristics. Finally, as the majority of cases in this study transformed to follow product generation, I describe this process and summarize the adaptation process (see Figure 6). That description is organized around transformation, sensing, and seizing with identified building blocks in these categories.

This Chapter further analyses and interprets the case histories, and their interlinking to the industry and corporate-level historical eras described in Chapter 2. These interpretations, vis-à-vis literature related to dominant designs and industry evolution, are used to set out the key findings of the study in the form of a set of theoretical propositions.

4.1 Empirical case history (products and services)

4.1.1 Service numbers

Background

Service numbers have two basic product families: Toll-free service numbers and premium service numbers. The numbers have been developed to meet different user needs, although they share similarities. A basic principle is that toll-free service numbers (launched in 1987 in Finland) are free to the end caller and premium service numbers (launched in 1988 in Finland) have a variety of prices. Toll-free service numbers are used for example in customer service (call center services). Premium service numbers have a different function; they make it possible for service providers (e.g., telelawyers or providers of hotlines) to do business in the telecom network. This also means the service providers can choose the service category according to their business: public service needs, information services (e.g., a distribution channel for companies), or entertainment.

The technological solution in service numbers is to route incoming calls to an answering point specified by the company receiving the calls. An *Intelligent Network* is used in this routing procedure and billing of the service numbers. In general, the aim is to provide services related to intelligent information transmission and delivery, in the telephone network (Sonera service description, 2009; Takala et al. 1994)

Transformation from previous product generations

In the present case of the service numbers business, there was no previous dominant design solution (or even an idea of a solution) in toll-free service numbers by the mid-1980s because of the absence of cost-efficient technology. Calls to a company were either forwarded via an operator or via some Direct Inward Dialing (DID) numbers. The term DID mean that an individual extension on a Private Branch Exchange (PBX) can be reached directly via its own standard outside number. Fixed voice business—such as trunk calls in the Public Switched Telephone Network (PSTN)[56] network—was a predecessor of toll-free service numbers. For their part, premium service numbers had previously been more like separate services, the business was a closed vertical system. An example of this was 'Neiti Aika' (the speaking clock in 1986), but these were more like operators' fully-owned and operated services (rather than services operated by third-party service providers).

The development in the market and technology gradually allowed the service number business to develop. Companies wanted to offer free customer service and centralize their contact centers. In the premium service numbers arena, a need was outlined in the market for new kind of value added service business, and Sonera also noticed it could create a new kind of open business ecosystem. Technology, largely originating from the USA, made the realization of this need possible. The development of Intelligent Network (IN)[57] at AT&T and Baby Bells (U.S. telecom companies) was rapid in the 1960s, accompanied with the invention of a voice response unit (VRU). VRU is a technology that allows a computer to interact with humans through the use of voice and Dual-tone multi-frequency signaling (DTMF) tones input via keypad. Consequently, new convergent types of services could be generated in the telephone network. Convergence as used here means that new technology was integrated into a telecommunications network in order to create a new type of business (e.g., Customer Relations Management [CRM][58]), as distinct from early voice transmission services.

[56] A term for all the publicly available, interconnected telco networks.

[57] The Intelligent Network (IN) is the standard network architecture specified in the International Telecommunications Union (ITU). The intelligence is provided by network nodes on the service layer, distinct from the switching layer of the core network, as opposed to solutions based on intelligence in the core switches or telephone equipment.

[58] CRM can be understood as a customer service and marketing support system, which has same purpose as service numbers. Sonera pioneered these types of systems in the early 1990s.

Sensing

Service numbers were a new business area and therefore it was natural that the area was not overly regulated, even in the consumer segment[59]. Only later, in the early 1990s, did business come to be regulated and an ethical code (including e.g., content of services and price levels) was set for running the business by the telecommunications operators themselves.

The sensing of ideas, not constrained by legislative regulation, had two main sources. First there was the R&D capability to tap into, learn, and develop the products that were in use in Great Britain (premium service numbers with limited functionality) and the USA (toll-free service numbers). Second, the market need was identified in the company by listening to customers in Finland, as described below.

The toll-free number idea was originally imported from the USA and was used in Finland to manage customer service operations. It was understood that customers of the telecoms companies wanted to improve customer service and to refocus and concentrate on their contact centers, and also to allocate their functions freely, or at least in a manner unrestricted by telecom infrastructure.

"Service numbers, especially this freephone [toll-free service numbers] was exactly targeted to these big corporations' customer service needs. This business was already happening in the USA in the 1980s with the freephone 800 number, and we wanted to help the customers by making it easier for their customers to call their customer service department" (Informant 34, Quote 1)

A new department, a test-lab, was established in Sonera in 1987. It was called the trunk network's value-added services. The unit was very entrepreneurial in nature, as evidenced by an acceptance that six out of ten projects would be failures. The unit was autonomous and enjoyed the support of senior management. It was found that the service numbers could be created in telephone centers, progressing from earlier Direct Inward Dialling (DID) solutions. Sonera's premium service numbers were globally pioneering.

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[59] Typically in telecommunications, the B2B-oriented domain is not regulated. In turn, authorities pose strict demands for service levels, price levels, etc. for the consumer and wholesale segment.

"..The USA had freephone services and then we invented a system that let the trunk network's 'mechanical counter'[60] functionality to be put onto the server, and then we could have different prices billed from each customer. This was the way the so-called premium rate services were modified and created in Sonera in Finland. The freephone was developed as a premium rate in Sonera." (Informant 7, Quote 5)

"I remember there was one company called Super Call in London, it had these service numbers but there was only a day rate and an evening rate. My colleague then remembered that we already had these similar types of service numbers like a weather line aimed at farmers etc. in Telecom Finland. These calls were routed through international telephone centers. It was important there was price differentiation in them, already more diverse than in everywhere else. Then we thought about this business and my colleague was a telephone exchange expert, he remembered that we had 12 different price classes in these exchanges. The cheapest price class was one Finn mark and the most expensive was 17 Finn marks—and then we just routed 9700 calls through these international exchanges, and created the premium service number business" (Informant 39, Quote 1).

Seizing

Toll-free service numbers were the first service numbers introduced in Finland. The idea was that the caller could call from anywhere in the country to certain numbers so that the call receiver paid for the trunk call. The 9800- toll-free service was developed in close cooperation with Ericsson, and the telephone exchange's own computer was used to create the service (Turpeinen, 1996).

The progression in the billing method, complemented with Sonera's technological expertise in managing the interactive voice response (IVR) process, aided the diffusion of the service business area. One example of this pioneering work was a CRM solution created for Postipankki (Postbank) as early as 1992.

The 9800 toll-free service was developed to be cost free to the caller when calls originated from Sonera's own local network area (earlier the caller had to pay the local network charge). This happened in 1991. Later, the calls also became free from competitors' network areas, because it

[60] The mechanical counter gives billing pulses in a trunk network (i.e., the technical infrastructure used when billing foreign and trunk calls in telephone centers that time).

became possible for an operator to buy access[61] capacity from a competitor, and consequently price their own service as an end-to-end service[62].

In turn, a new nationwide premium service called 9700-Teletori [TeleMarket] was launched on 6 September 1988. It was promoted as the world's most developed information service, partly because service providers were given 12 different payment classes in the trunk network. The service providers created the content (the actual service) and promoted the service to their end users. Sonera charged the end user on their phone bill, deducted its own commission, and forwarded the remaining money to the third-party service providers (Takala et al., 1994). So, in a sense, Sonera learned ecosystem and modular processes management though it was a closed integrated company at that time. Prices varied from one Finn mark to 18 Finn marks per minute. The service was totally unique (Turpeinen, 1996).

The initial technological solution relied on manual processes. IN was not used at that time for service numbers, and the calls were routed through telephone centers for foreign calls, which already had different tax classes and physical billing sections for calls to different countries. Only later were service numbers standardized in the European Telecommunications Standards Institute (ETSI) and ITU, and fully implemented with the IN.

The innovation characteristics can briefly be described as follows in the service number business area: Service numbers served new customer groups with new a technology adopted and nurtured, and used for new applications (Abernathy & Clark, 1985).

There was a strong appropriability regime and option to have a business risk-based fee to underpin pricing (as the legislative regulator did not control the prices). Thus, Sonera profited from its innovations and managed to diffuse the services. There was also encouragement inside the

[61] The telecommunications network is divided into access, transmission (trunk) and termination networks. Access refers to the non-traffic sensitive part of a network. It provides subscribers with access to the core network. Access is often termed the 'last mile' to customers' premises, where a customer has its end-device, e.g., a telephone. A call (from a caller to a call receiver) is divided into outgoing, transmission, and downward traffic.

[62] Previously, a customer paid separate fees to the operator, who owned the network. For example, when calling in HPY's network, a customer paid Sonera and Elisa. In this case (end-to-end pricing), service number calls are invoiced for on the same invoice as the other call types the customer has.

company to experiment with new businesses in premium service numbers. Importantly, the services were available at national level (a national number) regarding the possible billing mechanisms, which helped create a new service ecosystem. A new open-value network (a win-win ecosystem) was created.

At that time, Sonera still held the monopoly over trunk and international calls, a significant technological asset. Using their trunk and international telephone exchanges, Sonera added premium rate and 800 numbers to that infrastructure. The competitors were local operators and they had no capability to create a national service. There were no actual bottlenecks in production and the investments were profitable as one respondent at that time explained:

"We had no trade-offs in production so that the operator had quite a strong position. This meant that we could accomplish these pricing mechanisms with a good contribution margin for ourselves. On the other hand, we have had this telecom network infrastructure on our hands [IN and earlier trunk telephone switches]. This means that services can be used from all kinds of subscriptions and there is no bottleneck from traffic volumes that could place limits on these services. We also tried to develop this customer intimacy more than technology—as long as it was reliable enough and we had enough capacity—but of course it must be admitted we benefited from the unique situation we had in the beginning. Sonera had the tools and the competitor did not, and we had the time to design the services thoroughly and in a timely manner." (Informant 34, Quote 2)

The entrepreneurial spirit was also very strong at the time:

"Service numbers were the biggest growth areas for Sonera at that time. In retrospect, I could note that the pricing policy and business risks taken by the telecom operator would not be allowed today, because the pricing must be a cost-oriented wholesale price." (Informant 39, Quote 2)

The resulting dominant design characteristics

Toll-free service numbers already had a dominant design in the USA in the 1980s. In Finland, Sonera developed the service and was the first to adopt it. In turn, Sonera was the first telecom firm in the world to develop and implement premium service numbers in terms of comprehensive billing solutions and ecosystem creation capacity (Laaksonen, 2007, p. 223, interviews, Turpeinen, 1996). Sonera also held the leading market share in service numbers in Finland and the service was Sonera's most profitable business ever. Elisa (then HPY) also followed Sonera in this business area, adopting the same business model. In sum, the key dominant design features in service numbers (both in toll-free and premium) were that a customer could choose the fee rate of the service based on content, national coverage, pricing and income distribution model and the smooth management of the calls.

Transforming (to following product generations)

The growth curve of premium service (0700[63]) numbers was very steep, pointing to the strong latent need for the service. The toll-free (0800) service had a different growth profile from that of the 0700 service: growth was steady but not so steep.

The new 9800 toll-free number was a forerunner of services created in the Intelligent Network (IN). In 1988, the 9800-toll-free number was only the beginning of a wide IN development process, which would "connect telecommunications and information technology, also managing networks and services" (Turpeinen, 1996). The 9800 service itself enjoyed a 90% market share in Finland in 1993 (Annual Report, 1994). Eventually, there was product differentiation to meet new needs. In 1991, an automatic telephone system (APJ) was introduced along with interactive voice response systems (IVR) (Sonera Annual Report, 1992). 1993 saw the introduction of 0600 numbers (e.g., online services, such as expert advice or taxi firm hotlines), followed by low-price service numbers that commenced with 0203 in 1995 (priced at the level of a local call). Sonera's market share of the premium service number business was 70% in early 1995 (Turpeinen, 1996). Later on (in the 2000s), the 0700 service numbers were partly substituted by internet services and Short Message Service (SMS), but toll-free service numbers would still be used to operate customer service, and the service's role has remained stable over the years. In addition, in the business area of toll-free service numbers, an Attendant (a switchboard operator) service was later created, in line with the earlier CRM pilot from 1992.

Table 11 below summarizes the transforming, sensing, and seizing phases building blocks.

[63] 9700 and 9800 numbers were converted to 0700 and 0800 when the Great Numbering reform took place in Finland in 1995.

Table 11. Transformation, sensing, and seizing phases in Service numbers.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/company. In *premium service numbers,* there was a closed operator owned business model and services, and pricing was cost-based. Management discovered that pricing could be value-based and third parties could provide content to services. In *toll-free service numbers (Call center type)* firms arranged their call center function earlier so that customers called through telecom operator (attendant) or by some direct numbers (Direct In Dialing) to companies with an existing telephone network. Management discovered telecom operator could arrange the call center function so that it would separate place and time, i.e., so that call centers could be concentrated. **Convergence creation in company.** Capacity was created in Sonera to create a new value-added business in telephone networks. Processes were developed to integrate the telephone business and value-added services, and also service providers into Sonera's business model. **Market change in industry.** *Premium service numbers*. Service providers wanted a new business. Cultural change occurred because the telephone could be used to purposes other than talking. *Toll-free service numbers*. A call center function was needed in order to improve customer service. **Technology change in industry.** New cost-efficient technology that offered new functionality emerged in the USA, such as VRU and later IN. DID and telephone network (PSTN) were replaced.	**Regulation in industry.** There was no regulation of the service number business creation. **Source of innovation.** The business area management sensed that new service opportunities had to be identified globally. To do, so an entrepreneurial business unit was founded. The business area management sensed that R&D capability was needed in order to learn about and develop services, accordingly. Tele Research Centre was used. For the first time, the emphasis was on creating new markets and shaping market behavior.	**Standards in industry.** No de-jure standards existed. The Intelligent Network, Voice Response Unit and profit delivery mechanism were enhanced and developed further in Sonera. **Network effects.** A process to manage service providers (a billing process) was successfully developed. Sonera's infrastructure helped to diffuse the service rapidly. End customers could use the service easily, and accordingly, customers could expand their business smoothly. **Complementary assets.** Sonera's key assets (capacity in network, a monopoly over trunk and international call business, switching centers, billing procedures, Intelligent Network) were used. **Modularity management.** Modular numbering management with IN was carried out. Sonera rented platforms and recording capacity, and offered financial services to service providers. **Firm structure.** Part of Sonera's closed infrastructure was also used by service providers. **Ecosystem/Partners.** A new open win-win ecosystem was created by creating a new type of value chain using active premium service numbers and marketing. **Innovation type.** New customer groups with new technology were adopted and nurtured and the technology was used in new applications. The ecosystem was important to service diffusion. **Technological competences.** The IVR process, billing, the CRM process, expertise in switching centers, and IN knowledge were the key technological competences. **Appropriability for Sonera (and telcos).** A business risk- based fee was approved to be included in pricing, no real substitutes for service numbers emerged.

4.1.2 Telematic services: TeleSampo

Background

The concept of telematics[64] was born in France 1977, when the country started a considerable tele services development program (Kerttula, 1987). TeleSampo was built on progressing the European telematics standards.

TeleSampo was commercialized in May 1987 and it was terminated in 2004. TeleSampo was a commercial name for the videotex network, a telematics service network, one type of telematics service, developed by Sonera. The network was implemented in a data network and was a dispersed gateway type based on the use of Sonera's old DataPak network (i.e., its first packet switched network). The open system interconnection (OSI) model was used as architecture in the service. The dispersed nature of the network was a key element when trying to replace the earlier closed networks. The network enabled the use of videotex services (portal services to different databases, ordering services, bulletin board services, access to other videotex systems in Europe) and other services (for example e-mail, then named Telebox).

Transformation from previous product generations

Usage of information technology was increasing in the 1970s and this growth necessitated connections between computers and information systems. The earlier dominant logic was that there were separate information network applications for different purposes, for example in the banking, wholesale, and traffic business. These applications were run by the companies themselves, not by telecommunications companies (neither by offering managed infrastructure nor by offering platform services connecting the customer company and the end user together) (TIEKE, 2001).

The earlier videotex applications in use, for example Minitel in France, were considered closed systems. Interactive services were clearly needed by telecom operators and customers, because there was extra capacity in data networks, and new business concepts were few and far between. TeleSampo developed into the same kind of market as Internet services ten years later. The new market was associated with dispersed online

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[64] Esa Kerttula (1987) defines telematics as communication enabled by computers. The concept of telematics was born in France in the late 70s. Telematics comes from the words 'Telecommunication' and 'Information', and their synergetic collaboration.

services (banking, e-mail, shops) as well as consumers' end devices. Typical examples are visible in TeleSampo's commercial slogans at that time: 'TeleSampo – electronic marketplace' and 'With MicroPC to the World'.

The promotion of convergence in TeleSampo was challenging. There was a need to integrate telephone business, datacom networks, value-added services, and service providers in Sonera's network and business model. In addition, TeleSampo's services needed to be easy to use, well segmented, have a common network infrastructure, and moderately priced end devices.

Sensing

Standardization bodies and governments in Europe (especially France) were interested in telematics and advanced the plans to create information societies and technology in order to create a new kind of business in data networks. The public sector was also active in developing information society thinking in Finland and took telecommunications operators along, developing common information networks for Finland (e.g., TietoSampo [InformationSampo] project in Sonera).

Prestel, one type of telematics application, was the starting point of videotext. Prestel was an information query tool developed by the British Post Office. In Finland, videotex was first used in Helsinki 1978. It was called Telset, being the second service of its type in the world after Prestel (Tarjanne, in Teletiedotuksia, 1987).

Informants described the basic functionality of videotex and telematics and the reasons why these were developed.

"Videotex was an innovation that arose when the British started to think about information services and then they invented teletext to utilize the spare capacity on TV channels for videotex services. The other reason was that the telephone was popular in the 1970s but its, and therefore a telephone network's, usage was minimal. There was a need to increase the usage of the network; still the whole product (ultimately videotex) was too complex for users. The only thing which made the breakthrough a dominant design was this teletext." (Informant 52, Quote 1)

Prestel was, however, a progressive attempt to create videotex. A Finnish key person in Sonera's telematics area comments.

"TeleSampo has been called videotex before and it started already in the late 1970s, at the time of Prestel in Britain, but the Prestel technology was totally different and it was managed with the TV. However, videotex and TeleSampo used a normal end terminal, either home computers or VT100 or VT200 terminals [a video terminal that was made by Digital Equipment Corporation (DEC)]. An important factor was that home computers only became widespread after 1981 and TeleSampo's development actually gained momentum in the mid-1980s.This TeleSampo started from the fact that we developed a smarter system than other videotex systems at that time. Germany had Bildschirmtext, which was sold to the Swedes for big money, but it didn't work even once, while we launched our own TeleSampo service with VTT with smaller resources. There was only 10–20 million Finn marks for that TeleSampo project, it was technically very smart still had poor functionality…very clearly ahead of its time but it never achieved dominant design appeal with its ecosystem and marketing ideas" (Informant 51, Quote 1).

The creators of TeleSampo considered the deficiencies of earlier videotex systems. Traditional videotex systems were developed from an application not with a larger communication mechanism and infrastructure in mind. In contrast, TeleSampo used many technology protocols, attracted service providers into Sonera's network, and created portals and closed user groups. TeleSampo was compatible with the following end devices and protocols: ASCII (American Standard Code for Information Interchange), Prestel, CEPT, NAPLPS (North American Presentation Level Protocol Syntax), or a home computer that had an emulator.

TeleSampo was considered a flagship product by top management. One manifestation of this was that when Esa Kerttula (the Director of the Unit) had the idea for the name of the service, and it was immediately accepted by Managing Director Aulis Salin. Telematics was also made a profit center unit in the company in the new value-added services area (Appendix 3). However, as the unit was pioneering technology-oriented SBU, other organizations in Sonera saw it as a 'money hole'.

Seizing

The planning and implementation of the Finnish telematics access network, TeleSampo, was conducted in cooperation with VTT (the Technical Research Centre of Finland) between 1980 and 1986. The network, also called Videotex, was different from other telsets[65] in that it could be nationwide. Moreover, it created its own standard, called

[65] In Finland, in the Helsinki area, limited Videotex business and technology experimentations were made in 1978, based on the Prestel model. These projects were undertaken by Sanoma Oy, Nokia, HPY and Sonera. These businesses were called 'Telset' (s); Sonera's similar type of service was called Videotex service.

Telematic Access Point (TAP). However, the adoption was not rapid, as is expressed in the following quote.

"Videotex did not reach the targets set; the exception being in France. France has today (1986) almost 2 million Minitel-terminals and at the turn of the century that figure is estimated to hit 8 million, covering 15% of the population. In Finland, we should have in the same proportions by 1990, 750 000 videotex terminals. [However], the forecast for terminals in Finland is 20–30 000." (Tarjanne, 1986)

The dispersed interconnection network used Datapak for the new videotext (Figure 12). Access was available nationwide, to different services (e.g. a Telebox-messaging service), and also to other online databases and information systems.

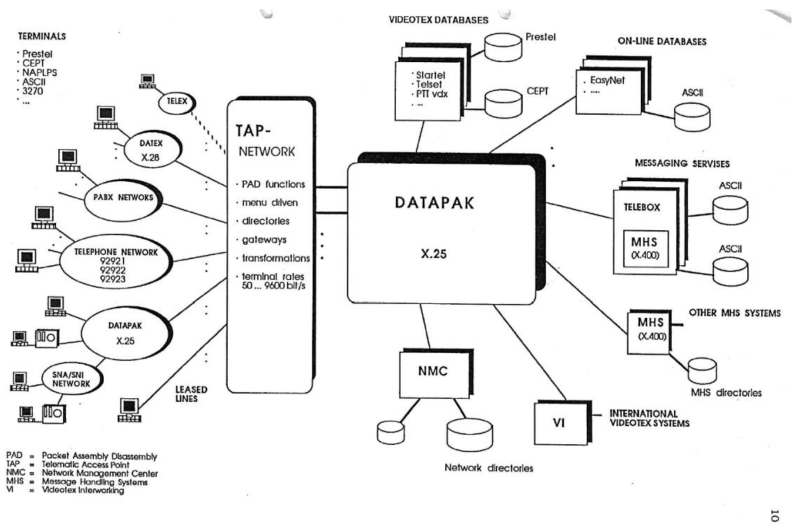

Fig. 3 GENERAL ARCHITECTURE OF THE TELEMATIC ACCESS NETWORK OF FINNISH PTT
Part 1: Terminal support (1987)

Figure 12. Telematic access network architecture. (Kerttula, Esa. Yleinen tiedonsiirtoverkko käytännössä:TeleSampo, tietoa yhdeltä kanavalta. Lappi tietoyhteiskuntaan III-seminaari 1.2.11.1988).

Figure 12 depicts the TeleSampo architecture in Finland. It describes the infrastructure type of the service. The Telematic Access Point (TAP) - network (decentralized into telecom areas throughout Finland) infrastructure was used, in order to use various telematics services. However, it was already obvious in the planning stage, that the 'intelligence' of the service must be located at the edge of the network, not in end terminals. This was a drawback when considering the case later when the Internet with its related technology inventions appeared. It later became apparent that TeleSampo was a closed system after all.

However, it was apparent even at the start of TeleSampo's development that the sales function, a critical element in order to create a new infrastructure, was a bottleneck. In addition, interviewees reported the ecosystem growth in the data network was more difficult than in voice services (service numbers) due to the requirement for users to be able to use a micro PC. TeleSampo's technology was based on telephone networks using modems, which were different from today's data solutions (e.g., Digital Subscriber Lines (DSL) [a family of technologies that provide Internet access], servers, routers and the Internet). In addition, TeleSampo had a very small developer community compared to, for example, CERN (The European Organization for Nuclear Research) organization, which targeted developing a large dispersed system.

The business model of TeleSampo was novel at that time in the sense that it integrated service providers into the system. Sonera made revenues from two sources: from its own traffic infrastructure and from service providers. However, it took a long time for the environment to accept the new kind of ecosystem:

"TeleSampo had business targets from the beginning, the first was to create new services that bring traffic revenue to networks, because there was plenty of free capacity in telecom networks after automation. The other point was this kind of vision about interactive services, that people start to consume services through information networks and there will be information societies, also this kind of information society thing was present in the 1980s…TeleSampo was a new delivery channel for services and it takes time to establish a new channel to become a complete functionality channel. One example was SOK [the Finnish retail group] in the 1980s when it moved to videotex ordering channels." (Informant 52, Quote 2)

However, TeleSampo remained a relatively closed system, and did not manage to create a widely accepted infrastructure and user base, in other words, a strong ecosystem.

The resulting dominant design characteristics

TeleSampo was the nationwide and technological market leader in Finland. At its height, TeleSampo had 60–70% market share in Finland. In Finland Sonera's competitor, Elisa, developed its own similar type of videotex called Infotel. The similarity of the services was evident, as there were plans to merge the two systems together when there was pressure to increase the usage of videotex by having a unified marketing message to consumers and industry. TeleSampo had an early, though limited, ecosystem (e.g., service providers, sub networks [currently called portals], and end device vendors).

In addition, the potential of TeleSampo's dominant design was evident as indicated by the considerations of licensing TeleSampo's infrastructure type of technology globally. However, the dominant design characteristics of TeleSampo were limited. The following discussion of the differences between TeleSampo and the Internet (which eventually replaced it) clarifies this point.

The Internet in its mature form (after 1990) was highly decentralized in that it was essentially a federation of thousands of service providers whose mutual cooperation made everything run. Furthermore, the various hardware and software components of the Internet are designed, manufactured, and supported by thousands of different companies. (Kavassalis and Solomon, 1997) TeleSampo had high networking targets, but some customers complained that Sonera did not offer a proper infrastructure to connect customers to databases (TeleSampo customer survey, 1990). In line with this, Sonera also analyzed TeleSampo against the Internet, and concluded that the Internet's inventions (html language, http protocol, and URL links) would have helped TeleSampo to grow faster. The key point was though, that while TeleSampo was created for the same kind of market as internet services (decentralized online services), the technology was in its infancy at end terminals before the Internet (as the personal computer spread to consumers only in the mid-1980s), and the TAP protocol was not in end terminals but at the edge of the network. The usability of the service might have been better if the TAP protocol, 'the intelligence of TeleSampo', was in the end terminals.

Transforming (to following product generations)

The slow diffusion of TeleSampo affected TeleSampo's life-cycle development, in terms of (1) targets set by top management and (2) the Internet, with its global diffusion and new greater usability compared with earlier videotex type designs.

The top management, business units, and consultants discussed TeleSampo's future in 1990. One view expressed was that too much had been invested in TeleSampo because it was originally considered an infrastructure product. The top management view changed, and TeleSampo was later seen as merely a value-added service above normal data products. There were also arguments that in the corporate B2B segment, TeleSampo's technology would become outdated while awaiting the new Local Area networks' (LAN) connectivity and dynamic networks.

These new networks in customers' use would replace TeleSampo (Source: Internal Report, 1990).

Differing views about TeleSampo were presented in the business unit.

"Strategic investment in TeleSampo is not possible through baby steps in a competitive environment without developing basic networks with infrastructure products. When Sonera's organization was changed two years ago, also TeleSampo's nature changed as it became a short-lived value-added service no longer having any strategic nature …We have clear backing for TeleSampo in the form of 700 000 terminals in offices and homes, we have services on computers and we have networks, there is a clear need to connect terminals, services and networks with TeleSampo. TeleSampo will offer ways to overcome the following current problems: different protocols and user interfaces, contract difficulties, no menus in services, difficult billing methods, and customers are served as a secondary function. In sum, as long as the strategies in telematics are part of monopoly telecom business and muddled international tele services and top customers selling strategies named "value-added services" there are no routes to success." (Informant 51, Quote 2)

The Internet spread quickly from 1994 onwards (Kerttula, 2004). Internet technology was different from that of TeleSampo. TeleSampo's services (for example portals) were realized through Internet technologies with a larger volume. The global standards of the Internet's html language, http protocol, and URL links enhanced the service diffusion globally to large volumes of people, and offered a true dispersed open network. One key here was the ease of use.

TeleSampo was transferred to the Internet later, and the development of a graphical TeleSampo, for instance, was frozen in the face of the burgeoning Internet use. The public sector (TIVEKE-programme, TELMO-programme, in TIEKE, 2001) "*was not…surprised about the advent of the Internet, but merely by the speed and nature, how the global network in the end was actualized*" (TIEKE, 2001, p. 22). The key thing was the easy-to-use user interface compared with other technological standards. It had been thought earlier that there could not be a properly functioning information network without robust central control (by telecom operators), which the advent of the Internet proved to be incorrect.

Table 12 summarizes the transforming, sensing, and seizing phases building blocks.

Table 12. Transformation, sensing, and seizing phases in TeleSampo

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. The industry had limited (interactive) value-added data services, i.e. only text-TV existed in Britain. This was not considered telcos' business, because these value-added data services were run directly by companies. The Sonera management discovered interactive portal services (i.e., 'pre-internet') could be created both for consumers and companies. For companies, the purpose was to create data networks, i.e., 'intranets', as well as sales and ordering channels directed at third parties. **Convergence creation in company.** Efforts were made to create a new business in data network, in terms of customer service usage experience, integrating elements of telephone network, data network, and third parties' infrastructure. **Market change in industry.** Customers needed a new marketplace in data networks, as well as an ordering-channel, intranet. Logistics arrangements in companies were in flux. **Technology change in industry.** Free capacity emerged in the telephone network, and initial efforts were made to integrate telephone and data networks. Teletext and Videotex (i.e., interactive services) emerged as new technologies, also later EDI (Electronic Data Interchange).	**Regulation in industry.** As TeleSampo was a business to business product, regulation was minor. **Source of innovation.** The business area management sensed that earlier standards needed and could be developed. Also, active scanning of ideas in CERN (European Organization for Nuclear Research, the birthplace of World Wide Web) was made in order to develop the service in Finland. The top management sensed that a new entrepreneurial, growth seeking business unit was needed. Consequently, a Telematics business unit was founded. The top management sensed the importance of telematics in creating a new Information Society for Finland, both to consumers as a digital marketplace and to companies as a logistics system.	**Standards in industry.** Sonera enhanced Europe-wide Videotex standards in Finland. This was manifested in TAP (Telematic Access Point) innovation, which integrated telephone and data networks. **Network effects.** There were limited network effects due to issues over service usage (e.g., cumbersome directories, registration, and complicated billing procedures). Internally in Sonera, there were competing business areas, differing views about the service's nature (top management vs. SBU). **Complementary assets.** Free capacity in networks was used in TeleSampo. The business area management thought there was insufficient usage of Sonera's sales function. Later, conflict emerged between top management and the business units over whether the product should be an infrastructure product or only an add-on service in the data network. **Modularity management.** There was an aim to develop a service that would support many end devices and create an open system. Portals, access to online databases, e-mail (Telebox) and closed user groups were made. **Firm structure.** End user was linked functionally in a limited way to Sonera's and the service provider's closed infrastructure. **Ecosystem/Partners.** Efforts were made to sell the idea of new delivery and logistic channels to companies, e.g., retail, wholesale and travel companies. Top Management concluded that effort was not successful, due to emerging competing solutions in the market (e.g. DataNet). **Innovation type.** TeleSampo served new customer groups with new technology. **Technological competences.** Development and implementation of Telematic Access Point, and enhancing earlier standards were the key technological competences. **Appropriability for Sonera (and other telcos).** Capacity in Sonera's networks could be fully used for new services. The business was, however, not profitable and needed infrastructure investments. In addition, substitute products continued to enter the market (e.g., companies' own logistics systems, value-added services in the telephone network, i.e., service numbers.)

4.1.3 Vipgate VPN

Background

Vipgate was a service and a service platform for companies' voice communication. Vipgate enabled companies to manage domestic and international, as well as internal and external, voice traffic with a better quality than using the traditional, public switched telephone network (PSTN) network. At first, direct lines were built between companies' switches in order to build a switch network. With its Virtual Private Network (VPN), an Intelligent Network (IN) technology, Sonera could implement these switch networks more flexibly than with direct lines and competitors, and so offer communications solutions to companies. The key point was the ability to create virtual networks, also enabling a numbering solution to a company beyond the PSTN numbering. The numbering solution supported calling with short numbers, for example. The service was completed around 1990–1991. At that time, Vipgate was a product name for the VPN service.

Transformation from previous product generation

There was previously no solution to companies' voice communication issues, as calls were traditionally routed through an operator (albeit that some direct in dialing [DID] numbers were in use). Trunk calls were used, which offered no functionality over and above basic phone calling. Previously, the networking service had been provided with expensive fixed leased line capacity, as calling a company's office was executed through public network numbering.

The first Vipgate product was a service called Vipgate VPN (Virtual Private Network). Through a virtual private (corporate) network, internal numbering was created to all sites connected to the network, thus creating convergence in creating a switch network and unified numbering. VPN could also be implemented by connecting small sites to the existing fixed switch network. At the same time, in the VPN, customers did not need to invest in their existing switching centers or build new ones. In the market, there was a need to create private networks, that is, voice communication networks by connecting the PABX's (private automatic branch exchange) employed by a particular private company (Lynross, 1996).

The competition started in this business segment in the mid-1980s. The local telephone companies feared Sonera would capture the corporate customers bypassing the local telephone companies' area network and connecting directly to Sonera's trunk telephone exchanges.

The Ministry of traffic estimated that about 6% of Finland's telecommunications was exposed to the competition following the decision to grant operating rights to Yritysverkot and Datatie (Häikiö, 1995, p. 92). Yritysverkot especially targeted these local telecom competitors' profitable B2B areas that were now open to competition, also by creating the VPN product.

This landscape describes the previous dominant logic in competition. Competition was not allowed on a large scale but at the same time, technology adoption occurred in Sonera and the firm considered how to take advantage of the regulative situation to attack competitors' areas.

Sensing

People in Sonera sensed a transition from the earlier situation and new business opportunities, where there were no (virtual) corporate networks service or the subsidiary of Sonera, Corporate Networks was not active. Virtual corporate networks were important especially in the competitors' areas. Sonera's Managing Director, Aulis Salin, commented that it was necessary to have the option to offer corporate customers local subscriptions, in order to link the customers to Sonera's national network services. Corporate networks, a newly founded subsidiary, got the chance to offer 2Mbit, mobile, analogue, and ISDN connection traffic for companies directly, but not to offer local switched traffic. This was important, as the business was now totally in the hands of Sonera, and there was no obligation to pay network compensation fees to Elisa, for example, for down warding/terminating traffic into Elisa's local access network.

A key antecedent to Vipgate VPN was top management's interest in gaining access to the corporate segment in competitors' local areas, which were previously local operators' monopoly areas. All available technology was adapted (e.g., VPN, 2Mbit connection, approved by a legislative regulator) and developed to this end. Market need and opportunities were prioritized: The target was for Sonera to have Finland's top 3000 customers (by turnover) and to reap the associated large gains from the local market. The local telephone business was estimated to be worth 4,000 million Finn marks (in comparison, the earlier key product was trunk calls, with only 700 million).

It was felt that VPN could simulate fixed switch network connections. VPN technology made the same functions as cost-effective as if the customer had networked its own PBXs' (Private Branch Exchange) with fixed connections.

Seizing
The corporate subscription product that Sonera used in VPN was created at the same time (TeleGate voice services, 1994, Sonera). By 1992, Sonera was also investing major sums in its trunk network and the local network in its competitors' areas in order to run increasing traffic amounts. Much of that investment involved installing fiber-optic cables.

Corporate subscriptions were finalized and the local telecom companies' network was bypassed. Corporations' internal switchboards were connected and company sites were networked. The concept of Vipgate VPN was the first communication service based on virtual technology in Finland, which shifted Sonera towards an offensive stance from one of defense.

Below, three experts clarify the technical steps taken in 1991, also pinpointing the role of VPN in the development of the FastNet (i.e., Sonera's integrative transmission capacity network) and TeleGate subscription, which was the spearhead subscription brand name at Sonera at the time:

"FastNet was a transmission capacity service, which offered, from a technological operability point of view, a managed connection. It made the delivery of different solutions possible with a physical transmission capacity, for example voice/ Data... In Voice area, VPN on the other hand, was made together with FastNet, because the definition of capacity was easy with the FastNet concept. VPN connections were made as part of FastNet and were distributed through telephone centers in order to make the services work, and without direct lines from switching center to switching center." (Informants 58, 13, 24)

The industry was willing and able to accept new solutions. In addition, the earlier regulative steps allowed the use of the new technology in some areas. In summary, the VPN was a novel and a profitable way to arrange communication on company sites. Telecom companies' proprietary technology was used, and Sonera's customer traffic and subscriptions increased with the new customers it acquired.

The resulting dominant design characteristics
Vipgate VPN was a widespread technological cost-effective solution that offered totally new functionality for companies. The solutions adopted prompted the growth of Sonera's internal market share in the corporate segment to over 60% in its competitors' areas, whereas the average market share was 30%. As part of the VPN service, calls to company sites were implemented with extensions, i.e. customers' telephone (numbers), and the clue was the numbering solution: The customers' extensions were

seen as a united company (i.e., harmonized and planned numbering solution for a customer's private network) while they could still be physically separate. Sonera's competitor Elisa followed the lead later with a service called Diana[66].

Transforming (to following product generations)

Vipgate VPN was developed incrementally to offer new product generations while the technical VPN solution was still in use. Vipgate VPN was developed into Sonera Cid Corporate Number service (1995) and Vipgate Concept (1995).

As a backdrop to Vipgate VPN, the turnover from bulk products (e.g., trunk calls, international calls) started to stagnate due to legislative liberalization in 1995. While the bulk share was 70% of the whole fixed voice offering in 1995, in 1998 there was 50% in bulk and 50% in value-added services (e.g., corporate network products). The pattern was that trunk call revenues declined (in addition to price reduction) when traffic moved to mobile calls and to internal VPN calls, amidst the networking trend in companies. The purpose of Vipgate VPN was to create voice communication networks and commit a customer to Sonera. The commitment was pursued by offering high quality services with national and international coverage. A customer could not access these kinds of services unless linked to Sonera's network. At that time, Vipgate VPN was one solution to link and commit a customer to Sonera (called a solution). The other option could simply be a customer using products that were not part of a corporate network system (e.g., using only separate products, such as a mobile subscription that has no switching functionality—called a non-solution).

From a commercial perspective, it was necessary for Sonera to sharpen and strengthen its image to portray its ability to provide comprehensive and reliable solutions. Moreover, there was need to increase the volume of transition to solutions like Vipgate VPN services, and Vipgate Concept (1995) offered a tool to do this. In turn, the Sonera Cid Corporate Number service (1995) was a forerunner of Vipgate Concept. Sonera Cid was also technologically more sophisticated way of implementing a VPN service and harmonized numbering to a company.

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[66] Diana was conceptualized in 1991, but at first it concentrated on data business, Häikiö, 1995. There are two versions how Diana's name was invented: 1) Dialled In Advanced Network Access (Häikiö, 1995, p.116) ,and 2) the HPY's main office was located in Helsinki, near the Diana park, from where the management took the name (Interviews).

Table 13. Transformation, sensing, and seizing activities in VPN.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Earlier, dedicated leased lines (expensive access capacity) were used to network companies' sites (i.e., telephone centers) together. Companies rented these lines from operators or built them themselves. Customers could only use local telephone operators' services. The management discovered that virtual private networks could substitute for the leased line business model and also make available Sonera's national services to local customers in competitors' areas (e.g., in big cities). **Convergence creation in company.** Capacity was created to redesign a cost-effective switch network, and fixed separate leased lines were replaced with VPN. VPN integrated public telephone network and companies' private switches, which offered new service functionality. **Market change in industry.** Customers and Sonera saw a need to have Sonera's national services available to new customers in competitors' areas, bypassing local monopolies. A networking need (to connect customer sites together) emerged in telephone services. **Technology change in industry.** Analogue technology was substituted with digital technology (including SS7 signaling, 2Mbit subscription, IN), which contributed to the establishment of the VPN service. Sonera was a pioneer in adopting, nurturing, and integrating these new technologies.	**Regulation in industry.** The national regulator allowed the productization of the 2Mbit access line and consequently increased competition in the business segment. 2Mbit access had superb capacity/performance compared with previous solutions, (i.e. analog lines); 2Mbit line was the tool create the VPN service. **Source of innovation.** The top management emphasized to legislative regulators and customers that VPN needed to be created for competition reasons. Global sensing was used (e.g., benchmarking AT&T & Baby Bells in USA about the VPN technology). Accordingly, a new SBU was founded in Sonera, which developed the 2Mbit subscription. The top management and business area management also sensed that marketing activities were needed. Accordingly, a new marketing brand, TeleGate, was founded, which was used in attacking competitors' areas.	**Standards in industry.** Sonera implemented a pioneering VPN standard for the corporate communications network and related technologies (SS7 signaling, 2Mbit, IN). **Network effects.** Company sites were networked, i.e., they could communicate easily internally, and use Sonera's other products. This increased customer productivity. Companies' switches were separated into 'Vipgate groups' in Sonera's telephone centers, and consequently, numbering was managed in switches and later centrally in an intelligent network. That meant there were also economies of scale in Sonera's internal production. **Complementary assets.** Emerging cooperation with network planning, numbering functions, and product management were seen in Sonera. Internally, VPN had the support of top management. Other products could also be used in marketing activities when selling VPN. **Modularity management.** N/A. **Firm structure.** A closed vertical production was partly replaced with a public telephone network. **Ecosystem/Partners.** Sonera offered comprehensive services that customers were committed to, and also volume-based price discounts. Sonera gained large top companies in Finland as its customers. Those firms bought the bulk of their telecommunication services from Sonera. The ecosystem appreciated Sonera's national assets and comprehensive services. **Innovation type.** VPN was a new technology that was used to Sonera's prevailing customers (also gained new customers). **Technological competences.** Network planning, switching functionality, numbering, and IN expertise were the key technological competences. **Appropriability for Sonera (and telcos).** VPN was a profitable business that enhanced usage of other services (subscriptions, traffic contracts).

4.1.4 Privatel

Background

Privatel integrates a company's mobile phones into the company's fixed telephone network and numbering. When Privatel is in use, the customer's closed numbering is defined in a way that calling uses extensions between fixed network subscriptions and mobile phones. Privatel calls had special fixed-to-mobile and mobile-phone call prices. Privatel was a company 'switchboard', which enabled a calling mobile customer to use a four-digit internal company phone number in a similar way to a caller on a fixed intracompany call (Laaksonen, 2007, p. 224). Privatel was Sonera's technology experiment, which was launched commercially in 1994. The key feature was that mobile phones were attached to a company's switch's extensions.

Transformation from previous product generation

There was no previous solution connecting companies' mobile phones numbers; they were not integrated into the company's switching function. A business switch functionality was separate in mobile and in fixed voice, and customers called mobile phones using their own, long numbers. People were difficult to reach, prices for companies' internal mobile phones were high, and the work of a PBX (Private Branch Exchange) attendant was laborious.

Gradually, there emerged a need in the customers to have mobile phones integrated into the company's switching environment. In addition, expertise had increased with respect to B2B mobile business switching in Sonera, and there was the capability to create the Privatel service. Sonera created the world's first industry solution. It created closed user groups to Nokia's switches. These groups were given their own mobile numbers that 'looked like' an extension number in a company's private voice communication network.

In Sonera, management found out that similar usage preferences were present in the mobile and fixed calls business. What was also important was that pricing was converging, that is, volume discounts could be given for all calls (including mobile calls).

Sensing

Privatel, one of the company's spearhead products, was proof of the need for companies to integrate mobile and fixed line communication (Annual Report, 1994). The sensing of ideas stemmed from the interest of the top management. The top management was involved when Sonera developed, purely on its own, the Privatel functionality for Nokia's switches. In fact, the Head of Sales at time, and later the head of the telecom unit, was selling the product himself to top customers. Sonera also used its own R&D capability to create new functionalities for mobile switches and was also listening to customer needs.

Competition was seen to be intensifying by 1989, and Sonera recognized that its switching functionality was the most important existing dominant design in the B2B segment. Privatel was the first product to match this challenge to include mobile phones. Sonera also identified the needs of those companies that had a large amount of internal communication between fixed extensions and mobile phones to integrate mobile and fixed line communications. At that time, all companies had fixed phones, and placing mobile phones within the same functionality created added value for companies that was above the basic mobile offering. It was understood that better functionality of mobile and fixed phones together would have process benefits for end customers that would create lock-in effects. Thus, it could be an effective response to emerging competition with Radiolinja, for instance (i.e., Elisa's subsidiary in mobile business).

Customers would also find the new service to be economical. Moreover, the new service also brought fixed voice and mobile silos closer to each other within Sonera, fostering cooperation and creating the first convergence products across the fixed and mobile communications in the company.

Seizing

The target was to gain nationwide customers through the Privatel product, and an active B2B sales organization (Corporate Networks Ltd) was established at that time to sell the Privatel product. Commercially, the product also had a lock-in effect, as it improved peoples' reachability, and enabled cheap calls and call transfers from fixed telephone subscriptions to mobile phones.

Privatel was a technology experiment in 1994–95. Companies had a switch network before the time of Privatel and the private communication network was then an expensive investment. So costs should be minimized, and at the same time the service should offer top-class functionality. Privatel was one way of reducing customers' costs. A head of the product unit recalls:

"We had a quite tough competitive situation after the mid-1990s when companies started to use mobiles in volume. Radiolinja tried actively to acquire big customers and we had to resist this somehow and one way to do so was to create a concept for the current switch network. With this network we could integrate mobiles into that and it was sold to a customer on the basis that you could call a short number with a lower price even it was mobile (the traffic could be 60–80% of traffic inside a company). I remember a case when the customer said that if we take your Privatel and currently we have 6000 mobiles and 2500 of those are yours [Sonera's] but if we take Privatel then we will not take any more of Radiolinja's mobiles" (Informant 27, Quote 1).

The 1980s and 1990s saw the implementation of a great deal of technology management inside Sonera, and this was also the case with Privatel. The project was more like an ad hoc solution to different technological challenges that arose along the way, but it offered valuable information and also practices started to emerge relating to how to do project work. There was learning on both sides of the organization: the mobile communications business area learned from the processes of the fixed voice business area, and vice versa. Sonera created the Privatel service in-house through its knowledge and resources in switches and Intelligent Network (Privatel also used IN technology). Vendors did not have a role in IN applications[67] (e.g., Nokia and Ericsson in the IN platform).

Regulative liberalization made it possible to use the Privatel concept. One success factor of Privatel can be seen to be in understanding the primary role of switch functionality. Another was the active sales organization at that time (Corporate Networks). Furthermore, close relationships were developing with large customers, partly due to the Privatel product. Privatel was also profitable and it paved the way for the increase in corporate network products.

The resulting dominant design characteristics

Privatel was a market leader; it had a significantly high penetration among corporate mobile phone customers[68]. The strong market demand was capitalized upon with progressive piloting projects with customers. Competitors followed suit, but at first did not have the same kind of functionality.[69] One informant noted:

[67] See the Vipgate Concept chapter 6.6 showing the services where IN is used.

[68] The penetration rate is confidential.

[69] Sonera was progressing in patenting the Privatel concept. However, a 'site accident' occurred, the patent got published in one Diploma work in the patent application period.

"That short number concept might not be valid in the current world... But with the concept, we got the pricing to work, and this was important as the rival company Finnet found it impossible to make a similar kind of product due its dispersed structure" (Informant 27).

The key to Privatel was the numbering service, making mobile phones look like extensions and that a specific internal call pricing could be achieved when calling customers' internal mobiles.

Transforming (to following product generations)
Privatel was gradually transformed into the MobiCentrex service. In the long term, the basic need—the integration of mobile and fixed networks—had changed, because there were now so few fixed phones, especially in small companies because they had been replaced by mobile phones. Consequently, substitute products had emerged in private voice communication networks, as MobiCentrex replaced Privatel for example. In 2008, there was more MobiCentrex services than Privatel installed in mobile phones.

Table 14. Transformation, sensing, and seizing activities in Privatel

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Mobile phones were not integrated with a company's switching functionality. Management realized integration of fixed-line business and mobile was important, a change in the filtering out of which innovations to pursue. The top management and business area management created a new business model to boost fixed and mobile calling usage, they also created a new revenue source: fixed-to-mobile calls.	**Regulation in industry.** The national regulator allowed competition with the 2Mbit subscription. This allowed the spread of Privatel into competitor's areas, as well. **Source of innovation.** Privatel was a local technology experimentation and a tool for preventing customers' switching to the competitor Radiolinja. Close relationships and piloting processes with large customers emerged.	**Standards in industry.** Sonera made its 'own standard' -- the first of its kind in the world. Sonera consequently had a one year head start in the business. **Network effects.** In customer companies, internal communication usage increased, and all customer company sites wanted to join the service. Sonera created the brand value: "Sonera as an integrator" and diffused it. **Complementary assets.** Mobile and fixed voice business units cooperated for the first time in Sonera. Inside Sonera, billing, sales, product management, and delivery functions cooperated with mobile and fixed voice silos. The billing system in the mobile business was modified to meet the needs of the business segment (which had not been done earlier). A business sales organization disseminated market knowledge to the mobile consumer segment.

Table 14 ***Continued.*** Transformation, sensing, and seizing activities in Privatel

Building blocks		
Transforming from previous product generations	**Sen sin g**	**Seizing**
Convergence creation in company. The management found that the same kind of usage preferences were present in the mobile and fixed switching environments. Unified price plans for internal calling were implemented, which was also cost-effective for the customer. The fixed and mobile business units and the R&D and sales functions in Sonera cooperated closely. **Market change in industry.** Customers and Sonera both saw a need to have a customer's fixed and mobile number extensions appear as one entity to external parties. Customers wanted cheaper internal mobile calls. **Technology change in industry.** Sonera developed internal R&D expertise to execute switching functionality to Nokia's switches. Mobile numbers worked as switch extensions. Sonera led the technological change in the industry.		**Modularity management.** Privatel was first defined and implemented in every switch, case by case. Later, functionality was gradually extended to the Intelligent Network, which increased reliability, cost-efficiency and quality. **Firm structure.** A closed vertical mode was used, no external partners were needed. **Ecosystem/Partners.** TOP 3000 customers ecosystem in Finland, a 'Sonera camp' started to form in the voice business area, because of Sonera's comprehensive and integrative services. **Innovation type.** Privatel was a convergence product, it was a technology application to new and old customers. **Technological competences.** Companies internal numbering, billing systems, IN knowledge, and knowledge about switches were the key technological competences. **Appropriability for Sonera (and other telcos).** Privatel was conceptualized as a profitable lock-in product, as it improved reachability and enabled cheap calls. No substitutes in functionality existed.

4.1.5 Company number: The Cid company number service

Background

Sonera developed a new national calling number for its customers in 1995, which it called the Cid company number service. The service made it possible for B2B company customers to have one national number. This suited companies that had many offices (Annual report, 1995). The service was conceptualized as offering reachability (of companies, services, and people), service management (a web-based tool), permanent business numbering (Communications ID), and follow-up service usage metrics. Further, the service was independent of underlying technologies, networks, operators, and end-devices.

Transformation from previous product generation

The previous dominant design was Vipgate VPN, but that offered no unified numbering when calling companies from a public network. There were different numbers for offices (area code numbering) and different prices for callers depending on which site they were calling (a local or a trunk call). The key point of the Cid company number service was that it enhanced the functionality of VPN, as a new server (Self-service application [Cid Manager]) was created; this enabled a dynamic numbering solution and it did not matter what kind of a physical connection the customer had. Cid Manager was a web-based self-service application for the management of the Cid company number service. With Cid Manager, the company could view their Cid numbering and the reachability services at their disposal. Cid Manager allowed the user to make changes to the numbering plan and services (Sonera Cid service description, 2010).

Initially, at the beginning of the 1990s, local and trunk calls were expensive. In response, Sonera's company number offered a new price plan—the same price nationwide when calling a company number. Reaching their workers was also challenging for companies in the mid-1990s due to the many fixed and mobile numbers in service. Moreover, firms had to cope with telephone numbers changing when they changed their functional organization structure or geographical location. In addition, the management of a numbering plan was complicated and it was not possible for the end customer to manage and plan its numbering solutions.

On top of the new functionality the Cid company number service introduced from a market viewpoint, was the consideration that Sonera could attack Elisa's capital region with the service. Until then, Elisa had had a monopoly for all companies in that area. Sonera created a new technology application for the industry by modifying the IN (Intelligent Network) and creating a dynamic management server to operate numbering solutions.

Sensing

The previous challenges in reachability solutions, the management of the service, and changing numbering when there were alterations to the company's activities, led to the ideas of developing the concept of the company number. Clearly, the market signals and R&D capabilities of Sonera led to the development of the company number.

In addition, the regulative legislation made sensing the business opportunity possible. There was a new opportunity to price freely end to end[70], which was not possible previously, when local telcos were not

[70] Earlier, a customer paid a phone bill to all the telephone operators, whose network was used. Now customer could pay only to Sonera. Sonera bought the

obliged to lease capacity. The numbering reform[71] in Finland in 1994 and the obligation to rent access lines also helped here.

"Also the great numbering reform in 1994 was important for the success of Company number, because that lowered the barrier to changing numbers" (Informant 15, Quote 1).

The knowledge to use the virtual network switch (VPN) with the help of IN, in order to create unified numbering plans for companies, was understood to be important. More specifically, the following aspects were seen as resources when developing the company number. On the resource side, Sonera added and fixed the functionalities of different Intelligent Network (IN) platforms (Tandem, Ericsson) so it could conduct mass transactions. In addition, in terms of concept development, there was progress on understanding how external numbering and the services behind that number were separated. This was used as a competitive tool, because Elisa linked numbering directly to services at that time, which was laborious and expensive. Sonera had the benefit of having hardware that was centrally managed, but Elisa had to do ad hoc platform work and harmonization was not possible (Turpeinen, 1996).

There was a need in the market to have products with superior functionality that could enable the freedom of place and time in terms of communications within customer companies. This would lead to productivity increases. Customer companies also wanted to have an advantageous brand, and unified numbering to external customers helped in that process.

Seizing

The business model and Sonera's own standard in the form of the company number employed sophisticated concepts so as to fully exploit shrewd price plans. These were ready to be created when the buying of access was granted. Some of the phone costs were paid for by the

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capacity from other telcos, and used that capacity in its own products and services, in this case in Cid company number service.

[71] Finland is divided into numbering (geographical) areas, each area has its own code. For example, Helsinki area has the 09-code. Before 1994, there were numerous numbering areas and each phone call had different price based on the area. In 1994, the numbering areas were reduced, and the codes were changed. Sonera now had opportunity to create more easily end-to-end priced calls and also customers were more willing to change numbers, as the codes changed anyway.

company and some by the consumer. The great numbering reform in 1994 was used as a tool and prerequisite for the service: a new idea to develop a new national calling number. The profitability of the product was also important, and a clever technological idea was developed for that. A competitor's switch would be directly connected to Sonera Corporate networks' company switch, and every time a customer called a Company number in the competitor's areas, the competitor had to pay access fees to Sonera.

In terms of project management, production and product management worked closely together. There was a strong demand in the market and a unified growth atmosphere in Sonera facilitating this cooperation. Expertise on IN was used efficiently, and capabilities also grew to create self-service portals (Cid Manager) and numbering management to the masses.

The industry accepted the new views about pricing in the Cid company number service (as the same logic in billing was as applied earlier in service numbers). In 2007, the business model for the Cid company number service was also considered for TeliaSonera's Swedish organization (Finnish customers wanted that), but that proved difficult. In particular, the Swedish organization found it difficult to grasp the business logic and the lock-in role[72] of large customers and, consequently, the potential of the Cid company number service was never thoroughly investigated in Sweden.

The resulting dominant design characteristics

The evidence of the fact that the Cid company number attained a dominant design position is its 59% market share gained by 2001 (Internal estimates). The competitor, Elisa, followed later. The Cid company number service was also described as being a globally unique network IN based service, and a very profitable product. It had a pricing model that defined how end-to-end pricing should be performed, as well as how transfer prices with competitors should be negotiated. In addition, customer companies were content with the service and wanted it rolled-out globally.

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[72] Cid company number's lock-in role consisted of the following facets: 1) the number offered brand value, 2) area code numbering is not national level number, 3) Attendant service can be outsourced. In addition, implementing the Cid company number to customer's private network numbering was a costly and tricky process. Abandoning Cid would bring extra costs to the customer. Also, at that time, the number portability in Cid was not allowed.

Transforming (to the following product generations)

The Cid company number service was a corporate network product that created a convergent offering. Thus, it integrated ‘fixed’ and ‘mobile’ call functions in a company. However, later, in 2002, active substitution started, rather than convergence, in the realm of mobile solutions. The integrative use of all services was emphasized less than previously.

The spearhead changed in 2002, as instead of going with an integrated managed total solution (fixed plus mobile), Sonera followed a policy of having one end device, which at that time was mobile.

“We diluted the dominant design between 1995 and 2000 in Vipgate ourselves, because we proceeded to a one end device policy. And why was that? Mobile phones were already very widespread and we proved to customers that it was cheaper to have one infrastructure instead of two. The reason was that the cost of mobile phones dropped so low that nobody believed any longer that the fixed-line voice business would grow. Fixed voice was taken as a cost efficient component, which would be replaced by IP-based traffic or mobile traffic; and then there came the idea that small companies needed only mobile and big fixed switchboards would be replaced with IP-based subscriptions, like SBVA (Sonera business voice access)” (Informant 4, Quote 2).

Between 2008 and 2010, Cid Company number service functionality was offered in Unified Communications.

Table 15 summarizes the transforming, sensing, and seizing phases building blocks.

Table 15. Transformation, sensing, and seizing activities in Cid company number service.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Earlier, companies' external and internal numbering was not uniform and the calling functionality was cumbersome. The management did not see that VPN logic could be enhanced by Cid, which would be a dynamic numbering suitable to all connections. The Cid service was net-based, contrary to the majority of solutions in industry. Earlier, the majority of services were PBX (Private Branch Exchange) based. **Convergence creation in the company.** Convergence was seen in unified numbering regardless of technology. End-to-end pricing was in place regardless of the technological nature of the call. Call routing was also conducted regardless of technology (i.e., fixed or mobile). **Market change in industry.** Customers needed productivity in communications and brand value in external customer relations. **Technology change in industry.** Intelligent Network (IN) usage diffused to telecom services. Sonera adopted and modified technology change (IN) to B2B services in corporate numbers—a world first.	**Regulation in the industry.** A numbering reform was used effectively as a tool when attacking competitors' areas. The reform allowed Sonera to compete more effectively nationwide. In addition, the option to buy access from competitors enabled end-to-end call pricing, which was a key point in Cid. **Source of innovation.** The business area management sensed that customer brand value could be enhanced with the service. The development of the IN network was used to invent new price plans.	**Standards in industry.** Different IN vendors' products were analyzed, combined, and developed in Sonera (e.g., time-based call routing). Sonera's 'own standards' were used in the Cid service. **Network effects.** Unified external numbering for companies was created in Sonera. Inside Sonera, a platform innovation was made, as service numbers used the same platform. The firm learned how to separate external numbering and service elements because of the mass market scalable application related to Cid. **Complementary assets.** New successful marketing concepts were discovered, e.g., reachability. Production and product management, as well as different business units, cooperated in Sonera due to the integrative nature of the service. The top management supported the service, as it was a flagship product in integrated business voice solutions. **Modularity management.** A self-service number management system and flexible process to open new 'number spaces' was developed, which helped to create new numbering solutions and attach new customers to the Cid service. **Firm structure.** A closed vertical mode was used, and no external partners were needed. Sonera in part used a common telephone network in its competitors' areas. **Ecosystem/Partners.** TOP 3000 customers ecosystem in Finland, a 'Sonera camp' was enhanced in the voice business area. The major large customers needed management of their network sites (also globally) and internal and external numbering. **Innovation type.** Cumulative old technology was used for current and new customers. **Technological competences.** Intelligent Network development and numbering planning were the key competences. **Appropriability for Sonera (and telcos).** Profitable, clever pricing and superb functionality created high earnings for Sonera, no real substitutes emerged from competitors.

4.1.6 Vipgate concept

Background

Vipgate was a new service concept created in 1995, and it was formed to create a comprehensive communications solution for companies with many sites. The concept included incoming traffic, internal traffic, and outgoing traffic. In the early period, one spearhead was also billing and reporting services for large companies, because competitors could not provide that service to their customers. Vipgate's building blocks were the earlier commercialized products Vipgate VPN, Privatel and the Cid corporate number service.

The Vipgate concept was positioned as offering communications solutions (in the earliest setting mainly fixed voice) for large national companies often with many sites. Vipgate was at its strongest during 1995–2000, however the earliest Vipgate product emerged as early as 1992 (a product called Vipgate VPN- virtual private network, see Chapter 4.1.3).

Transformation from the previous product generation

Earlier, there was little consideration of a solution for companies that had incoming, internal, and external traffic. The earlier products—VPN, Privatel, and the Cid company number service—offered solutions for a particular communication need, but the emerging need was to have these building blocks work together. Sonera soon also found that the total solution made it possible to use all the strengths of a big company; that is, complementary functions and other synergy-enabling products. In sum, the technological solutions were present, but the common sales and concept model had been missing, both in Sonera and among its competitors.

Another important point was discovered concerning the transition of business: the old bulk business (namely traffic and subscriptions) was under price pressure and their usage was simultaneously decreasing. In this situation, it was important to offer new value added services. The value added services consisted of corporate network solutions, namely VPN, Privatel, and Cid. However, the corporate network solutions accounted for only 5% of Vipgate's turnover in 1995. The Vipgate concept was considered appropriate, when trying to lock-in customers to Sonera's solution. This was especially important, as half of Vipgate's customers had a subscription with a competitor. Sonera needed its own 2Mbit subscriptions and blanket agreements in order to increase Vipgate's diffusion.

Sonera was ready to level up its capabilities in terms of concept building, as the following strengths identified in an internal SWOT analysis describe:

"We have experience in productizing total solutions and marketing to large corporation customers operating nationwide; We have technological forerunnership in various product areas (IN services, mobile); Sonera is "full service house" the total solution is extensive and components are good quality; Nationwide and international offerings are a strength; and Telequality is as a competitive advantage" [in the market] (Vipgate Business Plan, 1998).

Sensing

The sensing in Vipgate revolved around the top management interest in and anticipation of market needs for large companies. The commercial issues in the market effectively led to internal process development. Sonera tried to match the value concept communicated in the market, also working on internal processes, that is, an internal inspection procedure.[73] The Vipgate SBU had a charismatic leader, who made a true difference in the commercialization of products and in process development in Sonera. Partly for that reason, the unit was on occasions quite independent of the production unit and other SBUs in Sonera.

A customer-oriented way of working began to be important in the mid-1990s, partly due the influence of Vipgate on Sonera's processes. Most other processes were integrated piece by piece into B2B customer relationships with large corporate customers. These processes included sales, technical customer service, and allocated R&D resources.

The development of the Vipgate concept was based on deregulation opening competitive arena for trunk calls and international calls. This brought new demand for substitute and complementary offerings. It was seen that the basic bulk products (trunk calls, international calls, local calls) no longer offered distinctive value added, and the revenues were falling in that sector. Therefore, there was a need to offer something new and value added; and a comprehensive functionality of communications solutions in Sonera's network was seen as a potential offering that competitors would not be able to match. It was important to have customers in Sonera's network one way or another, and not to remain

[73] It was similar to stage-gate processes in product development, where project tasks with all stakeholders needed to be completed in order to proceed in the project.

captive to Elisa's or other local telecoms' local monopolies because they owned the last mile (access) to the customer. Ultimately, the target of the Vipgate concept was to sell traffic contracts (i.e., carrier services). The competitive targets of Vipgate are depicted in the following figure. Vipgate was positioned moderately as a forerunner and moderately preferred as the sole vendor by customers, but the target was for it to be the best placed forerunner and sole vendor (Corporate Communications "Gold"), in the Business Plan for 1999).

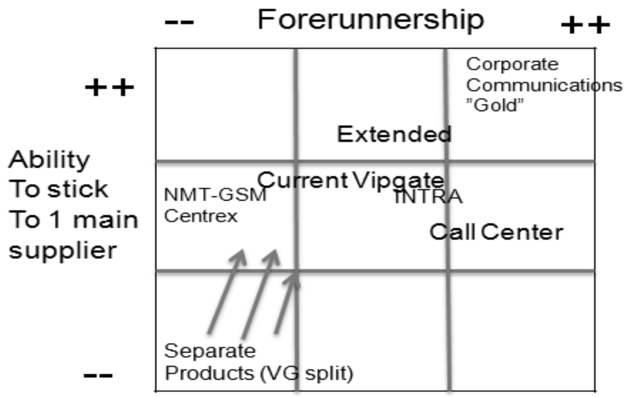

Figure 13. Vipgate positioning matrix 1999. (Vipgate business plans 1998-2008).

Customers who purchased separate products are shown in the lower left corner of Figure 13. When moving higher up in the picture, the customers are more able to commit to one main supplier in the offering, for example to the NMT-GSM Centrex (i.e., a PBX-like service providing switching by a telecom company instead of at the customer's premises). Forerunnership here is understood as the ability to create converging offerings; one example is the current Vipgate in the figure.

IT houses[74] and system integrators[75] were already seen as competitors in 1999. They were placed in the business plans at top of the value chain; in 'office solutions' layers, competing in the Corporate Communications "Gold" sector.

One important facet in Vipgate has been the role of the legislative regulator. The regulator did not sympathize with Vipgate's market

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[74] Information technology companies.

[75] Davies et al. (2007) write "a systems integrator is the single prime contractor organization responsible for designing and integrating externally supplied product and service components into a system for an individual customer" (ibid., p. 188)

definition (the SBU defined the market as market share in B2B segment). Regulator often interpreted the market share based on traffic volumes as such, (e.g., international calls) where Sonera was a leading player in 1990s.

Seizing

A new working culture emerged in 1995 in the internal R&D projects for Vipgate. In R&D projects, pre-studies, implementation, and quality checks were carried out. All the functions in Sonera—sales, product, billing, delivery, and production units—were involved. Sonera created a new competent sales culture and project/product development culture, starting with sales education (e.g., national sales tours, product catalogues, first product, and offering descriptions). There was also the formation of a firm profit center management structure, and growth and profitability targets were allocated to business units for the first time. It was also sensed that it was important to gradually start to standardize production regarding factors, such as quality, processes, and maintenance.

Figure 14 depicts the Vipgate product family as it was in 1998.

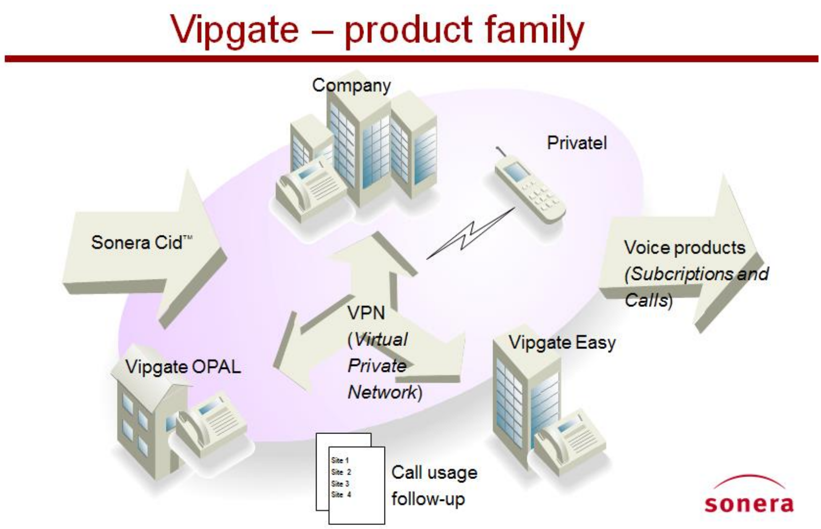

Figure 14. Vipgate product family. (Vipgate business plans 1998–2008).

Vipgate's building blocks at the time were the previous product generations VPN, Privatel, and the Cid company number. These three products had been forerunners in different periods of Vipgate and had helped the basic bulk products at that time (fixed voice traffic) to grow in volumes and create corporate network communication solutions for companies, that is, value added services. The Vipgate product family became a common way of describing corporate communications. The solution was comprehensive and the functionality worked between the modules better than competitors' solutions at the time (e.g., Elisa's Diana Concept [Häikiö, 1995]).

Vipgate was later built into IN, making Vipgate configured with and applying IN technologies. IN was used for different products in Sonera. The following table 16 illustrates the diffusion of the IN usage to Sonera's services (1996).

Table 16. Fixed network IN services in Sonera. (Älyverkon palvelunkehitysvisio 1998–2002. 1997. Telecom Finland. Internal report).

Service	Million Minutes 1996	Million Minutes 1997
Privatel	78	131.6
VPN	6.9	11.6
Cid Corporate number	70.2	142.4
Service numbers	41.6	44.6
Intelligent network services	79.3	96.4
iNET (Tele Internet)	88.7	123.9
TeleSampo	19.7	41.4

Table 16 above presents the services using Intelligent Networks and the minutes used on the service. The Vipgate services, Internet, TeleSampo, and Service numbers among others used the INs. However, to clarify, note that the other fixed voice traffic (i.e., 'the profitable bulk' of local, national, and international calls) still dominated at that time to the extent that with 4.444 million minutes (Annual report, 1997, p.35), it still represented more than ten times the 0.608 million minutes that were routed through IN services.

Vipgate was a great success, and that encouraged the company to use its national strengths to address the large business segment. In the corporate customer segment, Vipgate gained a larger share of customers in competitors' areas than its average market share, which had been traditionally about one-third in Finland (Annual reports). In addition, Privatel and VPN as products grew at a faster rate than customers' voice communication contracts, which indicated that companies wanted to commit to the solution. Vipgate was first (in 1997) targeted at big companies and especially those operating nationwide. Vipgate's target was not the small local group, but the large business segment, as the segmenting in the 1997 chart below clarifies (Figure 15).

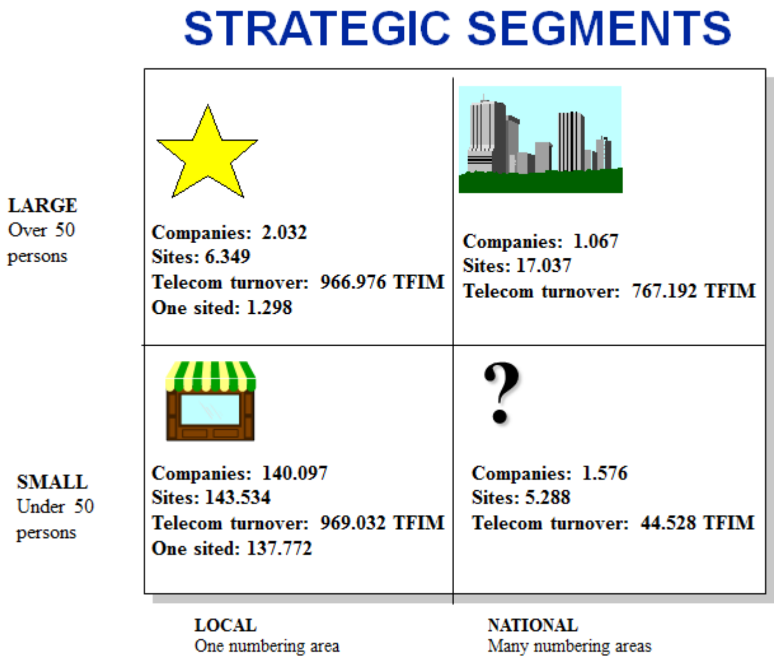

Figure 15. Vipgate- strategic segments. (Vipgate business plans 1998-2008).

The business planning chart from 1997 reproduced in Figure 15 segments business on the basis of company size and the way the companies are structured (i.e., local or national). The star segment represents local large companies but Vipgate also had the resources to operate in the national large segment, and to create a corporate communications network and therefore to provide value-added services.

However, the transition to value-added services was challenging. Initially, in 1995–1997, profit levels were poor in comparison with the old bulk business. The threat was seen to arise from the fact that a profitable transition from profitable bulk business (local calls, trunk calls, international calls) to value-added services would not be not possible and Sonera would remain merely a network operator, while IT houses would gain credibility. Furthermore, if there was a rapid transition to all mobile in the market, Sonera's comparative advantage in the challenging hybrid solutions would diminish.

The resulting dominant design characteristics

As evidence of the fact that Vipgate gained a dominant design position, by 1996 it had the leading market share in the corporate sector with 60%. Vipgate also gained comparatively more market share in the B2B sector in competitors' areas than its overall market share in the business segment implied; reaching over 50% market share in competitors' B2B areas, compared with its 'natural' market share that had averaged around 30% of fixed voice (and in some competitors' areas, only 10%; Internal reports, Finnish Competitive Authority, 1999). The competitor Elisa followed later with the Diana concept. Vipgate was built as a whole package, and small players were in a weak position because customers were learning to buy the comprehensive offering. The key plan was to focus and set the value-added requirements to serve companies that had many sites.

Transforming (to following product generations)

Vipgate was transformed first to the one phone concept in 2002, thus moving towards mobility. After that, it was transformed to Sonera's communication solution in 2004 (Chapter 4.1.10) and finally to Unified Communications in 2008 (Chapter 4.1.11). The dominance of mobility was the reason for the first and second transition. The last transition, to Unified Communications, was driven by technological developments (All IP) and a market need to have a more web-based, outsourced and easy to use bundled services.

In the area of technology, IP migration was seen as the most important thing leading the market and the competition, but that posed a challenge when the IT players role became more important, "*IP Service layer is guiding the value a customer sees linked to vendor selection, and in internal resources investments* [into services] *are low*" (Vipgate Business review). In line with IP migration, traditional standardization became less significant.

Table 17 below summarizes the transforming, sensing, and seizing phases building blocks.

Table 17. Transformation, sensing, and seizing phase building blocks in Vipgate concept.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Separate services were sold before Vipgate. No culture existed for one-stop-shopping, nor did the idea that productivity could be achieved with communications 'total solutions'. The SBU management found there would be synergetic effects in usage, when using Sonera's products, reconfiguring and redesigning those. **Convergence creation in company.** Sonera created convergence through marketing the brand. A uniform communication culture (a total solution) was marketed to customers: integration of fixed and mobile solutions, as well as pricing and volume discounts on product packages. A mindset favoring a 'standardized solution' diffused. **Market change in industry.** Large customers learned to do one-stop-shopping, buying whole communications solution packages. **Technology change in industry.** No new technology emerged. Sonera was the first firm to adopt technologies to create a concept for Corporate communications solutions. Earlier technological products (2Mbit, Privatel, Cid, VPN), were integrated in a marketing brand.	**Regulation in industry.** Legislative authorities set limitations on product bundling (i.e., volume discounts were not allowed on trunk/international calls, because Sonera was considered to have a monopoly). **Source of innovation.** The competition opened up in voice communications. Partly due to this, a marketing concept was constructed, which was necessary to sell traffic contracts. A new innovative growth-seeking, market-sensing business unit was founded, concept-creating and sales culture was established, The TeleGate marketing concept was devised, and pilot schemes with large customers were extended. The R&D, Solution sales, and customers cooperated.	**Standards in industry.** Prior standards (IN, signaling, VPN, numbering) were used, which made the productization faster. **Network effects.** Sonera's sales message pointed to elements that would create network effects in industry: 1) voice communications would be a value added component for customers, 2) reachability will be enhanced, 3) there would be an ability to master a large volume of contacts, 4) service would be manageable, reliable and efficient. The Vipgate brand was robust, and it served as a reference solution. **Complementary assets.** Inside Sonera, a unified growth atmosphere and cooperation with all functions existed. The only exception was that mobile solutions in the business segment were missing (as cross-selling and usage of customer lists were challenging). Inside Sonera a Solution Sales function was used. A productization and decision-point product development process was built. **Modularity management**. Vipgate business unit management found difficulties in fully integrating the mobile technologies into the offering. Different IT systems and also disputes over the ownership of business mobile products were challenges. **Firm structure.** In the big picture, a large vertical silo organization, 'product house' was used. It was successful in the productization of new services in voice business area**. Ecosystem/Partners.** TOP 3000 customers ecosystem in Finland was at its peak; a 'Sonera camp' was enhanced further in voice business area, by using Sonera's brand and volume discounts on prices. **Innovation type.** Cumulative old technology was used for current and new customers. **Technological competences.** Sonera enhanced the competences in the earlier services and solutions: Cid, VPN, Privatel and VPN. **Appropriability for Sonera (and other telcos).** VG was a profitable business, and individual products (traffic and subscriptions) were sold with the help of the VG concept. Elisa's (Diana concept) lacked national level services and some functionality.

4.1.7 DataNet

Background

DataNet (launched in 1989) and FastNet (launched in 1991) are some of the data communications products offered by Sonera. FastNet is a transmission level product (Basic Data); DataNet is higher in the layered technological system (Data WAN, Wide Area Networking; see Appendix 9, FastNet structure). The products have intertwined elements in light of the whole Sonera data communications offering.

DataNet is a service bringing data and communications solutions into one network with IP (Internet Protocol). It builds on the earlier Asynchronous Transfer Mode (ATM) and Frame Relay[76] technologies. The service is a flexible IP Sonera Communications Solution for the business customer (Sonera, DataNet service description, p.3). It is a service that, assisted by VPN[77], supports client-server/ client-client applications, an intranet, and internet applications. DataNet combines a customer's local area networks (LANs) in different locations into one single managed network entity, a VPN. The service concept is based on a secure, closed network architecture, and the principal idea is to create one IP-VPN for each customer, (or more if necessary). At each access point, the customer is provided with connectivity to the rest of the customer VPN and also to additional value added services.

Transformation from the previous product generation

The previous design was the X.25[78] protocol in data communications, which used the landline telephone network as the physical link. The progress of technology and a market need fueled the transition to the new DataNet service type. The competitive solutions to DataNet started to be seen as inferior to the forthcoming DataNet at that time.

A macro landscape shift emerged in the 1980s, which also describes the old dominant design paradigm in the industry before DataNet. New technologies, such as Local Area Networks (LAN), microcomputers, Transmission Control Protocol and Internet Protocol (TCP/IP), and the Internet in general created both needs and vehicles to change previous

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[76] Sonera used and implemented Frame Relay second in the world (interviews).

[77] Virtual Private Networks are used also in data communications (see the Chapter 6.3 Vipgate VPN).

[78] A standard protocol suite for packet switched wide area network [WAN]

forms of data communication (Kenney & von Burg 1999; Kavassalis & Solomon 1997). In particular, IBM's System Network Architecture (SNA), a proprietary and dominant system at that time, was unable to cope with the increasing traffic (ibid.). The Internet based systems replaced the old paradigms.

Indeed, IBM was seen as representing the 'old world'. Kavassalis and Solomon (1997) state that IBM's system network architecture (SNA) applied a relatively closed, proprietary solution to customers' demands for interconnection. They concluded that "SNA, being proprietary, never could become the underlying standard for the interconnect market. Computers are too powerful and too multivariate for any one proprietary networking solution" (ibid., p. 386).

A key person from Sonera described the situation like this:

"Cisco (a technology company) made it possible to tunnel the IBM traffic and at that time also to route it. IBM in turn made the mistake of thinking that [Cisco's routers] were toys. Still IBM had a reason to believe so, Cisco's routers cost 100 000 Finn mark and IBM's data communications' control system cost 1 000 000 Finn mark, but IBM lived in their own religion. However, they started to build their own 6611 routers to match Cisco, but it didn't help in the race with Cisco; in the end IBM lost that battle" (Informant 49, Quote 1).

The prerequisite for DataNet's success was technology progression (also stimulated by Sonera) and a vision of what could be done. Initial development of the service inside Sonera was conducted by talented individuals, who were trusted by the top management. Sonera was familiar with technological development in the USA in 1980s. At that time, universities in the USA had their own 'Internet' networks. Private companies, in turn, had their own closed expensive fixed-line TDM (Time-Division Multiplex[ing]) connections. There was clearly a market need and a technological opportunity to create a 'managed network service' (replacing TDM connections) with VPN to link customer local area networks provided by telecom operators, which had not been done before.

Sensing

The sensing centered on identifying customer needs with the active R&D focus on external vendors. In addition, the top management was open to exploring new ideas, and it let the R&D unit develop the DataNet service, even though it was cannibalizing the old X.25 data business.

The customers were waiting for more cost-effective solutions to local area networking. The earlier fixed-line connections were very expensive.

The key idea was to use vendors' switchboards to create a local area management that used the TCP/IP (Transmission Control Protocol [TCP] and Internet Protocol [IP]) typology. A key concept was to create this as a service business for customers too, rather than just for the operators' own network. There was also a view emerging that the firm should move to IP networks, because the data traffic would increase, whereas previously voice traffic volumes had dominated. The data traffic would need more capacity than voice traffic, and it was sensed that only IP networks would have enough capacity.

Seizing

In seizing upon the new needs in the market, Sonera created the DataNet product—its own standard. There was a new need to have companies' sites networked in the market. Sonera was active technologically, with new start-up suppliers, and with customers. The customers needed to think earlier about their own network topology, which was not their competence. In addition, they could not financially afford to have this backed up network, where most of the time, extra capacity was not used. Sonera created a progressive managed solution to networking, which had not been executed before.

Heinänen (2009) describes the arrival of broadband IP and the spread of the Internet into Finland:

> "The use of the TCP/IP protocol in Finland started in the 1980s mostly in universities and research centers, [in the] late 80s, the use of TCP/IP expanded to trunk networks. The Internet was commercialized in Finland in 1993: DataNet had a connection to Ebone and the USA, and TCP/IP created a breakthrough in 1994 with the aid of the Netscape browser. DataNet's plan was to offer a connection of companies' local area networks as a managed total service. The important technical steps were: a router trunk network in 1989 (Cisco), a frame relay trunk network in 1991 (StrataCom, Cascade), an ATM trunk network in 1994 (GDC, Cisco), and SurfNet managing programme software (developed in-house at Sonera)."

One person responsible for DataNet describes the history of DataNet and the Internet in Sonera. The service was seen to be very different from earlier solutions:

> "The Internet was the backbone of DataNet and the first routers had just come to the market, and we started using the same devices to offer corporate services as well. This was not earlier done with the virtual private network [VPN] principles or by telecom operators, but of course on the other hand corporations and

universities in the USA had Internet subscriptions... In the USA, companies had rented their own leased lines TDM [Time Division Multiplex(ing)] connections and built a real private network that had its own routers and this had nothing to do with a telecom operator. Telecom operators only rented bit pipes to customers and we had this idea we could offer this as a service that had only one trunk network router. With those means, we could offer basic Internet subscriptions and VPNs to companies" (Informant 44, Quote 1).

At that time, there was no internal bureaucracy in productization. The operator manually configured all routers itself. That was seen as a core competence. The next quotation illustrates the active partnership with new vendors and the entrepreneurial spirit in Sonera at the time. The partnerships were created by a few key people, as there was no official organization for managing partners at that time. This period marks the first time that an operator (Sonera) had adopted a managed service mindset in the data communications business area.

"If we think about the background of technological development, universities had the need to connect sites in different towns. Then came these Ciscos, which were born with switching technologies and others such as Stratacom, information network companies, and in the 1990s there were more of these companies like Juniper etc. The companies were startups then; in this way technological thinking began to be commercialized. Companies had needs but we also could communicate to customers what they can do with the new technology. This was not only the 'academic thinking', listening to customers was a real dialogue" (Informant 48, Quote 2).

Sonera was working with US universities to learn about internet networks, at the beginning of the TCP/IP time. For example, the idea to gradually use TCP/IP in Sonera's network and later for Sonera's customers originated at Stanford (Informant 43). In addition, the vendors were listening to what operators needed in their businesses at that time, and there was close cooperation and learning from each other, as well as early signs of partnering. A key informant remembers:

"I remember Cisco was quite astonished that we used the router to connect to our customers directly. Cisco treated the product as for corporations, but I said we are a telecom operator and our customers want to use this product as a tool in VPN routing. The innovation was that we noticed the large price difference to different segments and only a minor variation in quality. When you have a consumer product, which is virtually cost free, and then you have a corporate grade, which costs ten times more and then you have a telecom-grade, which costs again ten times more, and then we have a military-grade, which comes with more than its own weight of documentation and is ten times more expensive. Based on these grounds we took the advanced corporate grade stuff and made corporate network products and we got a tenfold cost advantage compared to these X.25 switches for example. The important thing was also that we took the responsibility of the service end-to-end and improvement of the service level to the computer network level. Kone was the first customer" (Informant 43, Quote 2).

DataNet was a very profitable service, and at first, there were no competitive substitutes for it. The customers had no resources and competence to manage their network topology and consequently, Sonera offered that service. In addition, customers could not afford to build a secured network where there was extra capacity in low usage times. However, it can be seen from the next quotation there was not instant support for DataNet in Sonera (and in the industry). Instead, the old technologies continued to fight back.

"We had some internal conflicts in Sonera about this DataNet, because the X25 world was so strong and even the CCIT [Comite Consultatif International des Radiocommunications] hadn't defined DataNet. At that time everything needed to be a circuit switched, maybe X25 packet switched was okay but the idea that we would send packets without the point to point connections [earlier way to have packet-switched networks] to was like a crime against humanity" (Informant 43, Quote 3).

The resulting dominant design characteristics

DataNet's market share was 67% in the initial years after the launch. It was a cost-effective leading solution in the Finnish market. DataNet also had a price premium of 20% over its competitors. DataNet's service concept later spread to the USA, too (in the late 2000s). The top companies in Finland were all DataNet customers and they were also financing the service and were engaged in pilot projects and close cooperation and solution design planning with Sonera. The companies paid in DataNet's piloting projects and in accomplishing the service the costs beforehand to Sonera. Full end-to-end responsibility for the customer was new and unique at the time. The competitor (Elisa) also followed Sonera with its own similar service (LanLink) one year after Sonera's launch.

Transforming (to the following product generations)

The development and running of the business was challenging in the era of DataNet. DataNet was earlier sold and marketed as being technology based, and it was transformed by acquiring different service levels (multi, basic, flex).

"In DataNet, there were technology based variants (DataNet ATM, DataNet Frame relay), and then service bundling (multi etc.). These variants were also the segmenting base, but the dominant design is the same" (Informant 29, Quote 2).

The overall technology theme in data business was the Internet Protocol (IP). The market need, networking, was accomplished with IP. In other themes, the large incumbent operator issues were common: Sonera had a large existing customer base, a significant market share, and a market maker position. There were also threats:

"Price erosion continues and customers continue to move from Frame Relay to ADSL [i.e., from expensive company products to cheaper consumer-type products, e.g. Business Internet and Consumer Internet]; wireless access is replacing fixed access reducing our turnover and access market control; system integrators are coming to the market; IT players would take the application business" (Sonera, ENS Business Review, 2003, 2006; Appendix 7)

In 2008, one challenge was to develop a modular and automated low cost offering for the SME (Small and Medium-Sized Enterprise) segment. In addition, the discussion related to finding a true value-added solution continued, as Sonera was aware that its products and services were still quite technical solutions that solved IT managers' problems, but did not address customers' business processes development very well. Therefore, Sonera introduced a new product, Sonera Business Internet.

Table 18 summarizes the transforming, sensing, and seizing phases building blocks.

Table 18. Transformation, sensing, and seizing phases building blocks in DataNet

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Earlier, the X.25 technology was rigid and expensive. It represented the 'old IBM world' in industry. Earlier, telecom operators did not have the service layer. Sonera was the first firm in the world to identify this need and to recognize that this could create a new business. ISDN was also abandoned as a data solution [i.e. data solutions in telephone network]. **Convergence creation in company.** Convergence was created in marketing messages and technology. The TeleGate sales brand was founded and offered one network for data, voice and video. A service was created, which had only one trunk network router in a data network. **Market change in industry.** Changes to customer demands meant a managed service was needed. New types of vendors emerged (e.g., Cisco, and start-up companies from the USA). **Technology change in industry.** Sonera adopted technological innovations (the personal computer, local area networking, and routing) and created the world's first managed service to data communications. A change of the router networks infrastructure and IP (Internet Protocol) was made.	**Regu-lation in industry.** DataNet was a B2B product, so regulation was not highly relevant. **Source of innovation**US origin protocols (e.g. TCP/IP) and new types of start-up vendors were used. Innovative partnering was conducted with vendors in order to create new business models for Sonera's customers and develop technology Small entrepreneurial R&D unit, with business responsibility was founded. Pilot projects were run with customers (e.g. Finnish Forestry companies)	**Standards in industry.** Sonera broke the old rigid standards. The old X.25 standard (defined in ETSI and CCIT) lacked the capacity to link local area networks. Sonera bought capacity from different network vendors, and routed the different protocols (IBM, Decnet, TCP/IP) to work together. Thus, Sonera implemented US-based technologies. **Network effects.** Scalability, cost efficiency, availability, and usability were Sonera's sales arguments in DataNet. These facilitated network effects in industry through learning by using, a well-known product and the assurance that the product would have a future. Sonera's customers' would benefit if all sites used DataNet. **Complementary assets.** Complementary assets were crucial sales arguments. IP-design function was used. The IP-design function created the data solution architecture to a customer with Internet Protocol, and security of the network was built (separate control network and firewalls in virtual network). Solution sales unit was used extensively. **Modularity management.** Surf Manager (a self-service portal in network change management) and IP network design functions inside Sonera were built. These helped offer fast and robust product implementation and in visioning with customers. Middle management seized the opportunity to buy network hardware and maintenance from different vendors. Earlier, it was possible to buy only one vertical solution. **Firm structure.** A closed vertical mode was used, where products had a strong role in Sonera. **Ecosystem/Partners.** A robust ecosystem was created jointly by many interest groups. The commercialization of the Internet took place in Finland in 1993 (TCP/IP in Internet). DataNet was developed with customers and vendors; the public sector was also active with its FUNET network in 1987–1988. The TOP 3000 customers in Finland to Sonera camp was being formed in data business. **Innovation type.** DataNet used new technology applications to new customers. **Technological competences.** Router and IP technologies and network security management were the key competences. **Appropriability for Sonera (and other telcos).** Customers accepted the 20% price premium. No real substitutes existed.

4.1.8 FastNet

Background

The FastNet network added competition to the local connection data transfer business in August 1991. It made it possible to integrate services for the whole length of the connection [the customer network] and enhanced the manageability and reliability as a whole. FastNet was based on Tellabs Ltd.'s Martis DXX™ technology. (Sonera service description, 2006). FastNet helped customers integrate their different offices into a joint network, which was controllable by network management. The network operated at the transmission layer (Appendix 9). FastNet served as a backbone to Sonera's other services, such as switch networks, local networks, and packet and circuit switched network connections (products such as Vipgate, DataPak, and DataNet).

FastNet's technological setup is shown in Appendix 9. The illustration shows that other services are built on FastNet, and currently the most important feature is the link to a public telecommunications network, as the other services are increasingly based on direct IP functionality.

Transformation from the previous product generation

The previous design was leased lines or Datel. Datel was Sonera's earlier product, it was cost ineffective but technologically cumbersome to manage. FastNet meant a customer could integrate its different offices into a joint network that was entirely controllable by network management in a cost-efficient way. The competitive situation in the FastNet era was characterized by MUX (Multiplexer) networks and the new Martis DXX node being central issues in the market. There was an active pursuit of new technological solutions, because earlier solutions were technologically inadequate and uncompetitive. Sonera co-created a new technology for the industry.

"The technological change was not so radical in FastNet: there was a new way to produce a managed leased line or leased line service, an earlier product was Datel for fixed synchronic data connection. That time the main reason for the usage of the [Datel] service was to use IBM-connections. Other local telecoms firms started using MUX networks, and so did we, because Datel was too expensive and inefficient. We used the Martis Company's DXX-technology [Digital Cross Connect, technology converts the communication signals from one communication device to another], which was the same as FastNet, meaning that when we put together the Martis DXX and the pricing concept, we had the FastNet product. The concept was so successful that we had 66.76% market share by 1996. FastNet was efficient, we had earlier used an all voice channel at 64 kbit/s, and now we could have four of those. That was important because trunk networks were at that time expensive to build. The other important thing was process innovation. In the new technology network, that is, FastNet, configuration was made automatically, whereas earlier you had to manually manage all switchboards, now the time reduced from 15 weeks at worst to 15 seconds" (Informant 58, Quote 3).

Sensing

In FastNet, many sensing sources were used: customers were listened to, Sonera engaged in R&D with its vendors, and top management was active in setting targets for a new data business unit. Production and product management cooperated closely; there was strong demand in the market, and a united atmosphere of growth in Sonera. These facets created a newly competent sales culture. Sonera also listened to and learned from its customers and partners that included many large visionary companies (e.g., Kymmene, Kone). FastNet was an important product in entering competitor areas, as was explained in the VPN section (Chapter 4.1.3).

In the B2B segment, data had been considered the most important spearhead in Sonera by top management that also helped in the creation of a successful growth SBU.

Seizing

In terms of seizing, technology management and customer relationships were closely connected in the 1980s and 1990s, and clear choices were made about the technology.

"One thing I remember as linked to our competitive advantage was that we learned to listen to and learn from customers, we had these visionary customers, and I remember one was Kymmene that time. Choices and discussions with customers involved issues such as network technologies. In the early 1980s, a circuit switched technology was used, at ISDN with 64kbit/s capacity. There was then an aspiration to bring data communications into this ISDN and I realized that this circuit switched technology (ISDN) did not suit data communications. I refused to accept that ISDN was offered as a technology for data communications and I tried to put the brakes on ISDN development and therefore we lagged behind on development in Sonera. Instead we chose very fast managed connections for Datacom, which became FastNet and DataNet, where we got all the prizes in the 1990s because we were the only firm that had chosen that path" (Informant 20, Quote 3).

Innovation in creating services and using the liberalization trend in markets was common to early technology management in Sonera. The chosen new vendor, Martis, was important. Both DataNet and FastNet were managed services, and DataNet was built on FastNet's base. In this way, Sonera had end-to-end manageability of the service. The important aspect of the Martis node was that it was co-created with Sonera, a new industry standard, and it had open network manageability to these MUX networks at the time. Sonera wanted to have this trunk network management to the node, a totally novel functionality. One key informant reported that this functionality actually turned out to be a dominant design[79] for this open network manageability to MUX.

Sonera's key resources were deployed when implementing FastNet and DataNet. These also formed the barriers to entry to market.

"Key capabilities are our own access network, own trunk network, own hardware premises and production capability and IT-processes" (Informant 58, Quote 4).

The loose but supportive management style of the 1990s, was partially responsible for the success of the data products in Sonera and in the industry. The high prices in the market offered new target segments. New products, a new kind of image, and a new selling style for products were present.

"[Regarding] the change in technology in the voice area: the main point is that Sonera was active with vendors, we sought solutions to customer needs. In 1991, we had this data services unit and the data and telecommunications units were restructured. We ended up with the FastNet technology choice and a product with Martis equipment, currently Tellabs, which made it possible for switching hardware to manage capacity with a time division, each domain, and interface in voice exchanges could be filled to the maximum. The consequence was technology could be offered efficiently and especially when we looked at how competitors had attempted the business: each voice connection was in the worst case made with rented copper. In this situation, if you bring in one integrative service whereby one fiber connection carries all data and voice you have a benefit. In this way, we created efficiency and the future-proof DataNet and FastNet (Informant 16, Quote 7).

The resulting dominant design characteristics

The dominant design actualization was the product's market share (66.7%), it was a cost-effective transmission capacity leading solution, which offered a secured managed connection, and it had no challengers. The driver was that because 2Mbit was very expensive, when a customer

[79] Informant used literally the term dominant design.

had data and voice subscriptions, 2Mbit offered too much capacity and copper too little, there were no products in the middle. FastNet allocated the 2Mbit resources to both data and voice. FastNet also carried a 20% price premium.

Transforming (to following product generations)

While the FastNet business model and technology was fundamental and robust, new technologies and a new customer usage culture were gradually also replacing FastNet.

"Changes since FastNet have been minor; there was no revolutionary market changing technology to the basic infrastructure. Naturally, customers today are interested in Microsoft OCS [Microsoft Office Communications Server, an enterprise real-time communications server software, providing PSTN connectivity through a third-party gateway or SIP trunk] and instant messaging and presence: that will ease the communication, but the fundamental way we did things in the 1990s is still valid in terms of the technological solution and business model, albeit the techniques have changed" (Informant 16, Quote 7).

At the time of the interviews (2010) FastNet was in the declining stage of its life cycle brought about by the IP phenomenon. There is currently a transition to DataNet and Business Internet.

"The evolution of voice offerings through a call for customer bids could be summarized as first there was FastNet, today there is Sonera Business Voice Access, voice communications can be made with the help of DataNet and Business Internet [substituting FastNet]" (Informant 16, Quote 6).

Table 19 summarizes the transforming, sensing, and seizing phases building blocks.

Table 19. Transformation, sensing, and seizing phases building blocks in FastNet.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Previously, Datel (expensive circuit switched technology) and leased lines were used as a data transmission solution. Management found that it was possible to create an integrative cost-efficient solution in the network layer. **Convergence creation in company.** Superior functionality (e.g., in security and automation) and low cost (standard hardware) created networked products... **Market change in industry.** Changing customer demand meant a cost-efficient managed service was needed. **Technology change in industry.** New types of vendors, e.g., Martis, developed MUX (multiplexing).Sonera co-created the market with Martis. In telecommunications multiplexing is a method by which multiple analogue message signals or digital data streams are combined into one signal over a shared medium. The aim was to share an expensive resource.	**Regulation in industry.** B2B product, so regulators had no role. **Source of innovation.** A new type of start-up vendor was employed in Sonera. Innovative partnering with vendors was put in place. Pilot projects were run with customers. Competition forced the organization to find cost-effective solutions.	**Standards in industry.** Sonera used the MUX technology and enhanced that solution further. **Network effects.** All Sonera's customers' services were integrated in the trunk network with one platform (end-to-end manageability). Accordingly economies of scale emerged. **Complementary assets.** Flagship product considered by Top Management. Own access network, own trunk network, own hardware premises and production capability and IT-processes were used and they were considered as barriers to entry. **Modularity management.** Functional efficiency was created with IT solutions for network management and consequently the ease of manageability of the service improved. **Firm structure.** Closed vertical mode was used, no external partners were needed. Sonera used partly common telephone network in competitors' areas. **Ecosystem/Partners.** Active partnerships with vendors; solutions were sought to customers' needs. A top 3000 customers 'Sonera camp' was enhanced further by being future proof and confidence in Sonera's technological expertise. **Innovation type.** FastNet used new technology to serve current customers. **Technological competences.** Integration of data and voice networks, and network security management were the competences. **Appropriability for Sonera (and telcos).** A competitive price-point was found. Customers accepted the 20% price premium in service. No substitutes existed.

4.1.9 Integrated corporate segment Mobile business- MobiCentrex

Background

Sonera MobiCentrex was a PBX Attendant [Switchboard operator] service that was implemented in the mobile phone network in such a way that the customer received it as a service. It substituted for companies' fixed telephone centers. Sonera MobiCentrex brought PBX features to mobile phones in a flexible and cost-effective way. The system required no investment in equipment (Source: Sonera sales material, MobiCentrex, 2006). MobiCentrex was launched commercially in 1997.

Transformation from the previous product generation

The previous design to manage switching functionality for mobile calls was Privatel. With Privatel, one could make internal calls between mobile and fixed extensions but there was no switching function purely for mobile, as there was for fixed voice. Convergence thinking was directed at the need to talk and communicate in the same way despite the end terminal, but in the market there were no products to address this need, namely the attendant functionality of mobile phones.

It was apparent in the market and Sonera that MobiCentrex would also decrease costs. In Nokia's 2005 presentation relating to Western European markets the typical phone cost structure of a company was as follows: There was 100% fixed phone penetration and 50% mobile phone penetration, but the trend indicated that fixed phone penetration would reduce to 40% and mobile increase to 60%. In this situation, if people only had a fixed or mobile line (not both); the optimized phone cost structure would lead to 28% savings (Sonera sales material, MobiCentrex, 2006).

The functionality of the service was in PBX (Private Branch Exchange) functionality; it could be transferred to mobiles. For example, the basic functions of fixed PBX: the previously unavailable call transfer, internal numbering, conference calling, reachability profile, and call back on busy services became available on mobile phones. The technology development in computers, Intelligent network (IN) and in signaling technologies led Sonera to create a new technology application for industry, called MobiCentrex.

Sensing

The sensing aspect centered on R&D and science. Accordingly, the first version of the product was developed in an independent mobile B2B R&D unit. Sonera had very modern interfaces with an Intelligent Network for different technologies at the time. The interfaces were between fixed voice, data and mobile. Sonera had started to develop all the interfaces with computers (IN, TMN [Telecommunications Management Network], TUP [Telephone-User Part] and INAP [Intelligent Network Application Part] and MAP [Mobile Application Part]-protocols) in 1991 and by 1996 owned them. These interfaces were used to connect IN applications to the telecom network, and between mobile networks and telecom networks [SS7, Signaling System No. 7]). The interfaces enabled the management and control of the services.

The R&D function in Sonera sought to develop a service that no one else had considered. The outcome was the GSM short number pilot, which later turned into MobiCentrex. There was also a sense of confidence that the infrastructure and platform created purely for a mobile PBX would work; the mobile switches had the required capability. A market need was also identified: pure mobility for the SME segment, which was seen as a service to customers where those customers did not need extra investments. In retrospect this need was overestimated, because the SME segment also needed some fixed voice infrastructure at the time.

"At the time, we thought what kind of service would be one that no one had and there was then Elektrobit, our partner and we developed the GSM PBX service [i.e., MobiCentrex] from Elektrobit's military exchanges, which was like a Linux-box [Unix-like computer operating system]. We assembled the IN exchange from that and said we want this telephone exchange in Linux so we could manage that easily with these INs, these telephone exchanges. The first pilot we started to make was the GSM short numbering service, where companies can call and show only GSM as a switch. Then we had the features of PBX in the mobile, so we constructed this mobile PBX, Sonera MobiCentrex. I remember this was around 1994" (Informant 7, Quote 7).

The first version of the service was Sonera's own research and platforms; in other words, it was not based on the Nokia or Ericsson IN (Intelligent Network) logic.

Seizing

MobiCentrex was implemented inside Sonera with Sonera's own R&D resources, creating the firm's own standard. The service was the first of its kind in the market and another manifestation of the firm acting as a technological forerunner. An expert clarifies:

"The first version of MobiCentrex was in 1997, and we were 2-3 years too early on the market, but I don't know if that was harmful or not... . We were somewhat early and currently there are plenty of operators who implemented MobiCentrex. At the time the engineers just thought let's make the PBX's features for mobile and perhaps mobility would be seen to increase, but it was not envisaged that mobility would replace fixed phones totally" (Informant 2, Quote 3).

However, despite the success in creating a new service, there was a lack of support in Sonera. The service was difficult to sell, and fixed voice was so profitable at the time, sales units had no incentives to add other products to their portfolio. Furthermore, there were only a few segments in the market that were interested in the product.

MobiCentrex can be seen to incorporate more advanced thinking in terms of mobility post Privatel. The mobile switching functionality became a central feature. However, the macro trend toward mobility was overestimated at the time.

"Maybe then when we started to make MobiCentrex, it was like 1997-1998, we had at first an idea behind of what the service could be; OK, Privatel was quite a heavy solution, let's make something else for the SME segment. SME companies are going straight on to mobile and they didn't have the wire line. We had to trust our own mobile extensions capacities, because it was a pure mobile concept. But, then it later turned out that it was the wrong vision at that time: quite few companies were already ready to migrate directly to full mobile" (Informant 27, Quote 2).

The business model was to have PBX functionality in the mobile arena. However, as mobility was so important and there being different diffusion levels in countries, there were different product variants. Especially after the merger between Telia and Sonera who had different usage cultures in the market, the need for the MobiCentrex product had also been questioned (in Sweden all the calls are routed through fixed PBX, leading to a heavy, expensive and difficult to manage solution). A mobile expert from Sonera remembers:

"It has been tricky to get the PBX's functionality into mobile. In Finland, we made this MobiCentrex, but TeliaSonera Group decided there will be one common solution for all, 'full mobile', and we have found out since the merger of Telia and Sonera, it is like Isaac's church[80] "(Informant 17, Quote 6).

[80] A project that took a lifetime.

The resulting dominant design characteristics

Evidence of the dominant design is provided by the very significant penetration of Sonera's mobile subscriptions[81], and in the longer term, competitors followed the firm's lead. However, in the early stages the take up of the service was low. Interviewees commented that the reason was the limited tools for the attendant to switch calls between fixed and mobile; this worked in the laboratory but not in real life. Accordingly, the service needed to be more like a type of call center. In addition, at that time all of the financial resources went on developing the fixed voice PBX, Meridian [Nortel Company's telephone type]. The sales people did not want to sell the MobiCentrex product (an interviewee speculated that the basic voice at time was so advantageous to the business there could not have been any extra earnings). So, in a sense, MobiCentrex was quite a stand-alone product in Sonera's portfolio at that time, meaning that it was not widely accepted internally in Sonera. The MobiCentrex product was a global first (Sonera- world leader in mobile and IP integration and migration, 2004; Sonera internal material).

Transforming (to following product generations)

Transferring corporate PBX functionality to the mobile environment was the grand view in the mobility B2B segment. Privatel was the first step toward mobile PBX, and the transfer has taken 20 years. The inclusion of a large business segment in the offering base helped to grow the sales of the products.

"It took a long time for MobiCentrex to start fast growth. Still the key was to have the large corporate segment as a customer: Then in 2003 the sales skyrocketed, there were a large number of mobile phones in MobiCentrex service; part were in the Sonera Attendant service, and part were full mobile solutions to SME segment which was the original intent" (Informant 2, Quote 4).

During 1994–2006 there was constant fine-tuning and development activities for MobiCentrex. The sales messages centered on making operations more effective and flexible and on self-service management. These messages were not present at the time of the first launch of the service. Later, in 2004, Mobicentrex transformed into Sonera's Communication Solution in order to develop the attendant switching functionality.

Table 20 summarizes the transforming, sensing, and seizing phases building blocks.

[81] The penetration rate is confidential.

Table 20. Transformation, sensing, and seizing phases building blocks in MobiCentrex.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Earlier mobile phones had no attendant switching functionality and they were not integrated into a fixed PBX system. R&D management found technologies to support mobile switching and identified potential customers. **Convergence creation in company.** Sonera's SBU management had an idea to have a fixed voice switching function in mobile phones. **Market change in industry.** A need emerged in the SME and IT (Information Technology) segment for a pure mobile switching solution, the need was not strong in other segments. **Technology change in industry.** Sonera created the technology change in the industry. Sonera created linking interfaces between mobile and fixed network signaling and IN and Linux computers. Signaling and IN technologies were developed and applied to enabling convergent services.	**Regulation in industry.** Not regulated service, MobiCentrex was a B2B service. **Source of innovation.** MobiCentrex was an independent R&D experiment to mobile corporate segment. The idea was to develop a service that no telecom operators previously had. Technological expertise was found in Sonera in interfaces between computers, the Intelligent Network, mobile and fixed network.	**Standards in industry.** Sonera created and applied computer, Intelligent Network, mobile, and network interfaces. Standards in combination were important to the birth of the service. **Network effects.** Network effects were gradually emerging. A switching function was seen dominant also in mobile networks. Deficiencies in usability (attendant's tools) hindered the diffusion of the service. The more Mobile Centrex was in use, the better reachability was in place in customer companies. **Complementary assets.** Limited. No sales support in Sonera, because fixed voice was delivering significant profit at the time. R&D function did not manage to sell the product to the market and inside Sonera to top management and other business units at the time. **Modularity management** Technological interfaces were developed successfully. These were protocols linking computers, the telecom network and the mobile network together. They also separated services and their management. **Firm structure.** A closed vertical mode was used, though Sonera had outsourced some IT development (Linux computing) to a subsidiary. **Ecosystem/Partners.** There was limited ecosystem creation, IT houses and some small businesses were interested in the service. **Innovation type.** New technology to current and new customers. **Technological competences.** Interface technologies between mobile, fixed voice and computer systems were the competences. **Appropriability for Sonera (and telcos).** No substitutes existed for customers.

4.1.10 The integrated corporate segment mobile business: Sonera's Communications Solution

Background

Sonera's Communications Solution is a switching tool and information system for PBX attendants and employees, and mobile phones can be used as exchange components; there are also options to use an outsourced PBX attendant service. It was launched in 2004 under the name Sonera Attendant Solution, pinpointing the new functionality in call switching tools between fixed PBX and mobile.

The service is a solution where switching happens at the workstation and no separate switchboards are needed. The system provides up-to-date information on the person being called and on incoming and returning calls. The most important feature is that mobile subscriptions are seamlessly integrated in the company exchange (or replace all fixed-line phones) meaning that calls switched to mobile phones return to the PBX attendant if they are engaged or unanswered.

Transformation from the previous product generation

The previous design was the Vipgate concept as a whole (integrated total solution with fixed and mobile). A spearhead was changing gradually to a one phone concept[82] with the MobiCentrex product. However, there were no reliable and user-friendly tools for an attendant [a Switchboard operator] and the full functionality of mobile PBX was lacking. This was the reason why the large business segment was lagging behind in terms of mobility solutions, whereas the full mobile concept was gaining credibility in the SME segment. In the market there was also a situation that only a little over a half of the organizations in Finland had invested in employee reachability (Finnish voice systems, 2005, Netwise Oy, in Sonera's Communications Solution product material), so there was room to improve reachability solutions.

At the launch Sonera's Communications Solution, management saw the following aspects to be important. The diffusion of mobile phones in Sonera's B2B segment was perceived and enhanced in the market with Sonera's Communication Solution. In addition, the transition to IP and getting rid of a circuit switched voice (PSTN) was seen as providing internal cost savings; there would be a transition either to mobile (small

[82] It was beneficial for customers and eventually to telcos (due cost savings) to have either a mobile or a fixed phone, not both, though both phone types existed/ exist in companies.

companies) or IP-based traffic (large companies' IP-based company subscriptions, e.g. Sonera Business Voice Access). Sonera created the technological change in the industry, when it created a robust switching tool for attendants, called a Merex service. Merex was Sonera's homegrown product/service.

Sensing

The sensing was led by listening to customers and observing market needs. A marketing innovation took place (a service bundle), which was based on developing customer companies' credibility and brand in the market, when their reachability was in order. Sonera's middle management realized that separate products could acquire synergy if they were marketed as a bundle. Functional benefits also emerged. The focus was shifting from costs to effects (e.g., staff reachability, for example integrating electronic calendar systems into attendant services). The earlier products were also used when creating synergy. MobiCentrex and the Cid company number service were linked to the Sonera Communications Solution. Management also sensed that if Sonera's Communications Solution were not started, it would not be credible to offer the customer a development path toward full mobility. The key plan for Sonera's Communications Solution was to integrate an attendant service into the full mobile environment or if a customer had both fixed subscriptions and mobiles, to both of these environments.

The customer need was clear and the industry needed the new functionality.

"Sonera's Communications Solution also made it possible for large companies to achieve full or near full mobilization. It fulfilled the promise of "full mobility" because mobiles could then be totally integrated into the company's call switching functionality. Before that, the full mobile concept was credible only in the SME segment. But after the service a LCC [Large Corporate Customers] segment was truly going to be mobilized. The concept was good in the sense also, that it was difficult for competitors to copy. Sonera's Communications Solution never got the attention it deserved because the Swedish didn't understand that LCC would abandon the fixed subscriptions, and because they didn't have it in Sweden, they didn't want to understand it" (Informant 2, Quote 5).

Seizing

There was important technological progress in technology developed by Sonera (Linux based Merex technology), which evolved into improved usability of the service.

"Before Sonera's Communications Solution attendant could switch a call to mobile but the calls never returned. This might sound a minor thing but actually it was a big issue because companies told us we can't increase our mobility if you can't fix this attendant functionality for mobile. After this service, the fixed lines amount reduced further and mobility increased" (Informant 2, Quote 6)

Sonera's Communications Solution was a strategic product in Enterprise Networking Solutions (ENS) (in the business unit, it was constantly the topmost of ten prioritized projects). The focus of the ENS unit was to create integrative B2B products, between the mobile and more consumer-type bulk products' units, such as consumer services units. The productization took two years and the product was launched in 2004. Challenges in creating the project were numerous, and included cooperation with product silos and the customer trainer not always having enough information about the integration world. In delivery and maintenance systems there was no single system where the product was manageable. Moreover, interest groups observed it was hard to understand different versions and the key differences between them.

However, despite the previous challenges, the internal management environment at that time supported the creation of an integrated product offering (despite the merger with Telia). A new organization was created, where B2B mobile and fixed voice were housed in the same organization. In that way synergy emerged and a new "success application," a product bundle (convergence product) comprising MobiCentrex, the Cid company number service and Sonera's Communications Solution was introduced.

"The business driver in Sonera's Communications Solution was the integration of current fixed and mobile business worlds, the protection of fixed network profitability and increase in mobility, because at that time mobile voice was clearly profitable" (Informant 2, Quote 7).

"MobiCentrex supported by Sonera's Communications Solution was a radical technological transition" (Informant 4, Quote 3).

In Finland, Sonera's Communication Solution eventually became a significant success in the market.

"In the late 1990s, MobiCentrex came but it didn't take off. But, technology houses adopted the service in 2000s. Then came the big organization change—fixed and mobile came together and a marketing innovation was developed. That meant the cross selling of the Cid Company number service and MobiCentrex. This brought credibility for corporations, MobiCentrex suited a certain size of company, but the attendant's tools were missing. Then the innovation of how to combine current robust fixed-line attendants and MobiCentrex was developed as Sonera's Communications Solution, which executed the integration" (Informant 15, Quote 3).

Sonera's Communications Solution did not receive the appreciation from the Swedish organization, because in the Swedish market it was hard to understand that complete mobility was also an option for the large business segment. There were also fears in the Finnish organization, that the product's strategic importance in Finland would be jeopardized.

The resulting dominant design characteristics

The manifestation of the dominant design was that there was significant penetration of Sonera's Communication Solution integrated into Sonera's mobile subscriptions; competitors tried to follow later. Moreover, strong convergence product innovation emerged between MobiCentrex, the Cid company number service, and Sonera's Communications Solution. The key dominant design product specification was to have up-to-date information on the person being called, and on incoming and returning calls, and calls switched to mobile phones that were returned to the PBX attendant if unanswered. The specification that defined the architecture was Sonera's Merex [Sonera's software product] and Merex mobile products, which were an in-house development. At that time competitors struggled to copy it. In addition, the dominant logic in the market shifted with Sonera's Communications Solution product, the new dominant logic turned out to be one end terminal policy. That policy meant customers could offer either mobile phones or fixed phones to their workers, and not necessarily both end terminals.

Transforming (to the following product generations)

New competences emerged during the product's life cycle.

"In Sonera's Communications Solution new competences have emerged: how to integrate contact management and the MobiCentrex service platform. And from the sales side, how to communicate and rollout change projects, the identification of user groups and their profiles, and how to manage voice traffic" (Informant 15, Quote 2).

During the period (2004–2010) the Sonera Attendant solution was developed into a marketing concept. That concept also involved other products being sold; namely Sonera IP (Internet Protocol) Voice solutions, terminal device services, and phone leasing. Currently the service is in use, but it is also offered as an element of the Unified Communications service.

Table 21. Transformation, sensing, and seizing phase building blocks in Sonera's Communications Solution.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous Dominant logic in industry/ company. Earlier, hybrid products were not available; products were either mobile or fixed business. Sonera's middle management believed that usage of mobile phones would increase in the business segment, if the usability and reliability of the mobile switching function increased to create a robust hybrid service (because large companies were not yet ready to give up fixed voice PBXs). **Convergence creation in company.** Sonera created convergence with Attendant functionality. The communication solution fully integrated mobile and fixed voice communication (including the crucial Attendant functionality). **Market change in industry.** Full mobility was starting to acquire the confidence of the market, i.e. mobile is as capable as fixed voice in attendant solutions. **Technology change in industry.** Sonera created the technology change in industry. Sonera had R&D capability that made possible the creation of Merex- an internal technology to bridge fixed and mobile switches and attendant's tools.	**Regulation in industry.** A business segment service, so not a regulated product. **Source of innovation.** Market feedback was used. The business idea was the one phone concept, meaning customers could have either fixed phone or mobile, and switching functionality could exist in both concepts complemented with an attendant solution developed in-house. The firm sensed that the switching functionality was inadequate in mobiles at the time.	**Standards in industry.** Sonera's own in-house standard was developed, a crucial element in the service. **Network effects.** Customers could also outsource the attendant management to third parties. In customer companies silo technologies (i.e., separate services) were integrated. Earlier usage of separate products increased. **Complementary assets.** Sonera created a successful marketing innovation to sell a product bundle: Cid, MobiCentrex and Sonera's Communications Solution products. Production across product silos worked smoothly, despite the silo structure of Sonera at that time. **Modularity management.** A solution was built that had modules a customer could choose. No aggressive migration in customers' solutions were pursued, on the contrary customers could choose their own migration path to service releases, i.e., hybrids in this case. That policy was considered successful for the incumbent Sonera at that time. **Firm structure.** A closed vertical mode was used, though some parts of the service were provided by subcontractors. **Ecosystem/Partners.** Very successful product that helped to regain a brand and impart confidence to Sonera in the business segment. Sonera convinced customers of its capabilities in creating hybrid convergent services (the customer could use fixed, mobile, or both technologies). **Innovation type.** New technology to current customers. **Technological competences.** The competences demonstrated were internal technology development with interface technologies between fixed and mobile voice, attendant and company's directories. **Appropriability for Sonera (and telcos).** A price premium was possible, no substitutes existed at first. Elisa followed two years later.

4.1.11 Unified Communications

Background

From a technology perspective, Unified Communications (UC) was driven by the adoption of Internet Protocol. UC is the name given to the attempt by enterprises to bring all their disparate modes of communications together in a managed way, with one client, through software communications applications (Gartner, 2007). Essentially, telecoms and collaborating software players would be merging telecommunications and Internet in this attempt (OVUM, 2007, Financial Times, 2010, Gartner, 2007).

UC was a mindset of integrating communication (telecoms) and the IT world—not just a single product:

"Maybe the technological change could be that we are moving into packet-based transmission and it opens the market, we are not so closed anymore and there will be other players, which partly opens up the industry. The progress in packet-switched technology enhances the development; there will be more value-added players besides a telecom operator, and it increases the risk that operators will drift toward or voluntarily move to the bit-pipe role" (Informant 2, Quote 8).

Thus, UC was reflecting what the most challenging customers were demanding in the B2B market. However, at the outset, UC was not an area very familiar to telecom operators:

"The most demanding customer case today is based on communication with presence information and communication as a total solution, what is then being sought? A mobile solution, fixed voice solution, customer service solution, voice attendant solution; Unified Communications brings demands with regard to what one wants to do, how one wants to communicate. Instant messaging, UC client to softphone, how e-mail is to be integrated, where one takes presence information. Microsoft is leading the discussion today; 80% of mail platforms are Microsoft's, but there will be other platforms as well" (Informant 16, Quote 9).

"These cases are difficult in a large business segment, for example CRM when we know that Sonera isn't an application integrator, also new kinds of flat rate pricings are popular, but traditional billing processes are still the majority in Sonera" (Informant 40, Quote 1).

Indeed, according to the OVUM (2007) report (p.8), the development of UC involved overlapping interests for telecom vendors and IT players. Telecom operators started producing IP-based voice in the 1990s, as well as audio and videoconferencing, but at lower quality than in their traditional PSTN networks. The IP-based voice was considered to be associated with Unified Communications. At the same time, IT players such as Lotus and IBM created and used the emerging collaboration techniques over the web, such as instant messaging or remote control of PCs. An example of a service that integrates both areas (IT and telecom) is IP-PBX and the related IP Voice.

Transformation from previous product generations

The previous design and logic in communications was a 'one device policy', which was manifested in Sonera's Communications Solution. The UC development would mean a shift from end terminal based communication to user-based communication. Technological issues meant it was not previously seen as possible to integrate the voice traffic of the Microsoft OCS 2007 [Office Communications System] to the external PSTN network or—in a user-friendly way—to integrate different communication channels into one channel. Convergence was present in UC: new players, new sectors and new types of vendors entered the telecommunications' value chain (Kenney and Pon, 2011; Sonera interim report, 2009).

Convergence was present in UC: new players, new sectors and new types of vendors entered the telecommunications' value chain (Kenney and Pon, 2011; Sonera interim report, 2009).

Unified Communications can be explained as a continuum during the period 1992–2012, as shown in Figure 16.

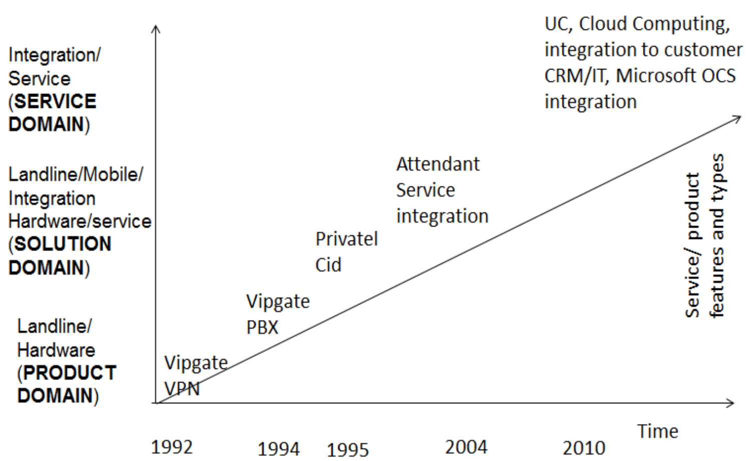

Figure 16. Evolution of communications. (Reconstructed from interviews and case histories).

Figure 16 depicts the evolution of the offerings. They evolved from a product domain owned by customers to a service domain operated by service operators on behalf of customers. The important thing in product life cycle management was the transition from terminal thinking to service thinking. Eventually, UC would be described as the last part of this communications continuum or life cycle.

"Now, in turn, it is so that with unified communication the user interface is unified, the relevant end user device is used, be it mobile phone, PC or laptop, or whatever" (Informant 15, Quote 5).

Sensing

The sensing sources of UC were centered on market feedback. UC was at the intersection of old and new offerings, and with old and new customer bases (Gartner 2007, 2008b, 2011c; OVUM, 2007).

"UC product development has started from the needs of middle management and markets. Finland is above all dominated by Microsoft and it has had its own message of what is to be done, so we had this idea about UC facets and started to develop how we could integrate them into office communication. Companies think UC and they are interested, but whether there is the ability to fully move to total IP-services from networks is uncertain. There are the IT houses and telecom houses as the producers of the UC service. Nevertheless we must also remember that traditional PSTN networks are very large and still important. For example in Sweden there is a totally different situation in traditional voice services than there is in Finland and the customers are reluctant to put all their eggs in one basket. The situation today is a hybrid, we have fixed PBX and mobile and unified communications connected" (Informant 15, Quote 4)

At a grassroots level, customers wanted better usability and UC functionality. Partner management was seen to be more important than it had been previously. IT houses, Microsoft and IBM were especially important, because the operator had to link the operator offering with the IT offering, which had up until then been provided mainly by IT houses.

The most important thing in the sensing phase (2008) was the idea that "all will be converged." This meant that first the circuit switched fixed voice would be integrated with mobile voice, and then this entity would be integrated with fixed voice IP (VoIP). Then this entity (VoIP) would be integrated with the company's IT systems and index of persons. In addition, messaging (e-mail and instant messaging) would be needed in the same entity. Finally, an effective Unified Interface (UI) for the whole communications solution would be needed. The converged environment was challenging, and Sonera saw some benefit in terms of legislative regulation, when it could offer the voice services with the required call ticketing (as this was not possible for players who had no telecom infrastructure).

Seizing

Different products were gradually productized in Sonera into the UC realm, under the name Sonera VIP. The technological solution behind Sonera VIP was as follows: a software client was added to the computer and mobile phones; a firm could influence the reachability of its workers and there were now attendant services in the mobile area. In this way, UC brought business benefits to customers in the form of cost savings and better cooperation. The most important thing from the user point of view is the service, not the network for data transfer or the technology. Sonera also offered UC services from its networks and this meant that customers were not required to make extra investments.

The UC productization project was complicated; including many formal vendor evaluations, different standards, three organizational changes, many internal political conflicts, and different objectives in the technology, business and product dimensions. It was also considered that the top management was not fully committed to the project. There were agreement negotiations where the middle management was on their own crusade to have a new type of vendor to implement the service (while earlier vendors were the known incumbents, Ericsson etc.). Also, the cooperation and persuasion of the 'old' units, especially the mobility unit in Sweden (and to some extent, the broadband unit), was seen to be very difficult. However, at the same time, the relations with Sonera's external partners were seen to be very smooth and professional. The project took about two years.

The goal of the project was to productize an internet-based, rich unified Sonera Communications Solution package for SME companies, to replace the bulk of Sonera's earlier services. These services were MobiCentrex, the Sonera Communications Solution, Privatel, Corporate Call, Opal (fixed Centrex service), and the reachability services forming part of the Cid Company Number Service. Under UC, a customer would pay a monthly fee per user. The earlier services, to be replaced, were based on volume based billing. In other words, there were many old communications infrastructure applications that were to be displaced with new UC technology, displacing proprietary telecom infrastructure.

"We now have a technological turning point which the dominant design is offered to customers. We already had unified messaging in the late 1990s, which indicated that e-mail, voicemail and fax are to be integrated into the same end device" (Informant 2, Quote 9).

Internal business management was seen to be a huge challenge in the productization of Unified Communications Interviews, internal project management material):

"The UC project started with IES time and it was run by the broadband division, Sonera VIP was the commercial product. The internal fight over whether we would be allowed to implement it and if it would harm the mobile business was huge—a typical discussion in Telia. The selling of UC was a big thing for the Swedes, but when other players were moving and customers wanted it, finally it was understood (including by the Swedes) that something must be done. Then there were discussions over whether a net based system was okay, and it took 6 months conversation to decide who would offer the product. This was an integrative product sitting between mobility and broadband, and then there was an agreement that broadband would offer these kinds of integrative products" (Informant 2, Quote 10).

An internal product matrix pinpointing the UC target segment is presented below in Figure 17.

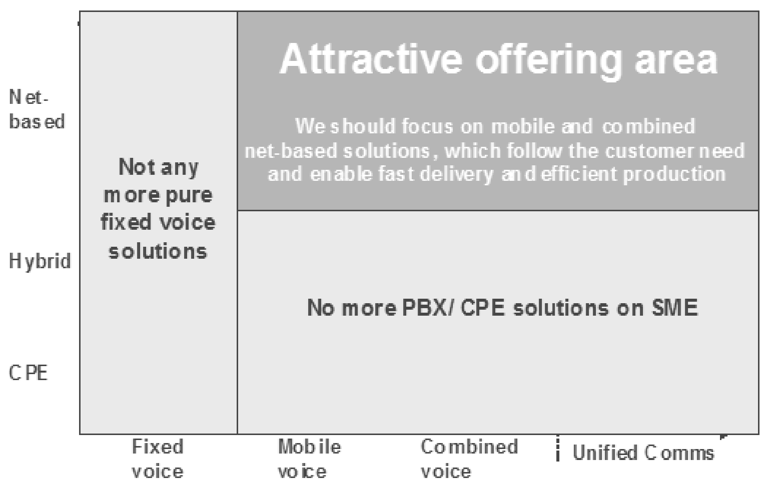

Figure 17. UC- Attractive offering area. (ComSol Product Strategy. 2008. Sonera internal material).

Figure 17 presents the technologies on a horizontal axis and the way voice solutions are offered to customers. The CPE (Customer Premises Equipment) and Fixed Voice offering was the starting point. The attractive offering area, which was seen as the target, was the net based unified communication offerings.

The next quotations illustrate how Unified Communications would bridge many themes: partner management, ecosystem building, convergence and cost saving in networks, and new kinds of capabilities demands. Partner management was seen to be more important than it had been previously.

"In UC innovation, beneficial partners are important. For example, we cooperate with Microsoft and IBM and also in this area we develop our own technology on the SME side. UC will bring big vendors heavily into play, we must know what they are offering and have good relations and cooperation, the world isn't ready in this UC world. We could say that Microsoft has their contacts with customers and possibly some sort of dominant design, but they don't have the network and connections, they always need a partner. Who wins the game is the player who can influence the customer with a suitable partner network and the winning player could also be Google" (Informant 16, Quote 10).

"With regard to the customer, UC means diluting the technological difference in production more and more and it is going to convergence (data, mobile, fixed voice) but in smaller steps that had been thought. There has been research on convergence for at least 20 years, that mobile and Internet will converge and old structures will collapse, but we still have a big Mobile business and big unconnected Internet business. However, in the transition area things are happening in an evolutionary way, the big idea is, for example that when the mobile business is in IP (Internet Protocol), then the machines are closer to each other inside the company" (Informant 38, Quote 1).

With the UC offering, in 2010, Sonera would finally have OCS (Microsoft's product, Office Communications System) functionality, integrating IT and telecom. The partner chosen to deliver the solution, Telepo, was different and more agile than the other, incumbent, vendors.

Unified Communications was both one entity and it had important separate telecom elements. IP networks were important in the creation of services but also from a cost optimization viewpoint. There were, however, contradictions in terms of identifying the strengths of telecom operators in UC.

"UC is linked to our production vertically. The UC is so critical to us so even these standards like Microsoft solutions are used in our production. And we are not making these UC solutions from the cloud [Cloud Computing] in this stage, if ever. Still, of course, the buyer and IT director want to have follow up information on how their UC investment is doing and report that to their organization" (Informant 40, Quote 3) .

"An operator has two clear benefits from the UC offering: we have experience of how to attach terminal devices and manage them in offerings, and the regulation requires call ticketing, login info, routing information, and this is the operators' area" (Informant 40, Quote 4).

There were threats in the industry at the connectivity layer, that some player other than a telecom operator would have the key resources. There has been discussion concerning a revenue model between telecom operators and IT players and the possible role changes. Operators were seen as having a bit-pipe role[83].

"In principle, UC is made in IP networks, if we look at it as a voice application. UC is one way to do IP VoIP Centrex, which means its own address jungle is built inside an IP network. The network built creates value-added services with different servers wherein the control gateway is the key element. The gateway takes control and defines what services are to be used and where to get them, even from the network layer. The gateway can also be operated by Google or Skype. It must be noted, however, that there is a law of the jungle in these servers, despite which the operator must offer legacy subscriptions, and in that case, the operator does not make money from the value-added services. The positive aspect is that there will be cost savings in the future when all the traffic, also mobile, goes to IP, which means packet-switched traffic" (Informant 24, Quote 3).

The resulting dominant design characteristics

Sonera's old products (MobiCentrex, Sonera's Communications Solution, Privatel, Corporate Call, Opal [fixed Centrex service], and the reachability services that formed part of the Cid Company Number Service) were to be replaced with UC, and in this sense, UC actually represented a new design and logic to provide services and define what elements would be converged. In addition, the ecosystem and the customers' buying habits were moving toward buying the products as a service (shared standard services), which meant Sonera offered and operated these services from its network.

However, the definition of what UC was, was not standardized. The UC concept could be restricted to voice communications only, or extend to office communications (including e.g., e-mail). A loose definition provided by Gartner (2011, p.3) was: "*Familiar technologies, such as telephony, messaging and conferencing, are being supplemented by rapidly developing communications applications based on fast-moving*

[83] A way of expressing Telecom Company offers only capacity, not value-added services.

networking technologies (such as presence and Session Initiation Protocol [SIP]) that will facilitate UC and enhance the role of communications in automating business processes".

Transforming (to following product generations)
At the time of the present case analysis (2010), UC was offered widely in the telecom/ICT industry. However, there were many standards and definitions of the concept regarding the scope of the service. Accordingly, the possible transformation to the following product generations was conditional on the de facto standard that was still being formed.

Table 22 summarizes the transforming, sensing, and seizing phases building blocks.

Table 22. Transformation, sensing, and seizing activities in Unified Communications.

Building blocks		
Transforming from previous product generations	**Sensing**	**Seizing**
Previous dominant logic in industry/company. Earlier, many dominant logics on how to integrate mobile, data, voice and user interfaces in corporate communications were in place. The emerging dominant logic in industry dictated that corporate communications would be fully internet-based. Sonera's middle management saw the redesign need of the corporate communications offering. The need was to offer net based, and bundled pricing per user. This was a new business model, necessary in order to be competitive in the market. **Convergence creation in company.** Interfaces were built between IT systems and the PSTN network. IP networks offered capacity to all services. The challenges lay in creating service convergence above the IP transmission layer, e.g., in the usability of services. **Market change in industry.** Changing buying habits in B2B sourcing (e.g., earlier telecommunications sourcing as a separate function from IT sourcing) would need to change. Alliances and cooperative arrangements emerged between telcos, vendors, and system integrators (e.g., IBM, HP, Tieto). **Technology change in industry.** Data storage technologies capacity and software programming skills progressed. These enabled IT players to provide cloud computing services (i.e., producing telecom services substituting proprietary telecom technologies).	**Regulation in industry.** UC was a Business segment product. It was not regulated, although some legislative norms existed. These were, e.g., call ticketing. **Source of innovation.** Sonera's middle management found out "all" would be converged. Middle management identified a need for the service from customers. Equipment vendors started to have IP-based PBXs. There was also pressure from competitors that had UC solutions earlier than Sonera. New business models were found (i.e., bundled services pay per user) in order to compensate for the declining revenues from old business services.	**Standards in industry.** Many standards existed in parallel; these would be used but they did not create the service as such. Telecom operators were forced to learn about IT houses' offerings, and standard interfaces were built (e.g., Microsoft standards). **Network effects.** Limited in Sonera. Hybrid solutions between old PBX-centric solutions and UC needed to be built, in order to have full network based offerings. **Complementary assets.** These were limited. Complementary assets in production existed in Sonera, but there was little support from top management to middle management. Product silos were still present in Sonera (especially in Swedish mobile and broadband areas). Further, Sonera was still learning how to sell service packages (exemplified by questions such as what part is UC and what part is other telecom infrastructure). **Modularity management.** Sonera tried to learn how to manage its customers' total solution (consisting of separate services). Sonera tried to develop routines related to IT systems. **Firm structure.** IP (Internet protocol) opens up the telecom firms (Sonera) and their product structures (i.e., players other than telecom operators could also offer UC). **Ecosystem/Partners.** Management of partnerships, sales and marketing costs became important. UC solutions were produced with IT players. **Innovation type.** New technology to current and new customers. **Technological competences.** The competences were net based solutions, billing systems, and the integration of current and new technologies **Appropriability for Sonera (and telcos).** Telecom earnings were threatened. The operator tried to offer value-added services (rather than acting as a mere "bit pipe") by having control of the control gateway in a transmission network. The gateway defined what services and what prices were offered (as IT players such as Google were also interested in this). The way of communicating was also moving to a partly off-line form (e.g., Facebook messaging), replacing telecom companies' preferred form of communications, that is, real-time online communication (e.g., calling and SMS).

4.2 Analysis of the nature of dominant designs and their evolution (answers to research questions)

The lifecycle of the telecom industry as a whole is considered when analyzing the evolution of dominant designs, and also the lifecycles of the different sub-industries[84] (Appendix 13). When I draw analyses and offer propositions, I elaborate on the appropriate level of analysis (i.e. industry, sub-industry or product lifecycle, and the particular stage of the cycles).

I discuss the findings in relation to research questions 1-3. Research question 1 was as follows: What sources of innovation and what processes are related to (a) a multi-product firm's successful management of its dominant designs and (b) successful transformation from one dominant design to the next? I elaborate on the sensing (sources of innovation), seizing and transforming activities in Sonera—and how these activities varied across more or less successful cases. Finally, with regard to the activities and building blocks of the transforming phase I focus on how the company moved from one dominant design to another within the product (development) cases.

[84] For the purposes of this study, the concept of sub-industry has two meanings. *First*, telecommunications, being so extensive, is commonly divided into different product areas called sub-industries (e.g., OECD, EITO). *Second*, hierarchical networks of sub-industries are common in technological systems, such as "microprocessors, graphic processors, and software" in PCs (Dedehayir and Mäkinen, 2011, p.629). The following telecommunications sub-industries are referred to in this study, each of which has its own life cycle (Appendix 13): 1) B2B data services with the following products: DataNet, FastNet, TeleSampo, and TeleSampo Internet service; 2) B2B integrated voice solutions with the following products: the 9700 and 9800 service numbers, Corporate number (CID), Mobicentrex, Sonera Communication solutions, the Vipgate concept, Vipgate VPN; and 3) Mobile Internet with the following products: Mobile iPhone and Sonera Zed; Mobile services with the following products: GSM, NMT-450, NMT-900. Unified Communications constitutes a new industry that includes all the above sub-industries. *The sub-industries have their own lifecycles, although this sometimes coincides with the industry lifecycle. Hence, the only difference between sub-industries and industries and their related lifecycles is the level of analysis*. I derived the sub-industry lifecycle stages by analyzing legislative regulation, the market structure, the number of companies, the emergence of standards, cost structures and levels, turnover, volumes, and price levels.

The second research question was: What are the relative roles of the sources of innovation in the successful adaptation of dominant designs and their 'building blocks' in terms of a) the process, and b) how they change over time? I elaborate on how these sources have shifted over time, and on the course of the adaptation process (VSR). I then develop a framework for the adaptation of dominant designs, grounded on the present empirical cases and their cross-validation with earlier theory and literature. Next I discuss the relative role of sources of innovation in successful adaptation. In conclusion I analyze the relationships between the building blocks, also elaborating on the concept of convergence.

Finally, research question 3 was: What role does the nature of products as complex technological systems play in dominant-design adaptation processes and outcomes? I analyze how the relationships between the innovations are related together infrom a longitudinal view perspective (i.e., a portfolio analysis) including. This section is organized to analyzing the technological sources of technologies (included in the sources of innovations), the capabilities in Sonera, and the relevant legislative regulation. The following chapter section, includes a portfolio analysis of technology development and innovation types, and discusses the nature of complex technological systems and ambidexterity in the management of dominant designs.

4.2.1 RQ1: What sources of innovation and what processes are related to (a) a multi-product firm's successful management of its dominant designs and (b) successful transformation from one dominant design to the next?

I begin this section by recalling which cases of dominant-design adaptation in the multi-product firm Sonera were successful, and which were not. This provides a basis on which to analyze successful sensing, seizing, and transforming in Sonera. I then proceed to analyze the successful transformations.

First I show how the cases are classified as successes or failures. I include the success metrics of the cases, and discuss what types of innovations Sonera created modified and adopted in the telecom industry lifecycle.[85]

[85] Technologies were developed during the introduction period (1980-1995), and the regulator did not allow full competition. The industry grew strongly in terms of volumes and players during the growth period (1996-2001), and competition was further liberalized. The number of players stabilized during the

mature period (2002-2007), and new product offerings were minor as far as the industry was concerned. Finally, new technology enabled more players from adjacent fields to enter the telecommunications industry during the new introductory period (of the industry) (2007-2010). The players in this (ICT) market are telecom operators, IT houses, and vendors. In addition, I have classified the industry life cycle as Closed (1980-1992), Semi-closed (1993-2001), and Open (2002-2010).

Case SUCCESS vs. failure	ILC stage	Sub-ILC stage	Launch year	Industry stage	DD to Sonera's market (Yes=1, No=0)	Standard product architecture emerged on Sonera's market (1=yes, 0=no)	New product profitability for Sonera, scale 0-1 (1=success, very successful)	New product advantage, scale 0-1 (1=success, far superior)	Local endogenous innovation.	Local exogenous innovation	Global exogenous innovation	Innovation type
SN 9800	Intro	Intro	1987	Closed	1	1	0.9	0.8		x		Architect
~TeleSampo	Intro	Intro	1987	Closed	0	0	0.2	0.6		x		Architect
SN 9700	Intro	Intro	1988	Closed	1	1	0.9	0.8		x		Architect
DATANET	Intro	Intro	1989	Closed	1	1	0.7	1	x			Architect
FASTNET	Intro	Intro	1991	Closed	1	1	0.7	1	x			Revolut
VIPGATE VPN	Intro	Intro	1992	Closed	1	1	0.5	0.8		x		Revolut
MOBILE GSM	Intro	Growth	1993	Semi-closed	1	1	1	0.9			x	Revolut
PRIVATEL	Intro	Intro	1994	Semi-closed	1	1	0.6	0.9	x			Architect
VIPGATE CONCEPT	Intro	Growth	1995	Semi-closed	1	1	0.7	0.8	x			Regular
CORPORATE NUMBER	Intro	Growth	1995	Semi-closed	1	1	1	1	x			Niche
~TeleSampo Internet	Growth	Growth	1996	Semi-closed	0	0	0.4	0.2			x	Revolut
~Mobicentrex	Growth	Growth	1997	Semi-closed	0	1	0.2	0.6	x			Revolut
~Sonera ZED	Growth	Intro	1999	Semi-closed	0	0	0.1	0.5	x			Architect
COMSOL	Mature	Growth	2004	Open	1	1	0.7	1	x			Revolut
MOBILE iPHONE	New Intro	Growth	2008	Open	1	1	0.8	0.8			x	Architect
~UC	Intro	Intro	2009	Open	0	0	0.5	0.6		x		Architect

Table 23. Success and failure cases.

Products and services[86] in the lower case are failures and in the UPPER CASE are successes. I base my classification of the cases as a dominant design or not on the empirical narrative in the relevant sections on dominant-design characteristics in Chapter 4. I determine success in terms of three facets: 1) whether standard product architecture emerged on Sonera's market (1=yes, 0=no), 2) the degree of new-product profitability for Sonera, scale 0-1 (1=success, very successful), and 3) the degree of new-product advantage, scale 0-1 (1=success, far superior) (Harmancioglu et al., 2009). The cases include three innovation types: 1) created by Sonera in-house (local endogenous innovation) (9700, DataNet, FastNet, Privatel, Cid, the Vipgate concept, MobiCentrex, ZED, Communication Solution), 2) modified by Sonera from innovations created outside the company (local exogenous innovation), (9800, Vipgate VPN, TeleSampo, TeleSampo Internet, and Unified Communications), and 3) adopted/copied and implemented by Sonera (GSM, iPhone) (Global exogenous innovation). The last column, innovation type, uses Abernathy and Clark's (1985) typology.

I adopt the view that the industry lifecycle is external to dominant designs, a that view has attracted little attention in the discussion (Anderson & Tushman, 1990), although Klepper (1996, 1997) mentions it. In addition, Sonera created different innovation types at all life-cycle stages. This contradicts Abernathy and Clark's (1985) view that dominant designs emerge only after architectural and revolutionary innovations.

Sources of innovation and processes associated with the successful adaptation of dominant designs

Sources of innovation. In order to determine the kind of processes that are related to a multi-product firm's successful management of dominant designs, I integrate adaptation processes on the company level with the analysis of the industry lifecycle. These dominant-design-specific processes include the sources of innovation and the processes as set out in the sensing, seizing, and transforming (Teece, 2007) tables in the case study. The relevant sensing, seizing and transforming elements are manifested in the capabilities, organizational structures, processes, and managerial cognition (dominant logic) that strengthened or restrained the

[86] For the purposes of illustrating differences in the environmental context and in how dominant designs were adapted (through creation, modification or adoption) I retain GSM, Sonera ZED and iPhone in the analysis: all three are discussed with regard to the history of Sonera/the industry. However, I do not analyze them in detail as cases (i.e. .Teece's (2007) typology of sensing, seizing and transforming in Chapter 6).

adaptation of the dominant design. I elaborate next on the multi-product firm's sources of innovation and processes in its management of dominant designs. Sources of innovation refer to innovative ideas in the sensing phase, and processes to activities in the seizing and transforming phases.

Sensing activities include identifying new information and its scope. Scope, in turn, refers to global or local reach, in other words how novel the new information, or ideas, are in relation to the company's current activities and business (e.g., McGrath et al., 1992).

As the case descriptions in Chapter 4 show, Sonera had different sources of innovation, especially regarding the various product-development ideas adopted in the sensing phase. These ideation sources included the company's own applied R&D activities, scientific markets and customers, investor and industry interests, top-management's visions, and vendors.

Sonera used many sources at the same time, but also on occasions emphasized certain sensing sources. Table 24 analyzes the sensing sources in the cases.

Table 24. Sources of innovation in the cases.

Case	Success (1/0)	Science	Internal R&D	Market	Top Management	Investors/Industry	Vendors
9800 (modification)	1	4	5	6	4	3	3
TeleSampo (modification)	0	6	6	2	6	7	2
9700 (creation)	1	5	6	5	4	3	2
DataNet (creation)	1	7	7	6	4	6	7
FastNet (creation)	1	5	6	7	5	6	7
Vipgate VPN (modification)	1	3	5	7	5	2	2
Mobile GSM (copying/implementing)	1	5	6	5	5	5	5
Privatel (creation)	1	5	6	6	5	3	1
Vipgate concept (creation)	1	3	4	7	5	2	2
Corporate number (CID) (creation)	1	5	6	5	4	3	2
TeleSampo Internet (modification)	0	3	4	5	6	5	2
Mobile Centrex (creation)	0	6	7	2	2	1	1
Sonera ZED (creation)	0	3	5	3	7	7	5
ComSol (creation)	1	2	6	6	4	3	2
Mobile iPhone (copying/implementing)	1	2	2	7	5	3	7
UC (modification)	0	2	3	6	3	3	6

The sources of innovation are classified in the table 24 as follows: 1= source of ideas in question not used/relevant; 7=source of ideas in question crucial for the innovation.

As is visible in the table 24, first of all, Sonera used the widest variety of sources (exogenous scientific inventions, internal R&D and selected technologies, new types of vendors, and market and investor needs) in the DataNet and Fastnet cases. In turn, sensing market needs together with top-management interest were especially important in the Vipgate concept. The main innovation sources in TeleSampo and MobiCentrex were R&D activities and developing standards, whereas in the Zed case the sensing focused on investor interest and top-management vision.

In the following I elaborate on the possible enablers of success/failure in the cases. *First*, the innovation may be created in the R&D function, and diffuse to the market via top management (influenced by investors) in the face of strong market demand, and at the same time certain of the old products are cannibalized. Understanding the need to maintain technological superiority combined with responding to a new market need (technological and market discontinuity) was a very powerful combination that led to success in the ideation of a new service concept without involving other functions or top management. This was the case with with DataNet (a new cost-efficient technology was used to meet emerging needs for customer networking); as it cannibalized the DataPak product (old limited technology). *Second*, the innovation may start from a careful evaluation of the possibilities, after which top management (influenced by investors and the industry) decides whether or not to enter the market (TeleSampo, GSM, FastNet, MobiCentrex, TeleSampo Internet, and Unified Communications), also investigating the company's current product portfolio and any potential cannibalization of old business. The key point is that the product is not allowed to enter the market without evaluation. Success is most likely dependent on the correct evaluation (by top management) of the market need and of the current products' capabilities in terms of meeting the need. These evaluations were challenging in the failure cases (TeleSampo, MobiCentrex and Unified Communications). *Third*, the innovation may emerge from the vision of top management (influenced by investors), but there is a danger of too fast/slow growth and a lack of capabilities, which led in the case of Zed, for instance, to a non-optimal productization process and entrance into an immature market (in which the window of opportunity closed). *Fourth*, the innovation may start from the correct sensing of customer needs, when Top Management support and ideation free resources in the company. Closest to this innovation type are successful products such as Vipgate, the Cid company number service, Sonera's Communications Solution, VPN, and Privatel. *Lastly*, innovation type may be merely an adoptive mode when there is such a strong global dominant design, and technological and market demands that there is no choice but to adapt to it. These are potential success cases if resources abound in the implementation phase. The iPhone, Internet and Unified Communications represent these types of innovation. In this case it was also important to develop the ability to work with partners. However, in the failed UC case there were challenges in obtaining resources for the project.

It seems that using many sources of innovation in the sensing process is typical of a large incumbent multi-product firm with many products that are launched at different stages in their respective industry lifecycles. Companies might also realize that they cannot create all their innovations in-house, but also need to modify existing or simply copy/implement external innovations. However, in terms of success/failure cases, there are some typical profiles to be found.

These notions lead to the following proposition concerning the identified success and failure profiles in the adaptation of a dominant design (i.e. creation, modification or adoption).

Proposition 1a. *The successful adaptation of a dominant design tends to be associated with the following profiles of innovation sources: 1) using science, internal R&D, the market, and vendors in combination, and 2) using the market and top management in combination. Less successful adaptation tends to be associated with the following profiles: 1) using only markets & vendors, 2) using only R&D, and 3) using both science & internal R&D and top management & investors in combination.*

The implication is that it is of minor importance to its success/failure whether the dominant design is created, modified or adopted. However, it seems that a successful profile is associated with having many innovation sources in combination: science, internal R&D, the market and vendors. Fewer sources are needed in the case of modification. A further implication is that certain profiles facilitate the creation of dominant designs. With regard to profile 3 (i.e. using science & internal R&D in combination), which is associated with less successful cases, it may be challenging to anticipate the future success of the innovation when it is evaluated only against the company's current offering and there is no market feedback. As for profile 1 (using science, internal R&D, the market and vendors in combination), the key was to use many sensing sources, and top-management influence did not seem to be necessary for successful development and commercialization. In turn, using only market feedback and top-management support could well have been enough to ensure success in some cases (GSM, Privatel, VPN, and Vipgate): the market uncertainty might be low and the target of technological development might be clear.

Proposition 1a implicitly further elaborates the dominant-design typology (Tegarden et. al., 1999). It directly contributes to the theoretical frameworks developed by Teece (2007) and McGrath et al. (1992) in emphasizing the importance of sensing elements and their combinations. I have empirically identified the success profiles, which are not analyzed in the above works.

Seizing and transforming processes. Over and beyond the initial sources of innovation analyzed above, I now turn to the processes associated with the (successful) management of dominant designs in a multi-product firm such as Sonera – especially when it comes to seizing and transforming activities.

Sonera, as a multi-product firm, relied particularly on 1) complementary assets, 2) firm structure (including the SBU/functional and vertical/horizontal options and modularity), and 3) technological brokering in the seizing process. In the transformation phase, in turn, dominant logic and convergence management were critical in successfully adapting to the next dominant designs. These elements are to be found in the theoretical framework of this study (Figure 6 in Chapter 3). Next I further elaborate on their role in Sonera.

Complementary assets are typical in large incumbent organizations, which tend to be multi-product firms that can use them to leverage innovations (Stieglitz & Heine, 2007). When such assets were used (service numbers, Privatel, the Cid company number service, FastNet, the Vipgate concept, DataNet), the dominant designs were also successfully adapted at Sonera (i.e. created, modified or copied/implemented).

The structure (corporate governance) of a firm delineates its boundaries and internal organization. Multi-product firms in which technologies are or should be integrated have to choose between an SBU model and a functional-management model. During the case-study period there was also a trend to open up vertically integrated structures on the horizontal level, which emphasized the need for modularity in the company.

In terms of technological brokering, Sonera had many product areas in its home market in which it could use technologies from other markets (e.g., IN, routing technologies, and voice-response unit).

Multi-product firms typically operate according to different dominant logics[87] in terms of which technologies, pricing models, solutions and level of integration, and level of technological integration to adopt in the new services, which could potentially also cannibalize the old business.

Sonera actively engaged in convergence management in the successful creation, modification, and copying/implementing of new dominant designs. At best, the following facets were associated with convergence management: the integration of networks and value-added business (service numbers), the integration of the public telephone network with private networks (VPN), the identification of similar usage needs that could be served regardless of the exact technology (Privatel, MobiCentrex), and the exploitation of a common umbrella brand in promoting several technologies (the TeleGate concept including DataNet, FastNet and Vipgate).

Sonera used many seizing and transforming activities in combination, but also on occasions in isolation. Table 25 charts the evident usage of seizing and transforming activities in Sonera's different cases.

[87] Conceptualized as follows: high organizational differentiation [in strong dominant logic]; a high degree of difference between organizational divisions in terms of their overall goals, marketing and production methods, and decision-making styles.

Case	Success (1/0)	Using Technological brokering	Seizing complementary assets	Firm structure options (SBU/functional; vertical/horizontal)	Firm structure (modularity)	Convergence creation in products/ services/ technologies/ customer needs	Manage different dominant logics (organizational differentiation) in Sonera
9800 (modification)	1	7	6	SBU/Vertical	3	5	4
TeleSampo (modification)	0	5	3	SBU/Vertical	2	3	2
9700 (creation)	1	7	6	SBU/Vertical	5	5	4
DataNet (creation)	1	7	5	SBU/Vertical	4	5	2
FastNet (creation)	1	7	5	SBU/Vertical	4	5	4
Vipgate VPN (modification)	1	5	5	SBU/Vertical	4	6	6
Mobile GSM (copying/implementing)	1	4	5	SBU/Vertical	4	4	7
Privatel (creation)	1	2	5	SBU/Vertical	5	6	7
Vipgate concept (creation)	1	4	6	SBU/Vertical	5	4	5
Corporate number (CID) (creation)	1	4	5	SBU/Vertical	5	4	2
TeleSampo Internet (modification)	0	3	3	SBU/Vertical	3	4	2
Mobile Centrex (creation)	0	5	3	Functional/ Vertical	3	3	2
Sonera ZED (creation)	0	3	1	SBU/ Vertical	2	3	2
ComSol (creation)	1	3	6	SBU/Horizontal	5	7	5
Mobile iPhone (copying/implementing)	1	5	5	Functional/Horizontal	3	5	6
UC (modification)	0	3	2	SBU/Functional/Horizontal	3	5	1

Table 25. Seizing and transforming activities in the cases.

The sensing and transforming activities are coded in the table 25 as follows: 1= the activity is not used/relevant; 7=the activity in question is crucial for the innovation.

With regard to the transformation from one dominant design to another, the following profiles (seizing and transforming activities) appear to be linked with the more successful cases of adaptation. As Table 25 above shows, the first success pattern seems to involve technological brokering, seizing complementary assets, and managing convergence. This occurred in the successful cases of 9800, 9700, DataNet, FastNet, and Vipgate VPN. Technological brokering was useful in implementing new technologies in Sonera's market. It may be that technological uncertainty made it necessary to explore new technologies and their application areas. In addition, complementary assets were seized and convergence was created according to technological and user needs.

The second success pattern included managing organizational differentiation (or the absence of such differentiation in the first place: cf. the cases in which organizational differentiation was high), seizing complementary assets, and having a modular structure. A modular structure facilitated cooperation in different parts of the organization under conditions of potential differentiation. This success pattern did not need technological brokering because the products were sensed and seized internally in Sonera. Moreover, the SBU/Vertical firm structure was used in the first and second success profiles, thereby ensuring usage of the company's complementary assets.

With regard to the less successful cases, it seems that a functional/vertical (MobiCentrex) or SBU/Functional/Horizontal (UC) firm structure with high organizational differentiation may lead to failure. One reason for this is the existence of different dominant logics in the company, thus the innovative unit is not able to seize the organization's assets because it does not belong to an influential SBU. Most of the productization in MobiCentrex happened in the R&D unit, and there were limited possibilities to diffuse the service vertically because organizational differentiation was high. Organizational differentiation was high in UC, too, and the many structural forms that were used at the same time led to productization challenges.

The following proposition concerning the identified success and failure profiles in seizing and transforming processes derives from these notions.

Proposition 1b. *The successful creation and modification of a dominant design tends to be associated with the following profile: using technological brokering and complementary assets, and managing* *convergence creation. The successful creation and adoption of a dominant design tends to be associated with the following profile: seizing complementary assets, managing organizational differentiation, convergence creation, and modularity. Less successful creation and modification tend to be associated with organizational differentiation combined with a functional/vertical and SBU/functional/horizontal firm structure.*

The differentiating factor related to adoption/copying is that technological brokering is not used in copying. However, there are insufficient cases (GSM, iPhone) from which to draw strong conclusions, and the evidence was contradictory. In turn, it may be comparatively easy to copy dominant designs, and therefore no factors relate to corporate governance in the less successful cases. Proposition 1b contributes directly to the theoretical frameworks of Teece (2007) and McGrath et al. (1992) concerning the importance of seizing and transforming elements and their combinations. I have empirically identified the successful profiles, which are not analyzed in the above works.

Successful transformation from one dominant design to the next (RQ1b)

I will now analyze in detail the transformation of dominant designs in the multi-product firm, as called for in Research Question 1(b).

I use the term 'reciprocation'[88] (Nooteboom, 2001) in the analysis. Transforming means changing from exploitation to exploration activities, understood here as shifting from an old dominant design to a new one (Nooteboom, 2001, 2003; Gilsing & Nooteboom, 2006). Reciprocation occurs between differentiation (i.e. dominant designs diffuse into new segments) and novel combinations (in technologies and customer needs) in product trials. In other words, reciprocation is the stage of creating hybrid products consisting of elements from previous dominant designs and the new one. It is when previous dominant designs collapse, namely, "*the phase of reciprocation forms the 'topple point' between exploitation and exploration*" (Gilsing & Nooteboom, ibid., p. 5). However, at some point these hybrids create 'diminishing returns', inconsistencies, and added complexity, and this call for architectural innovation. In sum, the relevance to this study is to show from a company point of view the key processes driving the managers of a multi-product firm towards seeking to replace current dominant designs with new ones.

[88] The Oxford English Dictionary (2014) defines the term thus: "Reflexive or mutual action"…" interdependent action".

This section analyzes the empirical cases, situations, and explanations in the transition from one dominant design to the next. From a managerial point of view, such transitions involve discarding an existing dominant design, and are motivated by the fact that the market no longer appreciates the offering, or that the company produces current offerings inefficiently (and could be more efficient with a new dominant design). I also discuss the new dominant designs that emerged.

First I recap the empirical cases and company histories from this perspective: the transformation of particular dominant designs over time, and the shift to new designs. I then compare the key elements in the cases (Table 26).

Earlier, every voice and data connection was dedicated to its own copper wire and technology, and that was a heavy and expensive solution. In the product area of data communications (FastNet and DataNet), new FastNet technology and the old switched technology existed in parallel. This case revealed that the old technology was not capable of integrating technologies cost-efficiently, which was motivation for Sonera's management when creating (new) dominant designs.

Sonera had technological competences that others did not have, and this phenomenon started to be globalized and monetized in 1998, at the start of the Hype period. Thousands of people were hired during the process of convergence in mobile and Internet technology, for example, but the complex organization, or overall 'entity', could not be managed effectively. Sonera's core business (Mobile and Data) expertise was not used appropriately and new competences could not be acquired from the market. It was too big a story [mobile and Internet] too early [no usage culture or end-devices, and a lack of acceptance among other telecom players]. The old mobile business culture and the new mobile and media culture existed in parallel, but there was no synergy between them. In this case, the mobile and Internet technologies were maturing. Sonera had relevant technological competence, and top management was motivated to create a new convergent technology, mobile Internet, based on the two technologies. This new dominant logic, mobile Internet, identified a need for new technological capabilities in Sonera and the telecom industry. However, these capabilities did not exist and could not be created.

Easiness of use and customer intimacy substituted technological expertise (many features, support of all bandwidths, speed, and technology) in the market for intelligent mobile phones (smartphones, i.e. the iPhone). The network vendor's (network and end device) role diminished. The role of the network now was simply to offer cost-efficient capacity, because products were no longer differentiated in terms of network-based facets (e.g., capacity). In turn, the usage experience was differentiated in the eyes of consumers in terms of services and operating systems. There was a transformation from technological competence to a new dominant logic, namely easiness of use.

There was also separation of the physical network, services, and network management with the advent of INs (Intelligent Networks). The first virtual closed network was accomplished. In this case management was motivated to create a convergent offering by means of new cost-efficient technology.

The Cid company number service started to get too heavy over time, too. Consequently, many marketing and pricing innovations were adopted, and dedicated systems were developed (e.g., customer-care and billing applications). By the 2010s the number service could be produced as part of UC (Unified Communications), wherein UC replaced many services with net-based solutions. In this case, the Cid company number turned out to be differentiated in too many segments, and it used too many complementary assets. Middle management wanted to streamline, to offer better usability, and to integrate Cid into Unified Communications.

The mobile-fixed integration message in Vipgate's concept marketing and on the production side was also considered too heavy, and was gradually substituted with the new marketing message, a one-end-device policy. Vipgate clearly used too many complementary assets (personnel, marketing, and proprietary billing systems compared to revenues), and it integrated too many elements. Market preferences changed to favor simpler and more cost-efficient solutions. Sonera was also motivated to streamline production in one network, instead of many.

Many earlier services were integrated into a new net-based solution, Unified Communications (UC), meaning that some earlier products were abandoned. However, challenges arose in replacing the old way of producing services with UC. This case revealed the mixed motivations among top management when transforming to integrated services. Earlier products had reached their technological limit, but the new emerging dominant logic in UC was difficult for Sonera to understand, especially for the Swedish managers, and there was a fear that the old revenues would be cannibalized.

The analysis reveals that elements in the transition to new dominant designs are associated with the limits of both the old and the new technology (i.e. neither is optimal: see the TeleSampo and MobiCentrex cases), market expectations differing from the internal reality of a company (e.g., Zed, Unified Communications), and the product area having grown too large with too many embedded elements (e.g., Cid, the Vipgate concept, Zed, service numbers).

Table 26 below shows the elements that are present in the transformation to the next dominant design in the different Sonera cases.

Table 26. Elements present in the transformation to the next dominant design

Previous product	Case	Success (1/0)	Market demand	Production rationalization	Limit of old technology reached in the-previous product	New technology immature-in the case product	Too large a product area at mature stage	Market expectations vs. company reality	Technologically demanding case product	Integrative case product	Cost-efficiency
DID	9800 (modification)	1	5	5	7	2	6	2	5	5	5
leased lines	*TeleSampo (mod)*	0	3	2	5	6	6	5	6	5	3
Fixed content numbers	9700 (creation)	1	3	5	6	2	6	4	4	5	5
x.25	DataNet (creation)	1	7	5	7	3	3	2	7	5	5
leased lines	FastNet (creation)	1	7	7	7	2	3	2	7	6	7
PSTN	Vipgate VPN (modification)	1	5	5	5	3	2	2	5	5	6
NMT	Mobile GSM (copying/implementing)	1	5	7	5	2	3	2	6	4	7
fixed to mobile calls,no switch	Privatel (creation)	1	5	4	5	4	2	3	7	5	4
separate services	Vipgate concept (creation)	1	6	5	6	2	6	3	4	5	4
Vipgate VPN	Corporate number (CID) (creation)	1	5	5	6	2	6	2	5	5	5
Telesampo	*TeleSampo Internet (modification)*	0	3	3	3	4	5	5	3	5	3
Did not exist	*MobileCentrex (creation)*	0	2	2	n/a	7	n/a	5	6	6	2
SMS service	*Sonera ZED (creation)*	0	3	1	2	7	7	7	4	6	2
MobX	ComSol (creation)	1	7	5	7	2	2	3	7	6	5
Smartphones (e.g. Nokia)	Mobile iPhone	1	6	4	6	1	n/a	n/a	2	4	4
Separate PBX based serv.	*UC (modification)*	0	5	3	5	5	n/a	5	6	7	3

The elements associated with creating, modifying and adopting/copying the next dominant designs are coded as follows: 1= the element is not relevant/present; 7=the element is crucial for the transformation.

As the Table 26 indicates, the more successful cases with respect to shifting smoothly from one dominant design to another seem to be associated with the creation of products that were integrative (i.e., convergent with market demand) under conditions of production rationalization and efficient capacity creation. These elements were present at least in the successful cases of DataNet, FastNet, and Vipgate VPN. This understanding leads to the following proposition.

Proposition 2. *The identification and implementation of the potential to create cost-effective products that are integrative (convergent) with market demand enable successful transformation from previous dominant designs to new ones. This is based on the assumption that production rationalization leads to efficient capacity creation.*

Two lines of inquiry are relevant to Proposition 2: research on the role of changing customer preferences, and on the question of when to integrate or disintegrate products and services. Integration is associated with vertical production (Cacciatori & Jacobides, 2002; Christensen et al. 2002). According to Tripsas (2008, p.79), "*preference discontinuities can also be the catalyst for technological transitions*", which means that mainstream preferences sometimes shift radically, and new technology is required to meet the new demands from customers. This phenomenon was evident in several cases: UC, Cloud Computing, and the iPhone. The new customer demands influenced how the products were produced and commercialized to customers, which in these cases meant dominant designs that were created successfully when integration (convergence) was pursued cost-efficiently. Christensen (1997) also expressed this view, pointing out that technology and market need have their own developmental paths. If and when these paths cross there is a drastic change in the competitive situation, potentially leaving room for competence-disrupting technological discontinuities to invade the incumbent's market. In the above I enhance understanding of how the discontinuities were seen by management, and suggest elements that are associated in this process as well as success factors that enable smoother shifting between consecutive dominant designs. I also contribute to the discussion on industry lifecycles (e.g., Vernon), a hitherto unnoticed potential new stage of the industry lifecycle: cost-effectiveness and convergence (technologically demanding).

4.2.2 RQ2: What are the relative roles of the sources of innovation in the successful adaptation of dominant designs and their 'building blocks' in terms of a) the process, and b) how they change over time?

Sources of innovation over time

This sub-section analyzes how the importance of different sources of innovation sensed at Sonera changed over time. I refer to sensing sources in the cases in Chapter 4.2.1 above. I have carefully interpreted in each case how these different elements were present. For example, all the sources of innovation were of equal importance in DataNet.

Based on the sources of innovation used and sensed in the different cases over time (Table 24), Figure 18 summarizes the overall development that seemed to take place in the prevalence of different sources between 1980 and 2010.

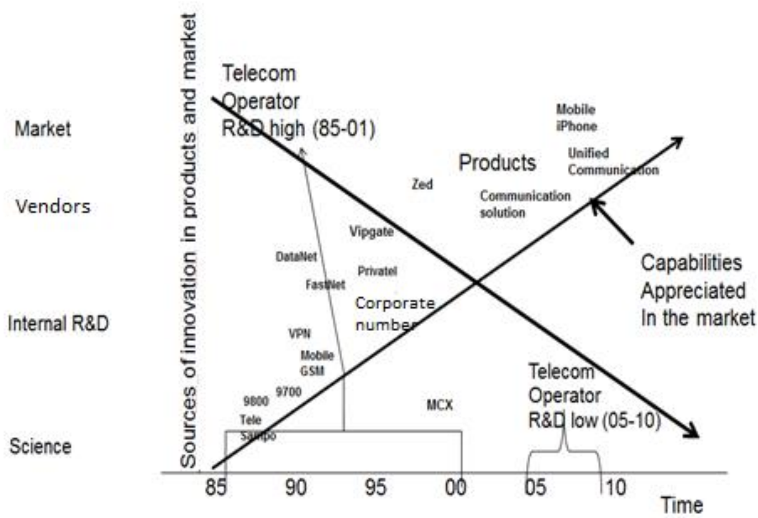

Figure 18. Sources of innovation in Products/Market conditions, 1980-2010

Figure 18 shows the extent to which various sources of innovation were appreciated and used in individual products. For example, the product, an exogenous science orientation, developments in videotex technology, and knowledge of building integrative networks (data and PSTN) were the most important sources in TeleSampo. In terms of market conditions, this era of exogenous science orientation was also a closed, introductory stage of the industry lifecycle. On the other hand, the product at the opposite end of the continuum, Unified Communications, manifested market feedback as a source of sensing. The overall market conditions had also changed, and the market was open as Unified Communications and iPhone started a new industry lifecycle. Indeed, an exogenous science orientation has often been associated with the closed-company view of market orientation (OVUM, 2002, p.92; Fransman, 2002b), and the use of market feedback with the opposite view. Internal R&D and vendor innovation fall between the extreme points. When a product is in the middle in the picture it means that all the sources of innovation had approximately the same importance level. This was the case with DataNet and FastNet, for instance.

The development was not straightforward and simple over time, as there were product-development cases that came back to being more exogenously science oriented compared to the overall trend in the market: the shift to a market orientation. One case in point was the Mobile Centrex product: the market was moving into a growth stage and becoming more market-oriented, but the Mobile Centrex product was heavily R&D-led.

Parallel with the change in the prevalent sources of innovation, the roles of the telecom operator vis-à-vis suppliers and complementors (network hardware, terminal devices and software) changed during the period from 1980 to 2010. Telecom operators' previous strengths – network-hardware development, sourcing and network planning as a whole – turned into basic competitive requirements, and ceased to be a differentiating factor. At the same time, R&D efforts started to focus mainly on software vendors. The main reasons for this were that the Intelligent Network (IN), Internet Protocol (IP), the Internet, and legislative liberalization gradually opened up (or broke) the earlier monopoly market of the telecom companies. This development gave players other than telecom operators the opportunity also to offer telecom services technologically, which was manifested especially in the mobile business as a whole (see Chapter 2.5.7 on the Industry history and the iPhone) and in Unified Communications. The change meant that the telecom operator was not necessarily developing offerings and services in-house using its own R&D capability.

In sum, on the basis of the empirical evidence from the cases and the industry history, I offer the following observations on the implications of changing environmental conditions for the prevalence of different sources of innovation. I also give a longitudinal view of the changing importance of the players (see Appendix 12 the coding).

Telecom operators were driving and defining the market in 1982, and then there was a gradual shift in importance to terminal devices and software vendors and a decline in importance of network hardware. In addition, the level of R&D and of its scientific importance in projects diminished during the case period. There was no clear pattern in the level of market orientation during the early period, however.

Complementing the analysis of R&D/science and market orientation, it seems that the importance of standards and in-house competences increased over time. These (earlier) competences included network planning, insourcing, piloting with vendors, in-house R&D for software development, testing end-devices and hardware, investment management, revenue growth, long-term planning, customer-ownership activities, delivery, distribution, switching, routing, transmission, and access management.

Developing a standard was close to synonymous with developing a product in the era of telecom monopolies, but this was no longer the case in the 2000s. Nevertheless, there were many standards in Unified Communications for example, which required cooperation, but they did not fully define what the product or service was. It may be that standards and earlier telecom competences were no longer important to the incumbent creating offerings (although they could have been important to vendors and niche players). At the same time, these (earlier) in-house competences of the operator diminished.

All in all, a clearer picture of the change factors facing the incumbent starts to emerge. The change concerned the telecom operator and its key facets in terms of productization and the other players' roles. This leads me to the following proposition.

Proposition 3. *In open and horizontal market conditions, when monopoly markets are permanently opened up as a result of technological progress, (a) the source of innovation underlying dominant designs shifts to marketing from R&D, science and standards; (b) the incumbents' role diminishes; and (c) the role of vendors and niche players strengthens. This development is likely to happen in subsequent cycles of innovation in industry lifecycles, addressing the same customer needs.*

Some of the products included in the analysis were created solely in Sonera, others were modified in Sonera, and Mobile iPhone was simply adopted externally. Hence, Proposition 3 applies to both endogenous and exogenous innovations.

In line with Proposition 3, Christensen (1997) and Christensen and Rosenbloom (1995) discuss changing capability requirements following the progression of the industry lifecycle. They further argue that R&D is not the only way to create offerings when an industry matures, and that customers' needs are also important. Their key point is that new entrants take the market over if incumbents oversupply the current market, because the incumbents serve the current value web and customers with the best possible knowledge. The above proposition adds to this argument the insight that the new value web is based on market orientation, thus suggesting a more general, organizational facet that is more important than the product-related features of convenience and price (Christensen, 1997, p.121). The above findings also contrast with what Christensen et al. (2002) state about "pendulum" (ibid., p. 956) switching in specialized firms between vertical integrated management (in conditions in which the technology is immature) and horizontal management (in conditions in which the technology is mature). The present cases rather indicate that there may be no pendulum swing when technological change allows the permanent replacement of a proprietary technology to a generic customer (i.e. a horizontal industry structure). In other words, the pendulum is associated with the emergence of a new industry lifecycle. Unified Communications and iPhone, which were created directly in a horizontal industry structure, could be used as examples.

Further, it seems to be rare for one company to progress alone over a long period of time (Utterback, 1996), in other words constantly creating dominant designs or otherwise successful innovations. This was also true of the case company: following the hype of the late 1990s, the process of creating successful innovations stagnated in the 2000s. Klepper (1996) found that early entrants tended to grow larger and to spend more on R&D (process innovations), and subsequently had a cost advantage over smaller players. In other words, they have lower average costs and higher output, and as a consequence they can spread R&D costs and show higher R&D productivity. However, contradicting Klepper's (ibid) model, this might no longer hold true when subsequent dominant designs are being built. R&D has been downsized and customer-related (e.g., marketing, customer service, branding) and IT-procurement costs are replacing R&D resources in the case company. It might be more difficult to achieve economies of scale and cost advantage over new entrants in these areas, at least for incumbent telecom operators.

The proposition also aligns well with the classic view of dominant design (Abernathy & Utterback, 1978; Christensen & Bower, 1996) according to which the players' role changes and the focus of R&D development shifts to vendors as the industry matures. Complementing this view, the present findings enhance understanding of how and why this change happens.

Dominant-design adaptation over time (variation, selection, and retention)

Next I draw together the information on changes in the adaptation of dominant designs in the case company and industry. In so doing I rely on the framework of variation, selection, and retention/transformation, which is the classic theory addressing evolution in this context (e.g., Van de Ven & Poole, 1995; McGrath et. al, 1992).

Table 27 shows the variation, selection, and retention/transformation from the perspectives of Sonera and the telecom/ICT industry. I draw on the industry and case histories, as well as on their intertwining. I use McGrath et al.'s (1992) typology of variation, which addresses the source and scope of innovation. In terms of selection, the following questions are the most relevant: What are the criteria in choosing the innovative ideas that will be productized? What kinds of technology are preferred? Products that are selected internally are then subject to external selection on the market, as they will be evaluated and adopted (or not) depending on the customers and the market conditions to a certain, more or less favorable, degree. The selected products and services are further subject to retention in the company and market, or they are transformed into the next dominant design. Table 27 also reveals the simultaneous, partly conflicting cognitions and practices in a company when it comes to retention and transforming activities.

Time	Variation in Sonera	Detailed selection criteria in Sonera	Aggregated selection criteria in Sonera	Selection criteria in the market	Detailed Retention activities in Sonera	Aggregated Retention activities in Sonera.	Detailed Transforming activities in Sonera.	Aggregated Transforming activities in Sonera.	Transforming activities in the market.	Cases
1982-1986	Standards, science, and R&D evaluation are sources of innovation.	Meet the demand for mobile business; capacity expansion in basic products.	Reinforcing new and old infrastructure; creating standards.	Service availability.	Protecting mobile/local monopoly and national assets by legislation.	Using national assets (e.g., int.telecom centers) and mobile monopoly.	Operative-excellence targets and activities, the automatization of the networks.	Learning activities to raise awareness of the importance of profit and loss.	Technology build-up (digitalization and fibre cables.)	NMT-450 NMT-900 Fixed Voice X.25 data
1987-1992	Standards, Sonera's own R&D activities, technological brokering, are sources of innovation.	R&D pioneering with commercial potential in the competitors' areas.	Creating de facto standards (i.e. Managed Services). Demonstrating commitment to customers.	Service availability, The functionality of the services, and new products were appreciated.	Protecting mobile/local monopoly and national assets by legislation and tech. expertise.	Using national assets (e.g., int. telecom centers) and mobile monopoly. Enhancing B2B customerships.	Creating 'the first' products in Sonera; the idea of a managed service; digitalizing networks and switches.	Digitalization activities and core competences identified in Sonera.	Data technology has progressed; legislative regulation started to be liberalized.	9800; 9700; TeleSampo; Vipgate VPN (local exog); DataNet;FastNet (local endog)
1993-1998	Sonera builds on knowledge from pioneering technological standard making, and its existing capabilities.	Increase the value of the business by service commercialization.	Negotiating standards (GSM). Demonstrating the availability of national & global services.	Visionary telcos & new services appreciated; Productivity, reliability, reachability and quality were important.	Protecting the customer base with national assets (e.g. IN) and integrative capabilities.	Using their reputation for quality.	Convergence creation, creating the first products and services in Sonera.	Finding gaps in Sonera's core competences needed in the future. Learning sales & segmenting practices.	Telecamps have formed and each camp's SWOT was identified.	GSM ; TeleSampo Internet (global exog); Privatel; Vipgate concept; Corporate number (CID);MobX(local endog)

Table 27. VSR in Sonera and the industry, 1980-2010

1999-2000	Market expectations, investors and top mgt. vision. New ecosystem creation with new capabilities.	Market visibility objectives of mobile and Internet products; an increase in company value.	Negotiating standards (UMTS). New business logic (global services) communicated. Using clout with transaction partners.	Companies valued productivity-enhancing services. Investors and consumers expected mobile Internet.	Patent protection, buying expertise (mobile and Internet) companies in the market.	Influencing the evolution of formal standards (UMTS); co-specialized assets (other companies).	Convergence creation; creating a new business area (Mobile-Media); globalization: Sonera's vision as a Smart Partner and global pioneer.	Unlearning from old telco's mindset (owning the customer); learning about M&A's & partnering.	Global growth search; idea that synergy will exist between mobile and Internet.	Sonera Zed (local endog)
2001	Market expectations, investors as a source of innovation	ROI targets.	Reinforcing existing standards (Sonera as a national player)	Cheap prices, reliability and service productivity were important.	Trying to prevent the 3rd national mobile player, DNA, from entering the market.	Influencing the legislative regulator	Focusing on national markets, core competences taken from earlier period.	Streamlining; learning to focus operations (with ROI targets)	Technological capabilities were appreciated in the smart-phone market (i.e. many features, suppor-ting many band-widths, speed).	
2002-2005	Market appeal and integrative products above basic bulk a source of innovation	No new services, ROI criteria in projects	Sonera as a national player. Productivity & cost savings on offerings	Cheap prices, efficiency, Service Level Agreements (SLA)	Retaining customers through price reductions and service integra-tion in B2B, preventing number portability in mobile.	Influencing regulative arrange-ments (3G bundling).	Focusing on national markets, core competence redesign.	Learning to use buying power & tendering.	Decline in growth, impermanence of mobile Internet and Internet service providers' business models.	Com-Sol (local endog)
2006-2010	External R&D & easi-ness of use. Alignment with IT players and end-device software makers' offerings.	Bulk busi-ness, and bundles with services and ext. partner usage.	Negotiating a new service culture (easiness of use/ bundling); using transaction partners (e.g., Microsoft); co-branding.	Cheap prices, bundled offerings, SaaS/ hosting model, handset/ OS driven business, SLA, inter-functionality of Telco, IT and the Internet.	Stressing the importance of hybrid offerings, cheap prices in consumer bundles.	Using co-specialized assets (IP, Mobile, and B2B Comm. Solutions).	Partner management grows in importance; focusing on managed ICT and customer service.	Learning to use adjacent industry relationships; investments in the customer (self) service.	Customer-driven commercialization (easiness of use) challenge the old vertical tech. mastery; technological development enables IT & Internet players to enter telco market	Mobile iPhone (global exog); UC (loc. exog)

Table 27 *Continued.* VSR in Sonera and the industry, 1980-2010

Specifically, Table 27 lists Sonera's innovations and whether they were endogenous or exogenous (created, modified or copied) in the case column. Variation refers to the source of the innovation. Detailed selection criteria refer to the idiosyncratic (Dierikcx & Cool, 1989) ways in which the projects were selected for commercialization in each time period, and the criteria and targets used. The column "aggregated selection criteria in Sonera" (in line with McGrath et. al., 1992) groups these activities on a more abstract and general level, whereas the column "selection criteria in the market" shows the criteria according to which the best products and telecom operators were evaluated and adopted. The "detailed retention activities" column (i.e. protecting the dominant designs) indicates how Sonera tried to protect its business model and the dominant designs it created, modified, or copied, whereas the "aggregated retention activities in Sonera" column conceptualizes these activities in more general terms. The last group, transforming activities, indicates whether, and if so how, selected products evolved into new products and dominant designs, possibly affecting the whole company. These activities may somewhat contradict the retention activities as there may be a desire to transform the company and its products/services, and a desire not to change them. The elements in the transforming activities reflect the previous eras, e.g., the activities in 1982-1986 reflect the activities in previous periods.

What is interesting about the VSR analysis is that it facilitates the studying of dynamics in that the UC case starts a new industry lifecycle. This point has not been documented thus far, although Utterback (1996) refers to the possibility that the source of innovation could be more heavily process-based in later rounds. Tushman and Murmann (1998) further note that cycles of dominant design are reinitiated at the next technological discontinuity, but do not specify how. In addressing these questions here I have explicitly separated the retention and the transformation activities – a distinction that is only implicit in earlier studies (c.f. Durand, 2006, p.60, 81).

There were clear trends in Sonera's VSR activities in general. In terms of variation, Sonera created technological standards, which peaked in 1982-1998 and raised external market expectations in the 1999-2000 period of hype. As a consequence, there may even have been excessive innovativeness, or variation activity (cf. Vesterinen, 2009, pp. 141, 145). Such activities diminished in later periods, partly due to the organizational merger with Telia, and especially in the period 2006-2010 appeared to be driven mainly by vendors and adjacent industries. The source of innovation had shifted from technology to market needs and process development.

There were three periods of selection activity. Overall, Sonera turned towards modifying and copying rather than creating its own dominant designs in the course of time[89]. Its activities in 1982-1998 included establishing credibility and telequality[90] , and developing the ability to create quality services in order to make customer-proof (customers trusted Sonera) and value propositions (in line with Huff, 1982, p.4). These factors were also appreciated in the market. The hype period in 1999-2000 was a watershed (see also Vesterinen [2009], who uses the expression 'juncture'). Sonera's top management started to use its brand value and clout internally and externally in order to negotiate a new business model. The new model was not accepted in the market at the time due to the still viable telecom (landline and mobile) business and the inability of technology to create convergence between mobile and Internet.

With regard to market selection, what was required of players tightened in the third period, 2001-2010: they were expected to offer cheap prices and service-level agreements. In addition, customers were reluctant to commit themselves to hardware investments, and demanded Cloud Computing-type services. Most significantly, the convergence of mobile and Internet was taken as a basic competitive requirement and was no longer a differentiating factor. The end result of this period was an abundance of business models and players in the era of new dominant design, corresponding to Unified Communications. Sonera, in turn, had mixed selection criteria. The company tried first to leverage its earlier technological expertise, and then to build technology links; however, this was challenging when the requirements in the market had tightened. Finally, Sonera needed to adapt to a new customer-service culture (easiness of use) and align itself with adjacent industries' offerings. This contrasted with earlier periods, when it was creating standards and exploiting its clout given its monopoly/monopolistic position, brand, and reputation as a technological pioneer.

[89] Sonera's Selection path could also be generalized to the market, although UMTS was a mistake and accelerated the selection trends. The overall market saturation and slowdown fuelled the rationalizing, and UMTS and Telia's culture accelerated the rationalization process in Sonera (Finland).

[90] Telequality is a way of expressing a very high standard in products and services. For example, faults in telephone calls were minimal 'earlier', i.e. one could call another person with 99.999% certainty.

In 1982-1986, Sonera used its national assets and mobile communications monopoly in its retention and partly interrelated transforming activities, but also profitably transformed to the next era, 1987-1992, with its digitalization activities and core competences. This was a necessary step as the company gradually adapted to the increasingly competitive market.

Sonera capitalized on emerging B2B customer processes and its specialized assets in 1987-1992, and again made a profitable transition to the next period, 1993-1998. Telecamps (the rival companies Sonera, Elisa and the Finnet Group) was formed during this period, and Sonera also realized the need for sales and segmenting practices.

The retention tactic in 1993-1998 was to use the reputation for quality and the de facto dominant designs Sonera had created. Transforming to the next era, the hype period of 1999-2000, was challenging given the need to create new capabilities. The globalization idea was sound: growth had stopped in domestic markets and in traditional business, and consequently there was a need to create new growth globally. However, the unlearning from the old telecom world was, in retrospect, a mistake in Sonera, and the pressure to create new innovations was too challenging (see also Vesterinen, 2009, pp. 138- 141). For example, 1) capabilities such as system integration and software solutions were substituted for expertise in mobile and data technology; 2) new enabling platforms were substituted for integrated telecom networks; 3) business-innovation management was substituted for profit centers; and 4) brands were substituted for customers.

During the 1999-2000 period of hype, Sonera tried to influence the evolution of UMTS in order to create a new telecom-led mobile Internet business model. This did not turn out to be a success due to a lack of capabilities and a misguided vision that telecom operators would create value-added content. Hence, the market, and Sonera in particular, went back into the realm of technological expertise in 2001-2005, mainly capitalizing on what Nokia invented in the market for mobile handsets.

Around this time, in 2001, Sonera tried to protect assets such as its Intelligent Network (IN) in Vipgate and its mobile business. This did not succeed, but in its transition to the next era (2002-2005) it learned to use its buying power in a structured way, following the merger with Telia. The shake out of mobile service providers also helped incumbent telecom operators.

In this as well as in the earlier period, Sonera tried to influence legislative regulators in its attempts to prevent mobile number portability, or at least to allow mobile 3G bundling in order to boost the usage of mobile data. However, these retention tactics were not effective, and for the period 2006-2010 Sonera transformed itself into a customer-led and IT/ vendor/ handset partner engaged more and more in telecom offerings.

During this last period, Sonera capitalized on its co-specialized assets (IP, Mobile and B2B Communication Solutions) in order to gain a role in this new dominant design in the industry, Unified Communications.

With regard to the discussion on dominant design, and contrary to earlier thinking (e.g., Abernathy & Utterback, 1978; Utterback & Abernathy, 1975; Utterback, 1994), it seems that new dominant designs (e.g., UC in 2006-2010) start from processes[91] (business-model thinking, pricing, co-operation with IT players, and vendor procurement negotiations) and an open ecosystem. Moreover, vendors have a strong role, product variety increases during the lifecycle, and there are many players involved. Suarez and Utterback (1995) also note that dominant designs raise the entry and mobility barriers in the industry, but this seemed not to be the case in Unified Communications[92].

It could be implied from the above discussion that dominant-design management is conditioned on industry evolution. It also sheds light on the nature of the shift in dominant designs over time from Sonera's viewpoint. The shift included a change in players' roles and deterioration in the telecom operator's situation, thereby reflecting all innovation types from Sonera's perspective: local endogenous, local exogenous and global exogenous. Hence the following proposition:

Proposition 4. *Driven by the industry lifecycle (i.e. market preferences and technological progress), new dominant designs tend to be more technologically progressive and process-led. This development facilitates the building of services based on customer and market needs, but also fuels the demand for capabilities in areas such as (a) software development, (b) managed service thinking, (c) vendor and partner relations, (d) value-added service creation, and (d) ecosystem creation.*

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[91] According to the classic approach to dominant design, innovations start from the product (e.g., Utterback & Abernathy, 1975).

[92] Unified Communications operated in an IP (Internet Protocol) -enabled open industry in which the 'Cloud Computing infrastructure model' allowed new IT players such as Google to enter the telecom industry. Google's business model is based on trial and error, financed by investors and advertisement-generated cash flow. This is a totally different model than the one the telecom operators used in that Google has no user-customers who directly pay for its services.

What is new in the proposition is the notion that technology development changes the scope of capabilities needed in the creation of dominant designs. Single players are challenged, and modification and copying are likely.

In sum, Proposition 4 claims that responding to the industry lifecycle (Afuah & Utterback, 1997) is more difficult for incumbents than for entrants. It is challenging when sources of variation diminish, there are potentially multiple selection criteria in the company, and the selection criteria in the market are more focused. Moreover, technological progress facilitates the substitution of 'open assets' for proprietary technological assets.

A framework for the adaptation of dominant designs

The proposed abductively derived framework identifies the elements of the adaptation process. It derives from the previous discussion, and in general from the author's understanding of how dominant designs were created, modified and adopted in the case company and the industry.

The framework describes the innovation source, the building blocks of dominant designs and the type of innovation that is created, and how all these are linked, influenced by environmental factors. The outcome is a dominant design /converged portfolio. Further, the framework identifies elements in the transformation to a subsequent dominant design/converged portfolio, which in turn is affected by environmental factors and the building blocks.

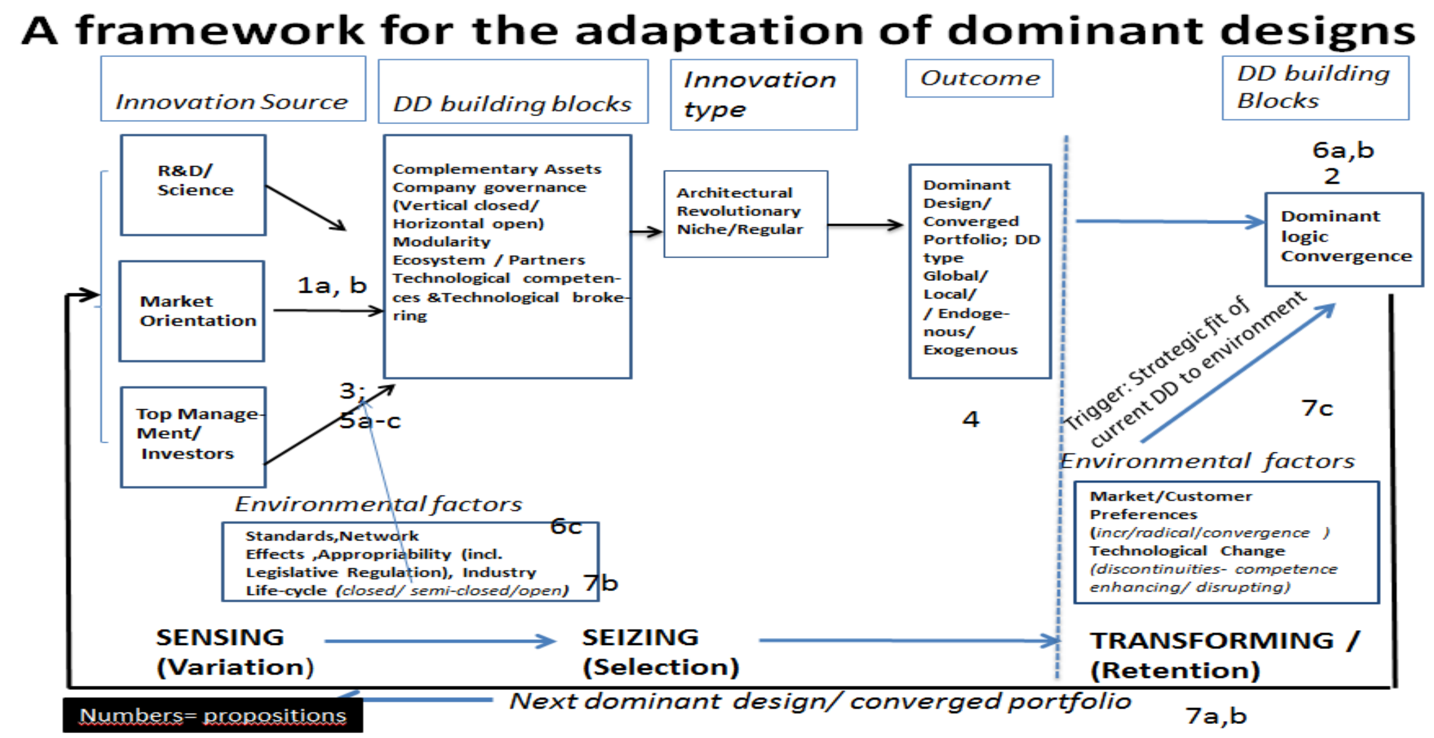

Figure 19. A framework for the adaptation of dominant designs

Figure 19 thus comprises my proposed framework for the adaptation of dominant designs. In the following I explain how the elements in the framework work, link that to the theoretical discussion and point out the contributions. First I consider the separate elements, and then assess the framework as a whole.

Sensing. First, in the sensing phase I have identified three major innovation sources: top management/investors, a market orientation, and R&D/science. These are differentiating elements, and in the cases affected the emergence of dominant designs in terms of capitalizing on the building blocks of the seizing phase. Moreover, it seems that they tend to differ in their capacity to exploit the company's resources. This finding sheds light on the emergence of dominant designs.

What is new in this aspect of the proposed model is that it includes the entire corporate perspective with its different levels and functional entities. The framework complements the models developed by Van de Ven et al. (1989) and Burgelman and Grove (2007). Van de Ven et al. (ibid.) consider innovators' actions as one unit, and top-management intervention as a moderating factor. Burgelman and Grove (2007), in turn, discuss innovation units, which they describe as induced or autonomous depending on whether the idea comes from the SBUs or top management. Geels (2002) proposes a dynamic multi-level perspective on the emergence of technological transitions, with technological niches on the lowest level, socio-technological regimes on the middle level, and landscape development on the top level. I parallel technological niches with R&D and Science as an innovation source, the socio-technological regime with a market orientation, and landscape developments with top management/investors, thereby potentially bridging the gap between dominant-design creation on the company and on the industry level.

Furthermore, I offer a novel interpretation of Abernathy and Utterback's (1975) and Utterback and Abernathy's (1978) seminal models according to which innovations characteristically follow product and process developmental paths [with strategizing implications], which vary in importance during the industry and product lifecycles. The innovation journey in my proposed framework can start from different sourcing points at different times, and only then follow the product/process division and paths shown in Abernathy and Utterback (1975) and Utterback and Abernathy (1978). This potentially offers a new perspective on the creation and management of dominant designs in general. The above-mentioned sources of innovation [R&D/science, market orientation, top management/investors] affect product development in that it does not necessarily follow the product-process continuum. This applies at least to incumbent players/industry, as identified in two cases (iPhone and UC).

Transforming. Second, I have identified the management of convergence and dominant logic as the most important elements in the transforming stage. Interestingly enough, strategizing went on in Sonera in that convergence management is described a tool for creating a dominant design. The two sources are ex ante constructs in my framework, and thereby differ from Tushman and Romanelli's (1985), Nooteboom's (2000), and Gilsing and Nooteboom's (2006) views of them as concepts that are external to the company and can be identified only after the dominant design has emerged. Dominant logic, in turn, appears in Schilling's (1998) model, expressed as a failure to invest in learning and comprising the interplay of core capabilities and absorptive capacity.

Suarez's (2002) model lacks the continuity from post-dominance to the next dominant design, as does Lee et al.'s (1995) process model of strategy. The same applies to Teece's (2007) model in that dynamism is not explicitly mentioned in connection with the shift from transforming to sensing, even though the reasoning is implicit: innovations and investments equip the company to transform itself. I agree with Kaplan and Tripsas (2008) that the sources of variation (the next dominant design) are inherited *from old technological frameworks and technologies that lose their salience* (ibid. p.800). In this sense the analysis of the transformation to the next dominant design reflects explanations of why new convergent offerings are made.

Furthermore, the building blocks in this stage concern both the company and the industry, highlighting the interplay between managerial cognition and industry-level development. This leads to the next facet of the framework.

Environmental factors in transforming. Third, I have identified technological, market, and customer discontinuities as triggers when determining whether a current dominant design can be retained or transferred to a new one. These environmental factors are associated with technology management, complementing the seminal work of Anderson and Tushman (1990) on the technology cycle (ibid., p.606) by integrating the views of Christensen (1997) and Tripsas (2008) on the reasons for the transition to the next (dominant design). The trigger of the next dominant design is the analysis of its strategic fit to the environment (e.g., Durand, 2001, 2006; Zajac et al., 2000). If an organization realizes it can successfully master the dominant logic and the convergence challenges in the company, it can move on to create the next dominant design.

What I add to Suarez's [2002] model), for example, is to separate the environmental factors into transforming and sensing/seizing phases. In so doing I argue that it is possible to analyze potential negative and positive path dependence (when environmental conditions are analyzed in the transforming and sensing/seizing phases, respectively)[93] , and add the concepts competence disrupting and enhancing discontinuities to this element (e.g., Anderson & Tushman, 1990).

Environmental factors in sensing/seizing. Fourth, I have identified standards, network effects, and the appropriability regime (including regulation) as the most important environmental factors. For example, standards can facilitate the creation of dominant designs (i.e. GSM), but cannot in themselves create them. In other words, customer demand is needed. These elements are manifestations of the economic (e.g., Arthur, 1989; Suarez, 2002) explanation of the emergence of dominant designs.

Again, I add a new element, the industry lifecycle. This is ignored in the theory of dominant design [as I interpret and elaborate on it later]: Anderson & Tushman's (1990) model, for example, defines it per se. The industry lifecycle has the following two roles in the proposed framework. First, the technology may be immature in the early phase, which incumbents typically dominate, thus meaning that there are barriers to entry caused by regulations, financial constraints or capabilities (i.e. immature technology), for example. When subsequent dominant designs are created to meet the same customer need, competence-disrupting discontinuities may be strong enough to challenge the management of the company. The reasons for this include the many dominant logics, or even different biases in the innovation source [R&D, Market, Top Management/Investors], and unevenly distributed disruptions in the company such that the economic perspective and incumbent advantage

[93] The target of a telecom operator is to manage path dependence, because the industry is capital-intensive and the basic need of customers, communication, is rather stable. Therefore, attempts are made to introduce new technologies to current customers through the old infrastructure. I found in Sonera that during the process of transforming to another dominant design the products were typically built upon each other, in other words there was path dependence. However, that was not always understood or acknowledged in the company (especially in the Hype Period), as it existed in different layers and in different silos: production, product management, sales and marketing. Environmental factors affect this transformation and path dependence. The strategic fit (Zajac et al., 2000) might vanish if there are strong enough discontinuities. The transformation phase facilitates entry into the industry, as happened in Unified Communications (2010).

may not guarantee the creation of dominant designs. A typical case in Sonera was Unified Communications. Second, the industry lifecycle as a factor in the framework facilitates analysis of the stage in which dominant designs are created, something that is not explicit in the literature (e.g., Abernathy & Clark, 1985; Anderson & Tushman, 1990). The implication is that different environmental conditions also apply to dominant designs depending on the stage of the industry's lifecycle.

Seizing building blocks. Fifth, I have identified complementary assets (e.g., Teece, 1986), modularity management (e.g., Christensen and Raynor, 2003), ecosystem management (e.g., Jacobides et al., 2006; J.F. Moore, 1993), type of company governance (e.g., Afuah, 2001; Nooteboom, 1999, p.143), and technological competence/technological brokering (c.f. Nooteboom, 1999, p. 130) as the essential building blocks in the seizing phase. With regard to company governance, I parallel vertical governance with a closed structure, and horizontal governance with an open structure. The vertical and closed model was typical during the early lifecycle stage of an immature technology. These facets capture the dynamics in the process of adapting a dominant design. The use of complementary assets is typical of incumbents, whereas focusing on modularity and ecosystem management might be beneficial to entrants (and also to incumbents who can and wish to focus on these factors). Moreover, I find earlier models that lack the element of technological competence/technological brokering somewhat vague: it seems to me that successful innovations also need concrete competences in the seizing phase.

Innovation type and dominant design. Sixth, linked to seizing, the organization creates different kinds of products (see Abernathy & Clark's [1985] typology of innovation). What is explicitly stated here is that all innovation types have the potential produce a dominant design. This thinking broadens the earlier strict dominant-design and lifecycle view suggesting that dominant designs are created only in the era of ferment (Anderson & Tushman, 1990): they can also be created in the era of incremental change.

The target is to create dominant designs of different types. What I add to the discussion are my typology of global vs. local, endogenous vs. exogenous, and 'open' vs. 'closed' designs, and the converged portfolio. 'Closed' dominant designs belong to incumbents and 'open' designs to entrants. This new typology brings a new understanding and variety to existing definitions, and identifies the reasons why incumbents may lose their dominant designs, especially in complex technological systems (see sub-chapter 4.2.3 in this study).

The framework as a whole. The framework integrates the industry and the company perspectives, thereby complementing McGrath et al.'s (1992) model, and in addition makes a clearer distinction between incumbent and entrant.

Furthermore, with regard to enablers of dominant designs McGrath et al. (1992) refer to selection as driving the processes , whereas these processes (sensing, seizing, innovation creation, the recognition of environmental boundaries, and transforming) are placed in chronological order in the proposed framework.

In conclusion, I illustrate the descriptive power of the framework drawing on the empirical evidence from the cases. I explain how it works using TeleSampo (1987) as a case that failed to achieve a dominant-design status.

TeleSampo (1987) was created in-house in Sonera, and benefited from earlier standards that were further enhanced in the company. The source of innovation was external R&D modified in Sonera, together with top-management/Finnish political interest. However, it lacked a sufficiently market-based view in terms of productization. Still, there was time to develop the service within Sonera's planned timetable in the early lifecycle stage, as well as sufficiently strong technological capabilities and motives on the company level. The market was clearly demanding convergence, in other words a pre-Internet portal, and consequently the implementation capability in Sonera to use complementary assets. However, as the appropriability regime was not optimal (earlier services were profitable but substitute services soon emerged on the market), Sonera had no complementary assets, which is why there were no network effects in the market or in Sonera's internal production. In addition, the dominant logics in the service-number and data business implied skepticism about TeleSampo's success potential, and modular production and resources were not transferred there from other businesses, for example.

Although the market was closed and proprietary, there were still challenges in integrating Videotex, Data and Fixed Voice services [TeleSampo used a fixed-voice landline network].

Videotex could also be seen as competence-disrupting discontinuity. However, TeleSampo's second release in 1997 was clearly based on market needs (pointing to the adoption of a market orientation) when the competence-disrupting innovation, the Internet, took the place of TeleSampo's email service, known as Telebox.

The relative role of sources of innovation in the successful adaptation of dominant designs

This sub-section concerns the role of sources of innovation as opposed to seizing capabilities and the industry lifecycle in the successful adaptation of dominant designs.

Sources of innovation. Top management/Investors (i.e. Zed and the Hype period) were motivated and tried to create an ecosystem (with limited success). There were no complementary assets in-house, and high differentiation (meaning strong and different dominant logics) in the company. In other words, top management did not control the capabilities and did not make optimal use of the firm's structure. This was manifest in its effort to create a mobile Internet ecosystem, and a new business model that was not typical of a telecom operator. As a result, convergence was not a success, which slowed the process of creating an ecosystem.

In turn, in the case of top management combined with R&D/Science (TeleSampo) the capabilities were in-house. However, there was also differentiation in-house (i.e. strong dominant logics), and conflicting motivations between top management and SBU management. Consequently the SBU did not control the complementary assets and convergence did not succeed.

In the case of R&D and the Market domain (Service numbers, DataNet, the Cid company number service) the competences were in-house, and the products succeeded. High organizational differentiation in Sonera did not spoil the success.

Cases in the Top management and Market domain (VPN, Vipgate) were not R&D-dependent, and the competences were in-house. There was limited in-house differentiation inside the company, and these were success stories. The motivations (SBU and top management) were similar, the aim being to create a competitive B2B offering in the competitors' geographical areas.

The cases with a pure Market orientation varied (Sonera's Communications Solution, Mobile iPhone in the Convergence period, and Unified Communications). Unified Communications had no capabilities in-house, and there was high differentiation in the company. The Swedish organization did not want to move to this market-orientation mode, and had different capabilities and motivations than the Finnish side. The organization in Finland became market oriented, but the diminishing role of R&D led to a slow and challenging project. In addition, the Finns felt that the firm's structure was less than optimal.

Finally, when the sole source was R&D/Science (MobiCentrex) there was high differentiation inside the company. Top management and the sales organization were content with the current structure and level of revenue in Sonera, and did not wish to cannibalize these earnings. Consequently, there were no complementarities and no ecosystem because the R&D organization could not create them alone.

When all the sources of innovation were present at the same time (FastNet, Mobile GSM services, Privatel) there was unity in the company, competences were in-house, complementary assets could be seized, convergence management worked, the structure was optimal, and the cases were successes.

It seems that both top management/investors and R&D as a single source were deviating factors that lead to failure in creating dominant designs and, according to the findings, represented a different culture. Top-management vision in particular seemed to contradict the reality in the company. Conversely, when 'more interest groups' were involved in the sensing the more 'unified corporate strategizing' (Ch2, theoretical framework) facilitated exploitation of the whole company's resources. Perhaps too, a market orientation as such capitalized more on sales organization, whereas if the product was solely R&D-led it could have been difficult to capitalize on the various sales units (as was evident in MobiCentrex and TeleSampo). A multiplicity of innovation sources seemed to impose limitations on the various cognitions and competitive tools, the motivation to acquire new technology, and consequently on the correct evaluation of the company's capabilities. A case in point is the Zed product: top management favored 'selling the story' without having the required capabilities in the company, and furthermore, the 'home organization' was not used in the productization process.

These findings on the sources of innovation in the process of adapting a dominant design (and of any innovation type) give rise to the following proposition.

Proposition 5a. *Through their varying relationships and usage of company governance and capabilities, the different innovating units (R&D/Science, Market orientation, and Top management/Investors) exploit the building blocks of dominant design differently. A market orientation is likely to lead to successful ecosystem creation and convergence, whereas R&D/Science and Top management/investors face challenges in managing organizational differentiation.*

The fact that the various sources of innovation tend to use the company's resources differently assigns significance to the role of the different innovative units. In general, a market orientation (Jaworski et al. 2000) and R&D (e.g., Srinivasan et al., 2004, 2006) are considered important. Proposition 5a also supports the view expressed by Afuah and Utterback (1997) and Rosenkopf and Tushman (1993) that capabilities need to change in the industry lifecycle. However, I argue that changing capabilities in the product lifecycle is difficult if the project is based in a very biased innovative domain, focusing on R&D in the initial sensing stage, for example. In other words, it is challenging to reach the dominant-design stage in the lifecycle of a product evolving from different sources of innovation.

This view differs from the one put forward in the classic discussion on dominant design (Utterback & Abernathy, 1975), which is restricted to the changing bias from product to process innovation. According to Utterback and Abernathy (ibid.), the lifecycle of the strategy process proceeds from performance maximization through sales maximization to cost minimization. In my opinion, the process may also start from a different domain from which it may be difficult to reach the cost-minimizing stage (seen in the end result as dominant-design exploitation).

The source of innovation in relation to the industry lifecycle. Some indicative patterns emerged concerning the influence of the industry lifecycle (see Appendix 13 for numerical values). More than one source of innovation was required in the introduction stage to ensure a successful project. TeleSampo was an exception: it was too early on the market despite having more than one innovation source. Only top management was pushing projects in the hype of the late 1990s, and these projects were not successes. Another interesting finding emerged in the case of MobiCentrex: R&D and Science failed as a source in the growth stage of the industry lifecycle. The implication here is that it does not pay to develop R&D internally in this stage. In turn, a market orientation was needed, as in the cases of Vipgate, Sonera's Communications Solution and Mobile iPhone services. I analyzed all industry-lifecycle stages and Sonera's cases accordingly, hence the following proposition is applicable to all innovation types.

Proposition 5b. *More than one innovation source is required during the introductory lifecycle stage because the pattern of success is not clear. Focusing only on R&D and Science in the growth stage leads to failure because of the slow and risky way of working. A market orientation is needed in open/horizontal market conditions because technological capability is not a differentiating factor.*

Fast action is needed in the growth phase, and 'turning back' to a slow R&D process might not pay off, because the market may have expectations of the upcoming dominant design (cf. Christensen and Bower, 1996).

Sonera has been a pioneer in the following telecom areas: the Internet, datacom, mobile communications, and value-added integrative services for the B2B segment. One factor that sets Sonera and Finland apart is the technologically challenging and heterogeneous market. A manifestation of this is that many European telecommunications manufacturers have been active in Finland testing their hardware. In the case of mobile business, for example, Siemens transferred their mobile software development to Turku in the 1990s. Because Finland was split into three telecom camps, with different network technologies, network interoperability was important, which was challenging technologically. Sonera was highly innovative in this environment, especially in the 1990s. The company produced first-in-the-world innovations, which were architectural and revolutionary in nature, and generated patent applications. In fact, these innovations shaped its strategy in the B2B segment, and the networking idea was commercialized, manifesting in managed services. Sonera also encouraged vendors to be active in Finland. For example, Nokia's mobile business started because Sonera was a very demanding customer, urging Nokia to develop the mobile switch to NMT-900 (Nordic Mobile Telephone, 900 MHz).

When many sources of innovation were used together, especially in 1987-1995, the market was typically in the introduction stage, being either closed (in a regulative and proprietary technology sense) or semi-closed. The regulative authorities liberalized the market in the semi-closed phase, and technology became a source of competitive advantage (e.g., in GSM, which was a digital technology).

It is worth elaborating more on the technological environment, which was heterogeneous in the eras 1987-1992 (the era of liberalization of telecommunications and data business) and 1993-1998 (the era of intense competition and growth in the mobile business), Telcos could use proprietary technologies, and customers and telecom operators had to allow data, voice, and mobile technologies to communicate. Consequently, the different signaling procedures needed to be compatible. These demands for different technologies, networks, and end devices to work together were especially challenging in the cases of Service numbers, DataNet, FastNet, Privatel, Cid, and Mobile Centrex.

Moreover, the individual products, namely Service numbers, DataNet, FastNet, Privatel and Cid were very profitable to Sonera. The market was also closed or semi-closed.

The following proposition is based on the above analysis of the sources of innovation and conditions in the early-lifecycle stage, and of Sonera's high-appropriability regime. It applies to all innovation types before the open-market stage: in other words, it does not apply to Unified Communications, which started a new industry lifecycle.

Proposition 5c. *Using many sources of innovation in combination is profitable in a closed or semi-closed market-introduction stage when R&D is in-house, and the market is heterogeneous and technologically challenging.*

Proposition 5c contributes to the discussion on market characteristics during the innovation process. According to Gatignon and Xuereb (1997), conditions of high market growth and tough competition require a stronger customer and competitor orientation. I would include the role of technology in the discussion. The characteristics and stage of the industry lifecycle do not in themselves explain success, and many sensing ideas should also be pursued together, especially in the introductory stage. In relation to the theory of dominant design, Proposition 5c points to the fact that the market may also be closed in the fluid stage, which thus far has gone unnoticed (Tushman & Anderson, 1986; Anderson & Tushman, 1990; Utterback & Abernathy, 1975). A further insight is that the industry lifecycle may not start from a dominant design, meaning that the two concepts should be separated theoretically.

Relationships among the building blocks

Appendix 13 gives the results of the analysis of the relationships among the building blocks in the model in numerical values. I used pair-wise comparisons to find correlations that complemented the earlier case analyses. The building blocks in question are dominant logic, convergence, the ecosystem, standards, modularity, complementary assets, and network externalities. The focus is on 'incremental building blocks' and 'discontinuous building blocks', respectively (see the framework for the adaptation of dominant designs).

Convergence. First I discuss the role of managerial convergence in the creation of new dominant designs.

Convergence has been prevalent in Sonera, both in enhancing current offerings (e.g., the Vipgate concept) and in developing new differentiating offerings.

The new insights concern the following elements, the management of which facilitated successful convergence: integrative capabilities, cross-functional collaboration, redesign and new service functionality, sensing and visioning customers' common usage needs, bypassing regulative restrictions, extending subcontracting and service management to offerings, the creation of new sales concepts, new cost-efficient service functionality, linking different technologies, and customer impact on defining what convergence is.

Convergence seems to be typical of telecommunications operators. Some of Sonera's products (fixed voice and mobile voice), for example, were explicitly integrated in terms of technological and usage experience: NMT-Privatel, GSM-Privatel, NMT-GSM MobiCentrex, Sonera's Communications Solution, Unified Communications, and the Cid Company number service.

Convergence typically started a new developmental phase. There was robust evidence of this in UC, as other players were offering the same functionalities globally as telecom operators, also often defining what convergence should be in terms of technologies and products. The need for a converged offering was evident in 2008-2010, for example, as respondents in the UC case described the most demanding customer types in terms of what they were asking for. This was a communications entity (UC) that was based on presence information, which meant mobile communications, customer-service solutions (including service numbers and attendant services), and fixed-voice solutions. Its customers wanted to know how to communicate in the form of short messaging, UC client to softphone and integrating e-mail, for example, and what to do with the presence information. These demands clearly demonstrate the usefulness of compatible product silos and IT systems. In terms of market demands, business-productivity solutions and value-added logic replaced the earlier technology- and product-based logic.

The above observations on the nature of convergence in the telecommunications industry lead to the following proposition. It is associated with local endogenous innovations, although depending on the capabilities of the company, it is also applicable to local and global exogenous innovations from an incumbent perspective, meaning that there is also the possibility to "*rule without assets*" (Jacobides et. al, 2006) and thus to create an ecosystem.

Proposition 6a. *Converged products and convergence management prepare the incumbent organization to create a new dominant design. Actions enhancing this relationship include (a) pursuing convergence in educating the market, (b) being active towards legislative regulators, (c) creating a silo-free organizational-governance model and IT structure, (d) demonstrating path dependence from the old to a new offering, and (e) analyzing the possibilities of creating an ecosystem.*

In the most successful example of convergence products in these cases, organizational learning promoting a more market-based and internally silo-free way of working enabled the case company to create an ecosystem. Supporting the above proposition, Augier and Teece (2006) note that functional integration is difficult when firms have internal boundaries or 'silos', claiming that integration actually constitutes a dynamic capability. When there has been constant restructuring of the management model, continuums and breaks, convergence management serves as a tool for organizational development (Cacciatori & Jacobides, 2005). Overall, Proposition 6a reflects the novel finding that managing convergence ex ante leads to a successful dominant design, thereby contradicting Tushman and Romanelli (1985), for example.

Dominant logic. Second, I raise the question of how dominant logic enhances or blocks the creation of convergence and an ecosystem, respectively. One could reformulate this by asking what it takes to create an ecosystem by means of convergence management. In my opinion, based on the case study, such creation needs open, customer-need-based thinking and offerings (contrary to 'technological-silo' thinking). Open cooperation between the functions and the product areas, modular IT, technology-management capability and the inclusion of customer preferences in the productization process are also prerequisites. These notions call for a more concrete analysis of dominant logic.

It also seems that transitions to new technologies and products can be blocked if there is a strong dominant logic, meaning that current technologies are in use and the organization is familiar with them, and also if there is positive feedback from customers about current services in the same product category during a dominant-design-management phase (e.g., Christensen, 1997). There was resistance in the case companies to moving to new technologies in the transition to new dominant designs. In other words the technologies were competence-destroying to these units, which together with their transition technologies were related to value-added services in the voice area, to X.25 and TCP/IP standards in data business, and to IP-PBX and UC in the PBX world. Thus, the transition was from proprietary customer-owned products and services to generic software as a service.

The targets of the 'old business' (i.e. performance) also constrain the acceptance of different business models and 'unified corporate strategizing' in the evaluation or sensing phase. It seems that, to some extent, convergent thinking fosters new business logics (on questions such as what products and related organizational silos are to be combined, and what the new pricing mechanisms are). This phenomenon was evident in Cid, which integrated many former services into one concept. When dominant logics appear in a company the development of products and resources follows that way of thinking. Different dominant logics were identified in the case company throughout its history (termed eras in this study), and there were differences in culture between Finland and Sweden (see especially the Vipgate concept, Cid, Unified Communications and Sonera Communication Solution).

Reinganum (1985), Henderson (1993), and Rosenbloom and Christensen (1994) argue in general that incumbents invest less in new technologies because they have a relatively weaker incentive to shorten the length of the current stage of incumbency. This is illustrated in the case of Unified Communications, in which the old infrastructure and the old way of using services generated major earnings. Consequently, productization lagged two years behind what was feasible, according to one informant.

Reflecting the literature and company history, and supporting Henderson (1993), Informant 7 said that all one's time in the 1990s went toward protecting the old monopoly business, and so there was no time to think about innovations. Informant 29 also noted the tendency to fit the 'new thing' into the old structures, which often led to rigidity and blindness to the new possibilities (see also Adner and Levinthal, 2008).

Dominant logic (Huff, 1982; Bettis & Prahalad, 1986; 1995) and the learning loop from the market affect the kind of products on offer, especially integrative products and product portfolios. The dominant logics differ in Finland and Sweden: it is fixed and PBX-centric in Sweden, and mobile and network-centric in Finland. It has taken a long time to identify, control, and respond to these dissimilarities.

To summarize the above discussion about the presence of a dominant logic in the case company and the industry (how one can observe it in practice), it seems that products were not developed on the basis of the most progressive offerings in the company. On occasions, B2B products were managed in accordance with functional, consumer-type processes, which do not take into account the special needs of the B2B segment. The regulator also interpreted market definitions based on products (Kilpailuvirasto – The Finnish Competition Authority, 1999b), not on offerings or true market shares within different segments, thus 'freeing' them, in a way, from earlier dominant logics. The service-usage culture and the operator role were different in different countries and in different markets.

These notions lead to the following proposition, which offers new insights into which building blocks are important in achieving a dominant design (e.g., Schilling, 2002; Srinivasan et al., 2004, 2006; Suarez and Utterback, 1995). The proposition is associated with local endogenous, and local and global exogenous innovations, in other words with both incumbents and entrants.

Proposition 6b. *A strong dominant logic blocks ecosystem creation and convergence management in order to secure the current business logic. The current business logic is secured by (a) using current technologies, (b) using old market definitions approved by the legislative regulator, (c) nurturing the current service-usage culture, and (d) not identifying or responding to differences in markets.*

Strong dominant logic exploits current technologies, and is not open to new ideas, especially those required in convergence and ecosystem management. This thinking reflects that of Srinivasan et al. (2004, p. 45), for example: "*incumbent inertia and threat of cannibalization of existing products slows the incumbent, providing opportunities for later entrants*". Moreover, according to Schilling (2002), "*Failure to invest in continuous learning processes will increase the likelihood of technological lockout".* However, Proposition 6b sheds new light on the mechanisms of dominant logic, not least by treating it as an ex ante construct.

Standards, modularity, complementary assets, and network externalities. Third, how are standards, modularity, complementary assets, and network externalities linked to each other? In addressing this question I will first consider what the target of a telecom operator is and what the process underlying all its actions should be. The goal is to create an industrialized solution. This differs from the goals of IT-system integrators, which are associated with customer specificity, lower investments and lower average profitability. The underlying process activity characterizing all telecom operations is constant migration from old to new technology, through which customers are retained and even taken along to experience and accept the new. Old services need to work in the new applications, and that migration should be done in a cost-efficient manner. The most obvious example in Sonera was the history and technological path of mobile business in 1980-2010, although other migration paths were present: PBX (Private Branch Exchange) business, VoIP (Voice over Internet Protocol) business, and ATM-Frame Relay.

The above examples apply both to industry and to company processes. With regard to processes, Sonera established its Solution Sales unit early on. The target was to create a standardized modular offering. The Vipgate concept also effectively illustrates the network externalities and the scaling up of internal operations. Its activities included cross-selling, developing new sales practices, IN (Intelligent Network) usage in the whole company, a new product-development process, and the active use of the Sonera brand. Successful aspects of the mobile business, in turn, included roaming, quality, the use of retailers, and sending a common message to the whole market to network with consumers together in order to diffuse the service.

Complementary assets are important to incumbent or monopoly telecom operators, according to McGahan and Silverman (2006) and Stieglitz and Heine (2007). Such assets act as a shield from external technological shocks (from a competitor or another industry) and could also enhance the adoption of an in-house innovation – known as synergy effects. Vipgate, Service Numbers, Mobile business, and FastNet in particular benefited from complementary assets, manifested in activities such as cross-selling, one-stop shopping, wider product-portfolio offerings, and discount-pricing policies. These pricing policies entailed the evaluation of Sonera's whole product portfolio in order to find critical price levels for *each* product.

Modularity works on two fronts: through the management or orchestration (Brusoni, 2005) of production, or partnering, when the production is more open and external vendors are used on the one hand, or via the company's internal way of working, especially in IT systems, on the other. Sonera's Unified Communications offering demanded very good modularity processes and know-how. It was argued in the interviews that Microsoft worked in a release mode, and telecom operators had to adapt to it. The challenge in Unified Communications, which used both telecom operators and Microsoft products in combination, was that the process put even more pressure on the company to master modularity. Modularity enhanced convergence-management capabilities through more flexible service implementation achieved by means of opening the company internally and to external partners through the integration of customers', the telecom company's and the external partners' IT systems.

Increasing returns (Arthur 1989, 2001) implies a 'bandwagon effect', and in the case of adoption can emerge from learning by using, network externalities, economies of scale in production, informational returns, and technological interrelatedness. This was seen in Sonera when customers did not have to think about the technology used by the receiving partners. These factors apply to Mobile business as a whole, on both the production and the user side. First, a service-usage culture was created (GSM technologies), and when the mobile network diffused, the positive path-dependence enhanced the technological path from ARP-

NMT-GSM-3G-4G. In a way, the standard-setting process helped to create this Mobile business.

The above discussion about a telecom operator's targets, complementary assets, modularity and increasing returns leads to the following proposition, which is associated with local endogenous and exogenous innovations just as the facets are associated with the assets controlled by the proprietary telecom operator.

Proposition 6c. *Standards, modularity, complementary assets, and network externalities have positive mutual impacts. It is beneficial to an incumbent telecom operator to pursue a standardized modular offering in order to keep and migrate its customer base. Migration is facilitated through the use of complementary assets such as (a) cross-selling, (b) technological interrelatedness, (c) brand value, (d) quality, and (e) a service culture. These assets enhance network externalities.*

This proposition is in line with Srinivasan et al.'s (2004) finding that complementary assets are beneficial in reaching network externalities. More recent support comes from Molina-Castillo et al. (2011), who parallel complementary assets with a large customer base, and Schilling (2002). These building blocks are 1) typical of multi-product incumbents and 2) synergetic.

4.2.3 RQ3: What role does the nature of products as complex technological systems play in dominant-design adaptation processes and outcomes?

Sources of technologies, capabilities in Sonera, and legislative regulation (complex technological systems)

I will now extend the discussion on the adaptation of dominant designs to cover complex technological systems, giving a systemic perspective on innovative activities in Sonera. My analysis covers technological sources, legislative regulation and capability analysis on the company level.

The analysis proceeds in three steps. First, I consider the technological sources by country of origin. Second, I focus on the capabilities in Sonera and incumbent telecom operators. My intention is to show that technologies may be competence disrupting, competence enhancing, or both. Interestingly, [converging] technologies may have different effects in different business areas. Third, I discuss the impact of legislative regulation on different technologies and businesses in Sonera and Finland.

Figure 20 below shows the sources of technology by country of origin.

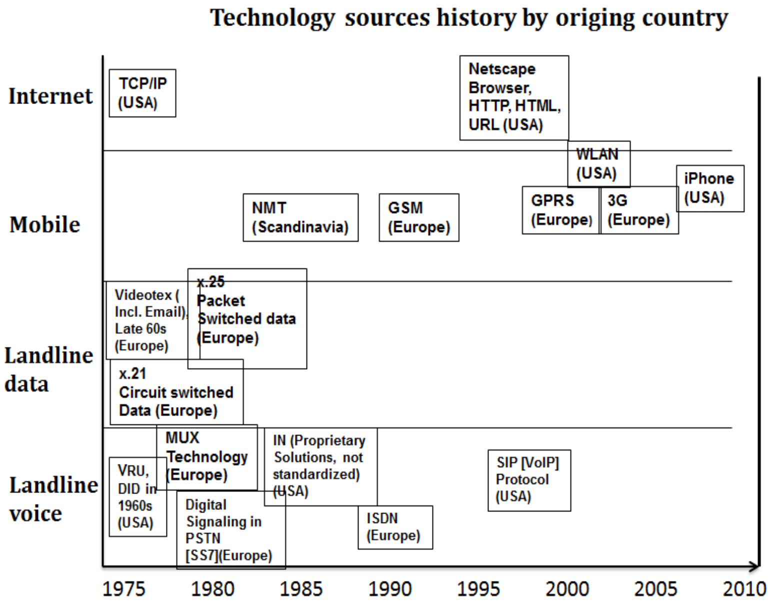

Figure 20. Technological sources by country of origin, 1975-2010

Figure 20 shows how the technologies differ in terms of country of origin. I refer to the empirical evidence (see Appendices 1 and 2 for the case and industry history) with regard to the substance of the technologies. In a nutshell, Internet-related technologies were pioneered in the US, and mobile-related technologies in Europe. Figure 21 depicts the capabilities in Sonera.

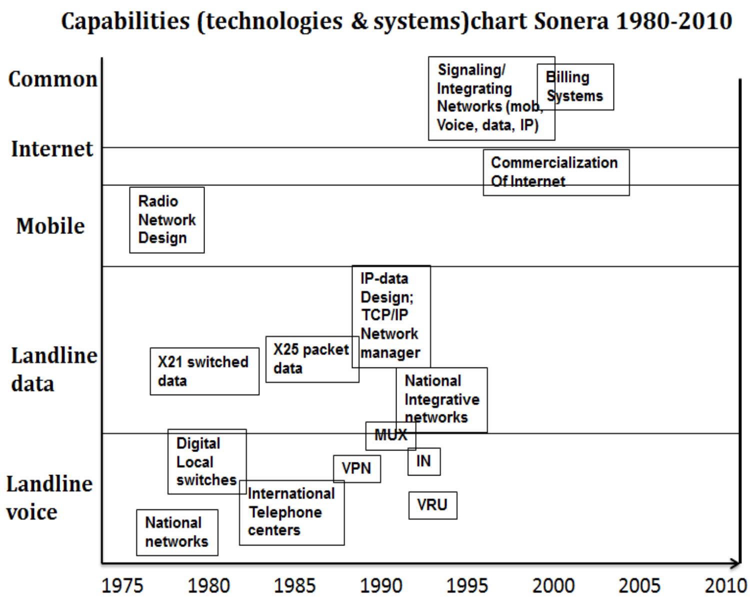

Figure 21. Technological capabilities in Sonera, 1980-2010

Figure 21 shows the distribution of capabilities in the different organizational units. The key capabilities were in landline voice, landline data, and mobile technologies, and in the integration of these technologies especially in the B2B segment. Again I refer to the empirical evidence (Appendices 1 and 2) with regard to the substance of the capabilities.

Figure 22 below depicts the impact of legislative regulation in Sonera and Finland.

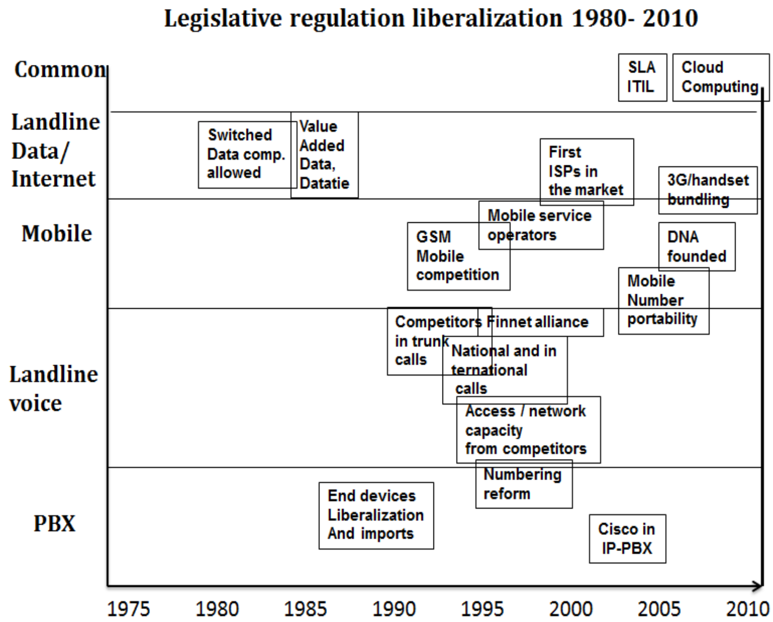

Figure 22. The liberalization of legislative regulation, 1980-2010.

The figure 22 shows how the legislative liberalization affected the different organizational units. The main units were PBX (Private Branch Exchange), landline voice, mobile, and landline data/Internet. The effects of the liberalization and the timetable varied in the different units. I refer to the empirical evidence (see Appendices 1 and 2) with regard to the substance of the liberalization.

The innovations were clearly systemic in nature. I draw an example from the fixed-voice business, which was *regulated* for a considerable period. Liberalization started in the mid-1990s (hence there was a lack of competition, new capabilities and new products). The capabilities were concentrated around the telephone operators' proprietary technologies. However, TCP/IP technology was gradually infiltrating the fixed-voice business as well. In terms of capabilities, TCP/IP was competence disrupting for fixed voice, and consequently the technology did not develop. As a result, the dominant design turned out to be 'IP Voice', also termed Unified Communications (UC). Fixed voice was thus 'absorbed' into the dominant IP technology. It would thus seem that some technology is so dominant that it has the capacity to 'draw in' adjacent areas and destroy previously dominant designs.

It is evident from the above analyses (source of technology, technological capabilities in Sonera, regulative liberalization) that dominant designs emerge along a networked innovation developmental path that is characteristic of complex technological systems. Allow me to elaborate on this. When technological brokering and technological capabilities were aligned in Sonera, accompanied with incentives to innovate (the opening up of competition, pressure from the competitive situation, and changing customer preferences), dominant designs emerged. On the other hand, these conditions were not present in cases like Zed (technological capabilities and technological brokering in particular were missing), and no dominant designs emerged. In the successful cases there were competent people and SBUs engaged in the process of adapting successful dominant designs, even if some of these innovations were competence disrupting for other units. In the light of the above discussion I offer the following proposition.

This proposition concerns the evolution of dominant designs in an industry lifecycle, and therefore is associated with global exogenous innovations.

Proposition 7a. *In complex technological systems, dominant designs emerge along a networked innovation developmental path and are likely to have a 'domino effect'*[94] *. In other words, they absorb adjacent standards that do not develop technological capabilities, exploit legislative regulation or offer commercial incentives in order to develop dominant designs.*

Proposition 7a concerns the development of innovations in complex technological systems (Rosenkopf and Tushman, 1993; Abernathy and Clark, 1985). It incorporates the term 'domino effect' with specific

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[94] The domino effect is a situation in which one event causes a series of similar events to happen one after another. The term originates from the game 'Dominoes', and "from the fact that if dominoes are stood on end one slightly behind the other, a slight push on the first will topple the others". Domino theory is thus defined as follows: " if one act or event is allowed to take place a series of similar acts or events will follow" (Merriam-Webster, 2014).

reference to such systems, and is closely aligned with Adner and Levinthal's (2002) reference to technological "invasion" as characterized by convergent technology and its application. What is novel is my conceptualization of the interplay among technology, legislative regulation and capabilities.

How the nature of complex technological systems affects the emergence of dominant designs

This section draws together the various strands in the above discussion to analyze the conditions that facilitate the emergence of dominant designs in complex technological systems.

I elaborate on the question of whether or not the evolutionary (regular and niche) and revolutionary (architectural/ revolutionary) innovations in the telecom/ICT industry and Sonera became dominant designs. I also discuss how innovations are linked on the technological level, and identify the dominant players of interest. I addressed this theme in the empirical part of the thesis in the process of explaining the transition from earlier services to new ones. These themes are depicted more explicitly in Figure 7, concerning service usage in Finland's Telecom industry in 1980-2010, and in Figure 20 concerning the role of Unified Communications in the evolution of communications.

Next I chart the history of the fixed-voice, fixed-data, Internet and mobile industries between 1980 and 2010. All these industries experienced both evolutionary (competence enhancing) and revolutionary (competence disrupting) development from the incumbent's point of view.

Intelligent network (IN) started to substitute for long-distance calls in the B2B sector [creating virtual private networks] in 1994, and also enhanced the service number business in the late 1990s. In turn, the cordless phone (CT2) and mobile Centrex (MobX) complemented the fixed PBX business, and at the same time (1995) consumers started substituting mobiles for fixed phones. These evolutionary developments (competence enhancing) were advantageous for telecom operators and happened in the proprietary telecom industry. However, discontinuities from adjacent industries were also linked with the fixed-voice business area. The revolution began as early as in 1975 when the TCP/IP protocol suite was tested: this turned out to be a clearly disruptive technology for the landline voice business.

In addition, shocks such as Skype, increased computer power enabling Cloud Computing and IP/PBX, together with TCP/IP (e.g., Gartner, 2005; Martikainen, 2006) transformed the closed fixed-voice business into a new open industry, namely ICT, in 2010, following its earlier transition to the mobile industry. Customer needs converged on both of these development paths in that the technology was required to create the convergent services.

There was both evolutionary and revolutionary development in the case of fixed data, as with fixed voice. At first the data was enabled by circuit-switched technology (x.21). Moving to packet-switched technology (x.25) was progress, as was the step to ATM (Asynchronous Transfer Mode), in which the functionality was similar to both circuit-switching and packet-switching networks. However, this was not a winning technology. Sonera clearly had state-of-the art capabilities in these areas, and was able to create dominant designs.

ISDN, in turn, was an attempt to rationalize the usage of both voice and data in the same telecom networks. These developments advanced further in proprietary telecom assets, and in Sonera's innovations such as FastNet and DataNet, which successfully used US-based IP Data technology (TCP/IP). Although the DataNet product decimated earlier revenues (x.25 based), it still managed to create a new profitable business and a new dominant design for a telecom operator. As was the case with fixed voice, here, too, the technological foundation of the revolution was the TCP/IP protocol. The Internet (HTTP, HTML, URL and the Netscape browser) accompanied with TCP/IP created the Business Internet in the mid-1990s. This (Internet) later destroyed the telecom operators' own content business, in other words it was competence destroying for TeleSampo and circuit-switched/packet data (e.g., TeleSampo and its email service [Telebox]), and later also constituted a challenge for DataNet. The closed data business has also transformed into a new open industry, ICT, enabled by Cloud Computing.

Interestingly, the evolutionary path of mobile business was triggered by a failure in the telecom industry. Mobile technologies evolved gradually: ARP (1972), NMT-450 (1982), and NMT-900 (1986). A digital GSM standard was introduced in 1992, which enabled competition. However, this was a positive development from the telecom operators' point of view. Then in the early 2000s an attempt by telecom operators seeking mobile-data and Internet convergence to create a new closed Internet was not successful. Enabled by TCP/IP, players such as Apple (iPhone) went on to create the mobile Internet market.

Figure 23 is a graphic illustration of technological developments in the telecom industry in the light of the Sonera portfolio.

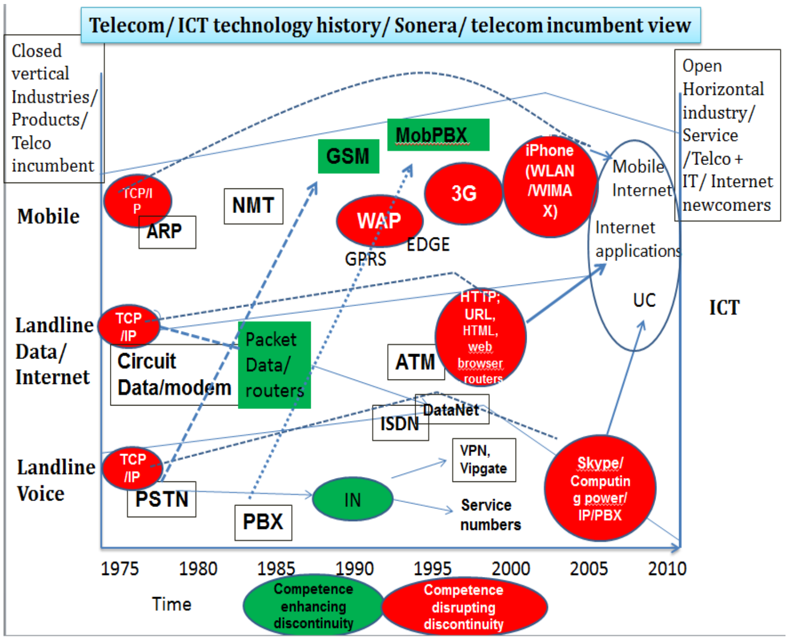

Figure 23. The history of the telecom/ICT industry in the light of Sonera's offerings

The closed vertical industries are classified Landline Voice, Landline Data and Mobile technologies in the figure 23. The elements include technologies, services and market events. Among the technologies, TCP/IP was the common denominator linking competence-disrupting discontinuities to incumbents. The outcome was a horizontal industry that enabled separate technologies to work in combination, although realized at different times in different industries, and a long time after the technological invention (see also Vesterinen, 2009, p.142). TCP/IP was commercialized when complementary innovations emerged and added capacity. The dotted lines from PSTN and PBX to Mobile in the figure depict the natural progression to Mobile from Fixed Voice. Competence-disrupting discontinuities marked the transition to a new dominant design and industry, namely ICT. Many players were involved in this open horizontal industry, not only telecom players, and customer needs converged.

Propositions 7b and 7c concern local endogenous and exogenous and global exogenous innovations, covering the whole industry lifecycle from 1980 to 2010, and the respective cases.

Proposition 7b. *New dominant designs emerge in complex technological systems characterized by industry convergence when the new technology aligns with the capabilities and incentives of the* *receiving unit. Incentives include liberal legislative regulation that opens the competition. Converging customer needs, technological interfaces, and synchronous discontinuities between technologies also need to be present.*

Anderson and Tushman (1990) found that incumbents commercialized both competence-enhancing and competence-disrupting innovations. Proposition 7b adds the insight that discontinuities may be competence-enhancing and disruptive at the same time in different units. The decision to commercialize technology is thus a result of conflicting targets (units with the capability to commercialize the technological invention also have an incentive).

The second line of research focuses on the integrative capabilities of incumbents (Srinivasan et. al. 2004, 2006) when there are open-industry conditions and a lack of capabilities and incentives to commercialize new technologies. Implicit in Proposition 7b is the assumption that new dominant designs tend to be architectural/revolutionary in nature [due to convergence in complex technological systems]. However, there may be a limit to one player's integrating capabilities (see Srinivasan et al., 2004, and Klepper and Simons, 2000 in the context of one originating industry in the field of consumer durables). In other words, it may be that the dominant logics are so different in conditions of multiple-industry convergence and competence-disrupting discontinuity in focal companies and incumbent industries that incumbents or any other single player simply cannot bring about convergence. However, Tripsas (2008, pp.87-88) found that new technologies invaded incumbent industries from different source industries, although they did not study the causes and incentives on the company level.

Proposition 7c. *Ambidexterity is unlikely to work in complex technological systems (telecom/ICT) if the service portfolio seems to be converging into just one offering. Many products in the telecom/ICT industry serve the same customer need and thus potentially use uniformly manageable architectures and common platforms.*

Proposition 7c is to the point with regard to managing products and the company as a whole in that there need to be integrated and/or chosen elements for the same manageable entity, not just for the separate entities (business units). Ambidexterity as such is thus not likely to succeed in the telecom/ICT industry. Platform thinking is a metaphor for the kind of integration that is needed: it does not refer to separate platforms for mature and introductory products, but to a common manageable unit given that there is a need and the required capabilities to build such a platform. An illustration from the case study supports this argument.

In the hype of the late 1990s, the organization was split into incremental (telecom) and disruptive (mobile & media unit) elements. This division did not work due to the different dominant logics, whereas it would still have been possible to manage the whole company from the same platform.

Ambidexterity is also discussed in the theoretical part of the study, the implication being that a company should both exploit and explore its portfolio of services. Proposition 7c is in contradiction to ambidexterity thinking given the proposed integration of the portfolio into one offering, namely ICT.

5. Discussion

This chapter summarizes the answers to the research questions, presents the limitations of the study, discusses managerial implications, and suggests avenues for future research.

To start, I present some views (in line with the research choices I have made) on what a theory is. I find the following definitions of "theory" from Merriam-Webster's (2013) dictionary useful to be a starting point: (1) "*the analysis of a set of facts in their relation to one another*," and (2) "*a plausible or scientifically acceptable general principle or body of principles offered to explain phenomena*." These broad definitions are not far from that given by Gioia and Pitre (1990): "*We broadly define theory as any coherent description or explanation of observed or experienced phenomena*" (p.587). The key issue here is a coherent, consistent (Suddaby, 2006, p.640), and credible explanation of the area of investigation. In my research, I aim to show a credible model of the dominant design adaptation process, in the light of my empirical narrative and previous dominant design theory. Whetten (1989) discusses the building blocks of a theory and notes that these can be summarized by answering the questions of what, how, and why. In answering the "what" question, it is important to determine "which factors (variables, constructs, concepts) logically should be considered as part of the explanation of the social or individual phenomena of interest" (ibid. p.490). An answer to the "how" question should indicate the way in which factors relate to each other. In answering the "why" question, according to Whetten (1989), it is important to show the justification of the selection of factors and the assumptions of the theory.

The next logical question to ask, then, is what constitutes a theoretical contribution. Whetten (1989) addresses this by stating that an answer to the "what" question should be comprehensive (i.e., all relevant factors are included) and parsimonious (i.e., include only value-adding factors, and discard that which does not increase understanding). On the other hand, the "how" question should prompt causal explanation in order to make a theoretical contribution. In a nutshell, a simple theory should include both description and explanation (ibid. p.491). Further, in considering the "why" question, researchers need to clarify their logic and worldview so that they can effectively judge the new contribution. This is needed because the target should extend existing knowledge and pose altered views. These views can arise when an earlier theory is not internally consistent or when new empirical data challenges an earlier theory (Whetten, 1989). In a similar vein, Corley and Gioia (2011) state that a theoretical contribution should include originality and utility, and that when both are present, a greater contribution results.

The purpose of this research was to study the process of adapting to dominant designs in a company, in an industry, and intertwined in a company and industry. In other words, the target was to investigate if dominant designs are born and to explore the factors influencing them. The main objective of the study was to understand how a company can create/increase the odds in creating, modify, or adopt dominant designs sequentially and how industry evolution affects this process (McGrath et al., 1992).

I carried out a longitudinal (1980–2010) empirical case study of complex technological systems in telecommunications/ICT industry and at the case company Sonera, a telecommunications/ICT firm. Furthermore, I used abductive logic (Dubois & Gadde, 2002; Kovács & Spens, 2005), thus integrating and extending earlier research approaches by building a dominant design adaptation framework.

The earlier research comprises the following six approaches. First, theoretical frameworks (no empirical data included) on dominant design building blocks have been built by McGrath et al. (1992), Lee et al. (1995), Suarez (2004), Schilling (1998), and Teece (2007). Second, survey research has been carried out by Srinivasan et al. (2004, 2006) on the factors that enable dominant design emergence. Third, empirical longitudinal case studies on strategy making and cognition in companies have been performed by Burgelman (1991, 2002), Cattani (2006), and Tripsas (1997), among others; however, these studies do not directly address dominant designs. Fourth, there are longitudinal empirical case studies of how one company and one standard (the video cassette business) (Cusumano et al., 1992; Rosenbloom & Cusumano, 1987) gained the dominant design position. Fifth, there are seminal works from the incumbent point of view on how to adapt to the innovation process

(Abernathy & Clark, 1985; Christensen, 1997; Henderson, 1993; Henderson & Clark, 1990). These empirical works focus on creating innovation typologies; however, they do not study complex technological systems. Finally, the seminal works on dominant design (Anderson & Tushman, 1990; Tushman & Anderson, 1986; Utterback & Abernathy, 1975) center on industries and companies at a "black box" level, single product areas, the emergences of dominant designs, and the influence of dominant design on industry conditions.

This study aimed to shed light on a gap in previous research. In so doing, I integrated research on the evolution of dominant design in the domain of complex technological systems. I identified success and failure patterns in the dominant design adaptation process. I found that this process is conditioned on the source of innovation, industry life cycles, and the nature of complex technological systems as such. This research approach led to a better understanding about the dominant design adaptation process.

5.1 Research questions answered—the theoretical contribution of the study

In this section, I present the research questions and their answers. I also propose a theoretical contribution in line with the criteria presented earlier.

RQ1: What sources of innovation and what processes are related to (a) a multi-product firm's successful management of its dominant designs and (b) successful transformation from one dominant design to the next?

For RQ1 (a), I first studied the different sensing practices (i.e., using science, internal R&D, market, top management, investors/industry, or vendors) and seizing/transforming activities (i.e., using technological brokering, seizing complementary assets, deciding the firm structure [including modularity], creating convergence, and managing organizational differentiation) within Sonera. I then linked this analysis to case success/failure and proposed patterns in the dominant design adaptation process. As a general finding, using all sensing practices together does not necessarily lead to success; however, using only one or two practices likely leads to failure. In seizing/transforming, the challenge was to operate under organizational differentiation when a strictly vertical structure strategic business unit (SBU) was not used.

Second, I showed the elements of the dominant design adaptation process at a company. These elements are shown in sensing, seizing, and transforming (Teece, 2007) tables in the case study and manifested in the competences, organizational structures, processes, and managerial cognition that strengthened or restrained dominant design adaptation. Earlier research has focused on studying dominant designs as ex-post only (e.g., Anderson & Tushman, 1990) and has not empirically identified success/failure patterns in the elements of the dominant design adaptation process (Suarez, 2004).

For RQ1 (b), I first identified the factors that lead to the collapse of a dominant design. I found that environmental factors had a strong role in the collapse of dominant designs (i.e., discontinuities in the industry). The change logic in the successful transition to the next dominant design was operationalized and given a success pattern (Nooteboom, 2000). This success pattern consisted of a perceived opportunity to create integrative, convergent products and services that have the potential for more efficient production. In addition, earlier research has found the element of convergence (Rosenkopf & Tushman, 1993) to be an *ex-post* construct and a synonym for dominant design. I have demonstrated that this element was the key building block in *ex-ante* dominant design creation at Sonera.

After analyzing the sources of innovation and a multiproduct firm's approach to the dominant design adaptation process, I shifted to investigating the evolutionary aspects of the dominant design adaptation framework and the effects that the aforementioned building blocks have on it.

RQ2: What are the relative roles of the sources of innovation in the successful adaptation of dominant designs and their 'building blocks' in terms of a) the process, and b) how they change over time?

I first analyzed Sonera and its sources of innovation in successful dominant design adaptation. This led to empirical evidence that the source of innovation has shifted away from R&D/science and toward a market orientation in the incumbent telecom industry and the case company Sonera.

The key findings are as follows: (1) the source of innovation leading to new dominant designs shifted from an R&D/science orientation toward a customer/market orientation, as the industry evolved to be more open and horizontal. (2) The incumbents' role was seen to diminish. (3) Technological progress enabled other companies to enter the telecom industry. (4) Sources of variation diminished, and selection criteria came to be focused in the market, causing difficult internal selection decisions at Sonera.

What, then, has caused the shift in the importance of sensing? Adner (2002) and Adner and Levinthal (2002) propose that the development of technologies allows for more customer segments to be satisfied. It seems that technology (e.g., TCP/IP) allows new players, along with their peculiar business models and strong market orientation (e.g., Google, Microsoft), to enter the telecom industry, thus posing a challenge to the business models of telecom operators. This may have a negative effect on incumbents' ability to benefit from R&D investments (Klepper, 1996).

In RQ2, the overarching theme is the changing nature of dominant designs in the industry life cycle. The seminal author Utterback (1996) addresses this question by calling for research on whether the industry will still face a shakeout in well-defined markets after the next wave of innovation (i.e., the mature stage of the earlier life cycle). However, it has yet to be questioned whether the next wave of innovation in the topical industry could start from process, and not from product, innovations. The variation, selection, and retention (VSR) analysis I undertook next clarified this.

I elaborated changes in the dominant designs through a VSR analysis of Sonera and the telecom industry from 1980 to 2010. Interestingly, the VSR analysis offered a potential for studying dynamics, as the Unified Communications case starts a new industry life cycle. Although this point was not documented earlier, Utterback (1996) called for investigating the possibility that the source of the next round of innovation could be more process based. Moreover, responding to industry life cycle (Afuah & Utterback, 1997) is more difficult for incumbents than for entrants. It is challenging when sources of variation diminish; there may be multiple potential selection criteria in the company, while selection criteria in the market sharpen and focus. In addition, enabled by technological progress, so-called open assets could be substituted for proprietary technological assets (cf. Jacobides, Knudsen, & Augier, 2006).

I determined how change in the stage of an industry life cycle influences the nature of dominant design. I analyzed the relations between Sonera's innovations and the industry's development. I found that, enabled by the progress of technology, new dominant designs are more customer and market oriented, but they also create demands for new capabilities, such as (1) software development, (2) managed service thinking, (3) vendor and partner relations management, and (4) ecosystem creation.

Under the conditions of subsequent discontinuities in technology and consumer preferences, I argue that the traditional approaches to seizing dominant designs are less effective and have less payoff to players at the same level in the value chain or value web. These traditional approaches include standards, network externalities led centrally by incumbents, a vertical company orientation, and in-house R&D. This contradicts Klepper's (1997) view that large companies could capitalize on R&D-related activities when creating dominant designs. Thus, when the industry matures, the initial way of pursuing dominant designs is no longer effective for meeting similar types of customer needs in subsequent dominant design life cycles (e.g., consider Unified Communications and the iPhone). This implies (cf. Abernathy & Utterback, 1978; Utterback & Abernathy, 1975) that new dominant designs are likely to arise directly from specific pattern elements (Abernathy & Utterback, 1978, p.154). In other words, the rate of major innovation is process oriented, not product oriented, in the new industry life cycle.

However, it is possible that even the specific pattern facets may not hold for new dominant designs. Production processes have tended to be efficient and capital-intensive, with organizational control centered on structure, goals, and rules (Abernathy & Utterback, 1978, p.154). In turn, production processes may become more flexible and less efficient, and organizational control may become less formal and more entrepreneurial (e.g., Google's business model).

Having elucidated the success patterns in the dominant design adaptation process and the influence of industry evolution upon this, I proceeded to analyzing these together and building an enhanced dominant design adaptation framework, with implications for successful dominant design adaptation. In addition, the framework pinpoints the relevant building blocks associated with dominant designs thus shedding new light on the nature and substance of dominant designs.

Regarding the dominant design adaptation process for complex technological systems, I (1) developed two theoretical frameworks, (2) evaluated the concept of dominant design, and (3) introduced the building blocks, including environmental boundary factors, and the sources of innovation. Earlier research (Lee et al., 1995; Suarez, 2004; Schilling, 1998) on dominant design management model building has treated the company as a "black box," and has not identified the connections between building blocks and the process of transitioning to a new dominant design.

There are several novel elements and contributions in the framework. The success factors (i.e., building blocks) seem to be industry life cycle specific. Compared to McGrath et al.'s (1992) model, my model creates a clearer division between incumbent and entrant. In so doing, I also divided the environmental conditions into sensing/seizing and transforming phases.

In addition, the proposed framework combines the entire corporate level for analysis. This makes the model more detailed, contributing to the influence of sources of sensing. This corporate view also includes sources of innovation: R&D/science[95] (Teece, 2007), market orientation[96] (Kohli & Jaworski, 1990; Narver & Slater, 1990), and top management/investors[97] (Jaworski et al., 2000; Tripsas & Gavetti, 2000; Cattani, 2006). These sources of innovation use company resources differently. Finally, the framework identifies the linkages between the dominant design building blocks, extending the work of, for example, Suarez (2004) and McGrath et al. (1992).

The framework offers a new way of looking at dominant designs; the strategy process can be conceptualized as starting from varied domains (i.e., not from a product or process bias, as Utterback and Abernathy [1975] have conceptualized). This new conceptualization of dominant design may reveal the difficulties in reaching the dominant design industry life-cycle phase. In general, based on the empirical evidence, using extremely biased sources of innovation leads to failure.

Keeping in mind that dominant designs have not been studied in relation to industry life-cycle stages, I elaborated the sensing success factors that are industry life-cycle–phase specific. More specifically, the introductory life-cycle stage needed more than one source of innovation because the pattern of success was not clear. In the growth stage, focusing only on R&D and science as a source of innovation led to failure, as this approach represents a slow and risky way of working. Under the conditions of an open/horizontal market, market orientation is needed

95 There is an active research community network that the case company uses when generating ideas. The progress of science is commercialized by an operator and plays an important role in the market and in a products' success. R&D is actively undertaken by an operator and/or the science community and device vendors. R&D plays a significant role in a products' success and includes active technology selection and many pilot projects.

96 Market Orientation includes (1) customer orientation; (2) competitor orientation; and (3) interfunctional coordination. High score (7): Organization-wide generation of market intelligence pertaining to current and future customer needs, dissemination of intelligence across departments, and organization-wide responsiveness to that intelligence (Kohli and Jaworski, 1990).

97 Top management/investor vision and strategy lead productization, centralized decision making, visible political action, and active market and market-structure making.

because technological capability is not a differentiating factor. Further, using many sensing practices was profitable in a closed or semi-closed technologically challenging market (Gatignon & Xuereb, 1997), as the pattern of success was not clear and there was a high appropriability regime for innovators (Teece, 1986).

I have grouped environmental factors in sensing/seizing as one dominant design building block entity, the elements of which have synergetic effects. This entity is typically a closed industry. A new finding was that the basic environmental building blocks (i.e., standards, modularity, complementarities, and network externalities) have a positive impact on each other, and this is basically the "world of incumbents." This world is also typically a closed industry. This means there are barriers to entry; these can be caused by regulation, financial constraints, or capability perspectives. Further, as in Eisenhardt and Martin's (2000) typology, this view applies to a moderately dynamic market. I argue that the incumbent operator's target is to migrate its customer base, and this migration is helped by using complementary assets: (1) cross-selling, (2) technological interrelatedness, (3) the usage of brand value, (4) quality, and (5) service usage culture. The usage of these complementary assets enhances network externalities.

I have grouped environmental factors in the transforming phase, in contrast to the other dominant design building block entity. In this transition, there are different factors at play that can be exploited by both incumbents and newcomers. These factors are changing customer preferences and technological progress. This notion is closely related to a discussion in Eisenhardt and Martin (2000) regarding how different kinds of dynamic capabilities are needed in relation to market dynamism.

During the field study, various tradeoffs were identified in dominant design management (from market-based changes and from the company management point of view). These tradeoffs were conceptualized mainly as convergence[98] and as dominant logic[99]. At Sonera and in the incumbent industry, convergence and the change of dominant logic challenged and posed threats to the current way of working.

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[98] Conceptualized as follows: The company appreciates convergent products. It has convergent products and offerings.

[99] Conceptualized as follows: Organizational differentiation is high (in strong dominant logic). The degree of difference between organizational divisions in terms of their overall goals, marketing and production methods, and decision-making styles are high.

Related to transforming, convergence is seen as beneficial to incumbents' ability to operate in complex technological systems, thus slowing down later entrants (Srinivasan et al., 2004, 2006). The most important building blocks leading to the successful creation of the new dominant design were generally identified as related to convergence management: (1) educating the market; (2) being active toward legislative regulators; (3) creating a silo-free organizational structure that challenges the extant dominant logics of different product areas; (4) demonstrating a path away from depending on the old offering to a new one; and (5) analyzing the potential to create an ecosystem.

These adjacent elements, convergence (Rosenkopf & Tushman, 1993) and dominant logic, contribute a fresh perspective on when to create new subsequent dominant designs. In addition, organization type (e.g., SBU organization, silo-free organization, and modularity) and managerial cognition boundaries were of central importance. In particular, one failure was portfolio management without a converging plan or a platform. These elements manifested in Sonera's case as the preserving of the old public switched telephone network (PSTN) business; a new, cautious unified communications strategy; investments in only market-oriented processes (e.g., customer service); and different organizational cultures and market situations that led the company to be vulnerable to vendors and adjacent industry players. However, the convergence is not always needed and appreciated in the market (Adner, 2002). Under these conditions, the organization type was not critical[100]. These findings (i.e., the company's internal organizing and its effects on convergence management) complement each other and create a bridge for the company structure discussion (i.e., vertical/modular). These discussions are found in the work of Williamson (1971, 1991, and 1999), Christensen and Raynor (2003), Cacciatori and Jacobides (2005), Jacobides (2005), and Jacobides et al. (2006) regarding creating dominant designs. A key finding was that a vertical SBU is beneficial when creating new dominant designs, which are convergent in nature.

Finally, in terms of dominant design building blocks, the case study also allowed the identification of a positive feedback loop among standards, modularity, complementary assets, and network externalities.

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[100] Conceptualized in this study as follows: Market preference types are the following (incremental = I, revolutionary = R, convergence = C). Convergence means converging preferences in the market (Adner, 2002). In turn, revolutionary preferences means new technology and new market is created.

Up to this point, I analyzed the dominant design adaptation process in an evolutionary way and determined success/failure patterns. In these analyses, I found the paths that led the incumbent to adopt, more than create, dominant designs. However, I wanted to investigate whether there was some common enabler of this. Therefore, I analyzed the cases as complex technological systems and product portfolios in RQ3.

RQ3: What role does the nature of products as complex technological systems play in dominant-design adaptation processes and outcomes? In Chapter 4.2.3, I have empirically shown how the innovation process works in complex technological systems. I first identified the sources of technologies, Sonera's capabilities, and legislative regulation events in order to find links between these factors. Earlier research (e.g., Suarez, 2004) has merely shown conceptual dominant design frameworks. In this longitudinal case study, however, I have explained the source of innovation (i.e., technological discontinuity) and capabilities as well as the incentives at the company level to start the innovation process. Technological discontinuities can be simultaneously competence enhancing and disrupting for different units in the company. The converged portfolio analysis showed how the innovation process was carried out in complex technological systems. It is interesting to note that as technologies develop, they enable convergence (Adner, 2002). Here, the main findings revealed that (1) the birth of dominant designs is a networked innovation path, and (2) in complex technological systems characterized by industry convergence, new dominant designs are born when new technology aligns with the capabilities and incentives of the receiving unit. The incentive can be, simply, a liberal legislative regulation that opens up competition. In addition, converging customer needs, interfaces with technologies, and synchronous discontinuities between technologies need to be in place (contributing to Adner & Levinthal, 2002).

The final contribution in relation to research question three discusses ambidexterity (e.g., Tushman & O'Reilly, 1996). Earlier research has applied the notion of ambidexterity (i.e., a capability to perform tasks using either hand) to the dominant design discussion. In this area, it relates to carrying out exploitation and exploration (March, 1991; Nooteboom, 2000) at the same time as a way of creating new dominant designs. I have demonstrated through empirical case history that dominant designs have a trend toward convergence. In this situation, it might be harmful to separate a focal market into different goals and the company into different organizational control structures. This is because common platforms, architectures, and organizational control structures are needed in dominant design creation.

In general, this study contributes to and introduces a view that the dominant design adaptation framework- sensing, seizing and transforming –is beneficial to integrate variation, selection, and the retention view of evolution. In addition, dominant design can also be local; this study indeed identifies relevant dominant design building blocks that help shed light on the nature and evolutionary characteristics of dominant designs.

Table 28 contains a summary of the theoretical contributions of the study, listing the key authors. I separate each discussion and theme.

Table 28. Theoretical contribution on dominant design discussion.

Key authors	Contribution	RQ	Proposition	Phase
Teece (2007); Suarez (2004); McGrath (1992)	Identified sensing, seizing/transforming success profiles.	RQ1a	1a, 1b	Sensing
Gilsing and Nooteboom (2006); Cacciatori and Jacobides (2002); Christensen (1997); Christensen et al. (2002)	Specified the enablers of transition to the next DD (convergence).	RQ1b	2	Transforming
Abernathy and Utterback (1978); Abernathy and Clark (1985); Henderson (1993); Tushman and Anderson (1986); Christensen (1997); Christensen et al. (2002); Utterback (1996); Klepper (1996, 1997); Utterback (1996)	New dominant designs are market oriented and more technologically progressive; the DD process at a company and industry changes after many subsequent rounds (waves of innovation) of discontinuities.	RQ2	3, 4	Sensing (3); Seizing (4)
Tegarden et al. (1999)	New DD typology offered: endogenous, global exogenous, local exogenous (to closed, semi-closed, open industry conditions).	RQ2		
Lee et al. (1995); Suarez (2004); Schilling (1998); McGrath et al. (1992)	The dynamic integration of the DD adaptation process at a company with industry life cycle *ex-ante.*	RQ2		
Abernathy and Utterback (1975, 1978); Teece (2007)	Sources of innovation conditioned with industry life cycle, with success patterns identified.	RQ2	5a, 5b, 5c	Sensing
Tushman and Romanelli (1985)	Identification of the role of convergence in DD creation.	RQ2	6a	Transforming
Srinivasan et al. (2004); Schilling (2002)	Determining the DD building blocks' linkages that lead to successful DD creation.	RQ2	6b, 6c	Seizing (6c); Transforming (6b)
Rosenkopf and Tushman (1993); Srinivasan et al. (2004); Klepper and Simons (2000)	Complex technological systems analysis revealed a networked view of an innovation path. In this path, a "domino effect" (i.e., winning technologies absorb others) is present in DD creation under certain conditions.	RQ3	7a, 7b	Transforming
Tushman and O'Reilly (1996); March (1991)	Ambidexterity may not hold in the telecom business, where there is a possibility to use shared platforms for the same customer need.	RQ3	7c	Transforming
McGrath et al. (1992); Durand (2006); Anderson and Tushman (1990); Teece (2007)	Dominant design adaptation framework- sensing, seizing and transforming integrated to variation, selection and retention	RQ1, RQ2, RQ3		
Srinivasan et al. (2004); Schilling (2002): Suarez (2004)	Dominant design can be also local; identified relevant DD building blocks that shed light to the nature and characteristics in an attempt in creating DD	RQ1, RQ2, RQ3		

5.2 Managerial implications

The practical objective of this study was to understand how the dominant design adaptation process is carried out over time. A related objective was to determine how the importance of the dominant design building blocks changes over time. This included investigating how capabilities change within the company and which capabilities are appreciated by the industry. I point out four key implications for management.

First, in general, the presented dominant design adaptation framework highlights (1) the elements essential to judging whether a design has the potential to become dominant and (2) how the variation, selection, and retention processes characterize the management of dominant designs. In the long term, this process has considerable influence on the "freedom to innovate," meaning that variation and selection seem to be focused within the course of the industry life cycle. In the short term, these influences are difficult to notice.

Second, this framework serves as a tool for analyzing competitors' actions. In other words, it helps reveal who has the needed dominant design elements as well as their advantageous management capabilities (Abernathy & Clark, 1985). Moreover, it serves as a tool to help firms decide whether they have the resources needed to create dominant designs (Tegarden et al., 1999)—and if dominant design creation should even be a target for them. Simply copying dominant designs might be enough.

Third, the dominant design framework puts innovation management in one format, ensuring that the whole company is speaking one language and helping to achieve a more holistic view of running and developing the business. In addition, as recognized in this study, the sources of innovation have three powerful entities: R&D, market, and top management/investors. If the management of a firm is not balanced in this regard, the innovation journey could end in failure (Polley, Garud, & Venkataraman, 1999). Likewise, the governance model is not trivial. In fact, there may be "a best place to innovate" (i.e.., the SBU), thus avoiding the challenges in ambidextrous management.

Fourth, the framework may reveal clues regarding the appropriate time to end some production and technology line. For example, when customer preferences change significantly in a specified market, the new dominant design may gain market acceptance. Therefore, running the old infrastructure in parallel may be too costly.

5.3 Limitations of the study

This research has certain limitations. First, concerning the metrics of the study, the subjective measures of success could be substituted with objective measures. However, establishing an objective evaluation of life-cycle stages could be challenging. In addition, the numerical values used to judge dominant design factors were based on the researcher's opinion. The results could change if these are judged differently. However, the historical narrative and case studies are in line with the numerical values, constituting a robust historical description. Further, careful analysis was conducted based on interviews, company archives, and participant observation.

Second, the case study depicted only one company and industry in the Finnish market. Although the findings of the study may be generalizable, such efforts should be taken cautiously. Nonetheless, similar findings may be found in other contexts, such as capital-intensive, technology-based industries where products and services constitute the offering.

Third, the analysis stage would have been helped by control data (i.e., data from other actions and products during the case years), enabling a clearer view of the relative position of the cases studied. After all, the number of dominant designs and successful innovations are less numerous compared with the whole portfolio of projects and products in the company.

Finally, this study established (1) a dominant design management framework, (2) a new dominant design typology, (3) a change in the dominant design management framework and the payoff of the building blocks, and (4) the role of complex technological systems as such. In this sense, the contribution may seem somewhat fragmented. However, the thread connecting these elements is an investigation of a change process within an incumbent telecom company and industry. The same fragmentation is present in other co-evolutionary (Lewin & Volberda, 1999; Volberda & Lewin, 2003) works, where the changed VSR process is studied in a company, in an industry, and within a company and industry together.

5.4 Future research

In terms of future research, four tracks are offered:

Operative excellence and metrics. In the future, researchers should investigate specific themes more deeply (e.g., analysis of the dominant design building blocks), especially as they relate to financial and strategic marketing tools.

What are the marketing actions, for example, that influences the phenomenon of increasing returns? What type of business strategy is needed to ensure that the key elements of dominant design (e.g., modularity management) are enhanced and can be used to benefit the company? It would be interesting to assess the costs, as well as the cost and revenue typologies, of various dominant design elements in industry life-cycle stages at the start of the productization process. Are all elements necessary, and how profitable is it to pursue these?

Development of the company and dominant designs. In general, researchers could aim to determine the actual triggers that start the creation of dominant designs across the whole industry (and in other industries, such as capital-intensive, technology-based industries, where products and services constitute the offering) and how companies react to these triggers.

Dominant designs and industry landscape. Future research could address the relative importance of having a dominant design (e.g., how many there are in industries) and whether they are they global or local. In addition, it may be worthwhile to investigate the interplay between dominant design elements (e.g., can the niche player skip some element, and must an incumbent manage all of the elements?)

Changing dominant designs. This study proposed that subsequent dominant designs are market and process oriented. Future research could explore this point in more detail. For example, how are successive dominant designs created? Are the products and services path dependent, and why? What are the related mechanisms of interest? Defining the level of path dependence is of central importance to the telecommunications/ICT industry as well as other industries. This would extend the co-evolution research into other industries that have complex technological systems.

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Appendix

1. Sonera's strategic decisions 1977–2010

1977. Pekka Tarjanne is appointed Director General of Posts and Telegraphs of Finland.
1980. The decision is taken to adopt the Nokia DX 200 digital hub for voice landline communication in the Korppoo municipality, so creating a digital network (IDN).
Sonera decides to build a MUX (Multiplexing) network alongside the general data transmission to rationalize usage of capacity.
1981. Sonera Research Center replaces separate telephone laboratories.
– The pilot scheme on a separate data network starts after a 10-year planning and development phase.
1982. Sonera begins development of a videotex system and the creation of the pre-internet-based ecosystem.
1983. Sonera embarks on GSM design work and takes the decision to transition to GSM.
1984. Pekka Tarjanne notes that the new telecommunications bill failed to resolve the dispute between Sonera and local telephone companies over the division of work (especially on data business).
1985. Aulis Salin is appointed Chief Director of Telecom in Sonera.
–Regional Teledistricts are transformed to profit centers in Sonera.
–Local switching centers start to be digitalized to create new services.
–Sonera continues to develop ISDN (integrated services telecommunication networks), and participated in the design of the network to draft international recommendations.
–The first 927 service equipment (freefone) is introduced to start value added business in the landline voice arena.
1986. Sonera orders NMT-900 center (mobile business arena) from Nokia.
1987. Sonera's organization becomes profit center based: centers are divided by products.
–Sonera decides to commercialize the 2Mbit Voice Access product (landline) to compete in big cities.

–Enterprise Networks Ltd (Sonera's subsidiary for the large corporate segment) applies for a license.

The decision is taken to invest in the development of remote fiber optic network transmission (instead of radio links and coaxial cables).

1988. Enterprise Networks Ltd is founded.

–Sales of phones boom nationwide following liberalization of ownership of terminal equipment and traffic agreements (tie-in sale practice was ended).

–Sonera decides to start Internet services to B2B segment.

1989. Sonera decides to cooperate with start-up vendors, e.g., Cisco.

–Expansion and growth begin in contact center arena (customer service).

–Data Business Area begins the "Star Wars" project to attack competitive fields with the best possible new technology.

– Sonera opposes the granting of a license to Radiolinja (a rival mobile operator, Elisa camp) in Finland.

–Sonera decides to apply for a license to provide regional services (landlines) in competitors' areas.

–Sonera begins import of telecommunications equipment (e.g., NMT-phones, TeleSampo end devices, PBXs).

–Sonera creates an internal data network linking IP and IBM solutions to create future customer data networks.

1990. Ten regional offices and twelve new profit center areas are set up to strengthen the commercial approach.

–Customer relations way of working is prioritized (decisions on increasing the role of Solution sales, IP design, emphasis on Top customers, service development roadmaps).

–Deputy General Director Aulis Salin presents Sonera's vision of the 1990s: a focus on development and aggressive behavior, customer satisfaction, and the availability and quality of service.

–It is decided to make the Post and Telecommunications Office a public utility.

–Sonera imports Canadian Northern Telecom's Meridian 1 telephone exchange to attack the B2B segment.

1991. Martis vendor was chosen at FastNet productization, prolonging the Star Wars project.

–Idea emerges of separating Sonera's physical network and services with software.

–It is decided to nationalize the Post and Telecommunications Office.

–Sonera announced 158 million Finn marks will be invested in local networks in metropolitan areas in 1992–1996.

–Sonera decides to invest in an Intelligent Network (Nokia Tandem database to DX 200 switches).

–Sonera reduces its regional telecommunication structure from ten to six units.

–A Service Development Unit is founded to design and develop Sonera's business-to-business services and complex systems management.

–New distribution channels are acquired in the end devices arena with the acquisition of Rinox and Mobitele companies.

1992. Sonera's business plan 1993–1997 is ratified. It prioritizes the competition, telecommunications becoming real business activities, and EC legislation.

–Sonera decides to set up the TeleGate marketing process combining products for the TOP 3000 segment.

–Sonera targets workforce reductions from 9000 to 6000 by the end of 1993.

1993. Aulis Salin becomes President and CEO of Sonera.

–Sonera tenders to build a GSM network in Turkey (Turckell).

–Sonera invests in the PBX product segment during a recession, in contrast to other operators.

–The decision is taken to invest in the local network in competitor's major cities.

1994. Switchboard operations are concentrated entirely to Sonera's subsidiary, Tele Communications Company Ltd.

–Parts of the former state enterprises were made for each a separate company.

–Segmentation is applied to four key areas: industry, public administration, banking and trading sector.

–Sonera embarks on UMTS (3G) mobile networks research.

1995. The network operator/service provider interface is separated in Sonera and leads to the rise of customer offering thinking.

–Sonera decides to press ahead with organizational changes in 1996 (seven divisions); and emphasizes it will prioritize sales and marketing, and network and service layer separation.

–R&D investments approved in Intelligent Networks and their applications, the development of broadband ATM networks, mobile communications, and multimedia in new services.

–Sonera launches Internet service to consumer market (consumer ISP).

*1996***.** Sonera took part in the implementation of the world's largest ATM network (the Social Insurance Institution, Finnish pension fund) in conjunction with IBM Corporation.

–Mobile business is separated into network and service business.

– The ATM network begins to be used as Sonera's internet services platform and intranet services to corporate customers commence.

1997. The company focuses its efforts on comprehensive service and product packages and improving quality, e.g., with the Surfnet self-service portal.

–Sonera sees an opportunity for growth in international operations (globally expanding markets for mobile communications and data and media communications).

–Sonera agrees a joint development programme with Japanese company NTT DoCoMo to develop UMTS.

–Sonera founds two subsidiaries in Germany for data services and electronic payment.

–R&D investments are made in mobile communications and multimedia, intelligent network technology, software based management, and information systems.

*1998***.** Sonera is listed on the Helsinki Stock Exchange.

–Sonera forms a joint venture with Hansenet, in Hamburg Germany to develop landline telecommunications and the VPN business.

–Telecom Finland becomes Sonera Ltd on April 15.

–Sonera is concentrating on customer focus, R&D, and the business opportunities arising from the convergence of telecommunications and information technology.

–Sonera commits to grow in its core businesses: mobile, data and media communications and to seek cooperation models that support growth based on the company's expertise in these areas.

–Sonera increased its holding in Turkcell (a Turkish mobile operator) and Pannon (a Hungarian mobile operator), and acquired a 19.4% holding in US GSM operator Aerial.

–Sonera concludes Finland's first mobile call service operator agreement with RSL COM Finland Oy.

–Sonera purchases a majority holding in the joint marketing company of the Päämies chain.

–Sonera submits an application to the Ministry of Transport and Communications for an UMTS license for Finland.

1999. Sonera is listed on the Nasdaq stock exchange in the USA.

–Sonera decides to adopt a global service provider strategy (Smart Trust, Zed).

–Sonera Solutions is founded, a strategic move toward offering comprehensive solutions for the B2B segment.

–Primatel is sold, meaning all Sonera's fieldwork and maintenance activities are now outsourced.

–Sonera acquires more than 20% of 724 Solutions Inc. to develop Smart Trust.

–Sonera purchases a 9% share of Powertel, a US company that provides GSM based PCS services.

–Sonera announces the acquisition of 37% of Talentum Oyj (a Finnish company) to create its own content services.

–Sonera's introduces a new business unit, the Mobile & Media unit and Telecom.

--Sonera forms a joint venture in Italy (with telecommunications operator Tiscali) to provide directory services.

–Sonera buys 15% of Xfera in Spain, which is applying for 3G licenses in Spain.

–Sonera investigates joining a consortium led by Virgin Ltd, which is applying for a 3G license in the United Kingdom.

–Sonera announces plans to buy 34% of Digita, a subsidiary of the Finnish Broadcasting Company.

–Sonera's Smart Trust business invests in partnerships with Leonia Bank and TietoEnator to become the first company worldwide to offer banking services based on digital signatures used in WAP phones.

–Sonera makes a cooperation agreement with Equant on data services that offers comprehensive international data network services to Sonera's business customers worldwide.

–PBX business is expanded to a managed service (i.e., SIP product).

2000. Sonera participates in 3G auctions in several countries: Spain, Italy, and Germany.
–Sonera decides to sell its holdings in US mobile operators and to shift the focus of its operations to the third-generation mobile market in Europe (particularly Germany).
–A new departure for Sonera when it decides to begin developing and offering new services for other operators and service providers.
–Sonera decides that carrying voice or leasing a network no longer suffices as a foundation for growth, and that the new growth factors be located outside the traditional field of operations.
–Mobile product projects to B2C field drive stock market visibility.
–Sonera Plaza rolled out the Sonera Internet PC service package, comprising a computer and an internet subscription bundled together in a three-year license agreement.
–Kaj-Erik Relander becomes President and CEO of Sonera.
–Aimo Eloholma becomes acting CEO of Sonera.
–Sonera expands its GPRS network to cover the entire Finnish territory.
--Sonera decided to retreat UMTS concession projects in the longer without success.
2001. Harri Koponen becomes President and CEO of Sonera.
–Organizational change sees the creation of 'One Sonera', P & L responsibility passes to the sales unit and products have a minor role.
–Sonera downgrades the Service Businesses (Zed, Smart trust, Plaza) and focuses on projects that exploit its domestic customer solutions.
–Sonera makes a share offer: holding two existing shares entitles subscribers to one new share at EUR 2.70.
–Sonera and Auria (telco operator in Turku, Finland) become partners.
–Sonera begins to carry telephone traffic via its new IP-based backbone network.
–Plan emerges to make the Ethernet IP (link) migration in the R&D unit to streamline technological solutions.
2002. Telia and Sonera merged.
–Anders Igel becomes TeliaSonera's President and CEO.
–Tapio Hintikka becomes Chairman of TeliaSonera's Board of Directors.
–TeliaSonera's management team positions divided equally between Sweden and Finland.
–TeliaSonera announces that Sonera's 3G investments are making a huge loss, and that Telia's investments in international network capacity services were a failure.
–TeliaSonera adopted a Fast Follower strategy manifesting in reduction in R&D, a focus on customer service and being a service company.
–Sonera announces that profitability will be improved through synergy benefits, but through cost-efficiency (i.e. synergy in size, not in business).
2003. Decision that Nordic and Baltic States are TeliaSonera's home market spurs a focus on those territories.

–TeliaSonera's vision 2010 states: "Simplicity makes everything possible"; technology is invisible, services should be easy to use.
–Corporate management function is founded (Harri Koponen to lead). Targets creating a new Telco, an IP-ICT-Service integrator type of operator.
2004. Finnish country organization (Sonera) adopts the mobility of the dominant mindset in B2B segment, the next step would be all-IP and integrated communication solutions (Swedish Country Management does not agree with this, however).
–Finland (Sonera) decides to introduce a cheap service operator: Tele Finland
–A Focused Service Portfolio (FSP, technological products were in a key role in business classifications) project starts in TeliaSonera.
–Some R&D activity is transferred from in-house development to cooperation projects with customers, suppliers, universities, and research institutions.
–Tapio Hintikka resigns as the Chair of TeliaSonera's Board of Directors.
2005. Finland defended its mobile market position leading to 20% price erosion; Anders Igel notes Finland is a failure in the mobile business due low profitability.
–Focus on mobile business in Finland shifts from a market share battle (with price competition) to one over customer loyalty, quality and services.
–TeliaSonera declares it is in the middle of a major transformation that focuses on mobile and internet-based services (the migration from fixed to mobile and internet-based services).
–A strategic renewal of TS's R&D is initiated. TS aims to have cost-efficient innovative service development by establishing partnerships with key external competences and resources across the globe and the required local value-chain actors (e.g. IP multimedia communication).
–Investments in MegaFon (Russia's third largest mobile operator).
–Distribution of additional capital to shareholders through an extraordinary dividend.
–In Sonera, the project portfolio guidance role is growing in importance, and will lead to the introduction of product control matrices, product silos, strong decision point (DP) process management, boards and the matrix model, and the project management model, TS Promo.
2006. Distribution of additional capital to shareholders through an extraordinary dividend and increase of an ordinary dividend.
–TeliaSonera undertakes a European telecommunications market consolidation to spur economies of scale and growth.
–The number of Finns in TeliaSonera's management team drops to two.
–Mobile R & D is centralized to Sweden (including Finnish R&D).
–Sales management is strengthened and centralized to Sweden.
–The mobile data service Connect and the mobile portal SurfPort are launched in anticipation of the increased use of mobile data.
–Mobile prices are stabilizing and then increasing in Finland (due to new price plans, an opening charge, and a flat monthly fee).
–Bundled packages (3G phones and calls, video calls, music and mobile TV) are introduced.

–Integrated Enterprise Services organization (IES)) is founded to build the leading Nordic and Baltic IT and telecom system integrator.
–Acquisition of Cygate, a leading supplier of secure and managed IP-network solutions and system integration in the Nordic market.
–Sonera's unified communication products offering is launched; Telepo is the selected vendor (a fast agile new player).
2007. Lars Nyberg becomes CEO of TeliaSonera.
–TeliaSonera decides to add value with marketing and partnership competence, plans to introduce exclusive iPhone services.
–TeliaSonera announces five focus areas: the migration of Swedish fixed voice customers, participation in growing markets to boost cash-flow, improve B2B sales process, and be a world-class service company and lower costs.
–Company announces mobile handset browsers and increasing functionality are driving content services. Handsets also become more capable of using different networks (e.g., GSM, GPRS).
–Company announces the value chain has more players than telecom operators.
–Company announces the technology drivers are IP-telephony and higher network speeds in mobile, and the increased capacity of end devices.
–Broadband Services (an organization unit in TeliaSonera) separated from traditional and IP-based services.
–Globalization and IP-development forces TeliaSonera to radically increase use of open platforms from vendors, third parties, and software oriented solutions. The solutions are driven by market demand and with partners and end users the target is to get an early proof of the concept and reduced time to market.
R&D and sales functions are centralized to Sweden.
–A managed hosting specialist company, Crescom is purchased.
–Sonera increased its prices for mobile services in Finland.
2008. Integrated Enterprise Services is discontinued as a separate business area.
–The number of Finns in TeliaSonera's management team falls to one.
–TeliaSonera applies for 4G licenses in Sweden, Norway and Finland and plans to launch 4G commercially as one of the first operators in the world in 2010.
–TeliaSonera chooses Ericsson to supply the initial 4G city network in Stockholm and Huawei for the network in Oslo.
–In R&D, to reduce risk and ensure easy to use services a proactive engagement of end users in all R&D phases becomes mandatory.
–Sonera switches from volume-based to time-based pricing for mobile data services in Finland (Flat price).
2009. R&D efforts to roll-out 4G.
–Sonera announces plans to charge mobile data users a variable fee (charging for access, consumption, and speed).
–The strong growth of mobile data confirms the importance of a business model, as a consequence correct mobile data pricing is vital for telecom companies.
2010. The business service portfolio is further developed with an emphasis on cloud-based functions.

2. Key industry events 1977–2010

Technology.

1977. X.25 is an ITU-T [Telecommunication Standardization Sector in the International Telecommunication Union] standard protocol suite for packet switched wide area network (WAN) and is used widely in data communications (substituting circuit switched data transfer).

1980. SS7. Signaling System No. 7 (SS7) is a set of telephony signaling protocols used to set up most of the world's public switched telephone network (PSTN) telephone calls. Rich digital call-related services can be developed, when signaling and using telephone channels are separated. Replaced earlier R2 signaling procedures.

1981. MUX. Sonera's MUX [Multiplexing] network, a packet-based data network that used a new node developed by Sonera and Martis was launched. A packet-based data network replaces circuit switched data transfer.

1982. TCP/IP. Transmission Control Protocol and Internet Protocol typology (a networking model). TCP/IP provides end-to-end connectivity specifying how data should be formatted, addressed, transmitted, routed and received at the destination. In 1982, the US Department of Defense declares TCP/IP the standard for all military computer networking.

–*NMT 450*. NMT (Nordic Mobile Telephony) 450 standard is introduced.

–AT&T introduces *Toll Free Service Numbers* in USA.

–*Minitel*. Minitel, a videotex online network [pre-World Wide Web online services], is launched throughout France.

1983. DID. Telecom operator provides Direct Inward Dialing to commercial customers' extensions without the need for attendants. Only a limited number of subscriber lines are needed, a predecessor of call center functionality.

1986. NMT-900. Nordic Mobile Telephony 900 standard [900 MHz] is introduced, where Nokia made a NMT-900 switch.

1987. ISDN. Integrated Services for Digital Network is a set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network. It is defined in CCITT in 1988.

–*2 Mbit Voice access (R2).* 2 Mbit digital subscriber line (consisting of 30 customer channels to landline voice communication) is productized in Sonera.

1988. Cisco (US data communications start-up company) enters the routing technology field. Sonera uses its router in DataNet. A router is a device that forwards data packets between computer networks.

1992. ATM. Asynchronous Transfer Mode (ATM) is "a telecommunications concept defined by ANSI and ITU (formerly CCITT) standards for carriage of a complete range of user traffic, including voice, data, and video signals." Sonera is the first Telco in the world to implement this network.

–*GSM*. Global mobile telephony [digital] standard is implemented in Sonera.

1993. IN. Intelligent network (included in SS7 architecture) becomes the standard network architecture. The intelligence is provided by network nodes on the service layer, distinct from the switching layer of the core network, as opposed to solutions based on intelligence in the core switches or telephone equipment.

1994. CT2-CT3. A cordless telephony standard. CT2-CT3 technology is a pre-stage of mobility in PBX. However, it is not successful due limited mobility and functionality.

1995. VoIP. Voice over Internet Protocol (VoIP) is a methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks.

1996. HTML. HyperText Markup Language (HTML) is the main markup language that can be displayed in a web browser.

HTTP. The Hypertext Transfer Protocol (HTTP) is an application protocol for distributed, collaborative information systems. HTTP is the foundation of data communication for the World Wide Web.

URL. A uniform resource locator is a specific character string that constitutes a reference to a resource. URLs are commonly used for web pages (http:).

1997. UMTS. The standard is introduced (but is not yet in commercial use). The Universal Mobile Telecommunications System (UMTS) is a third-generation mobile cellular system for networks based on the GSM standard.

GSM *WAP* standard in use. Wireless Application Protocol (WAP) is a technical standard for accessing information over a mobile wireless network. A WAP browser is a web browser for mobile devices such as mobile phones that uses the protocol.

2000. The general packet radio service (GPRS) standard is introduced. GPRS is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM).

11 Mbit Voice Access. High capacity subscriber line is introduced for landlines.

2004. Cisco enters the *IP-PBX* technology field. An IP (Internet Protocol) PBX (Private branch exchange) is a PBX that provides audio, video, and instant messaging communication through the TCP/IP protocol stack for its internal network and interconnects its internal network with the (PSTN) for telephony communication.

–Microsoft and Nortel provide a server to IP/PBX.

2007. Ethernet [a family of computer networking technologies for local area networks (LANs)] - IP transmission in trunk networks. Gradual migration to all-IP system, this is done by majority of operators, Sonera is among the first.

–*iPhone*. Apple introduces the iPhone. Intelligent mobile phone capacity and usability increases.

–*LTE/4G*. The long term evolution (LTE) standard is introduced. LTE is a telephone and mobile broadband communication standard, increasing capacity and speed; all traffic is in data technology. The world's first publicly available LTE service was launched by TeliaSonera in Stockholm and Oslo on December 14, 2009.

–*WLAN*. A wireless local area network (links two or more devices using a wireless distribution method) usage is increasing.

2009. Google Wave. A VoIP application introduced by an internet player.
2010. SaaS, PaaS, IaaS. Software as a service , Platform as a service (PaaS), Infrastructure as a service (IaaS). These technologies refer to Cloud Computing phenomena, where IT and Telecommunication services are provided virtually.

Regulation.

1984. Telecommunications law proposal enters preliminary debate in the Finnish parliament. It aims to reverse earlier monopolies in the Finnish market.
1985. Datatie is founded [Elisa camp], a competitor to Sonera in the data business and later in the landline trunk call business.
1987. Telecommunications law is passed. Competitive licenses now available to pursue telecommunications business.
–Datatie and Corporate Networks Ltd [Sonera's subsidiary] are granted nationwide licenses.
1994. National and international landline calls are fully liberalized.
First service providers are granted a license.
1995. It becomes possible to buy landline access capacity from competitors.
–The great numbering reform; abandoning of numbering areas.
1996. Operators are obliged to lease network capacity to other operators.
–Network operator/ service operator split into separate companies is made mandatory.
2001. 3rd mobile operator [DNA] is given an operating license.
2003. Mobile number portability is allowed in the market, causing price competition and record levels of churn.
2006. 3G subscription and mobile handset bundling is allowed to boost mobile data usage.

Competition and Appropriability regime.

1977. Time-based/ data usage based business model profitable and accepted in the market.
1985. Digitalization of the telecom network switches and usage of fiber cables made local telcos like Datatie competitive.
1992. Radiolinja enters the mobile market with GSM technology.
1993. Exotic players enter the trunk call business (e.g., Telivo, a state owned electricity company).
1994. First commercial consumer-focused mass market ISPs [Internet Service Provider] launch (Eunet, Scifi).
HPY (Elisa is founded)- Helsinki Telephone association's operations are privatized.
1996. Finnet alliance (local landline telcos) is established.
1998. Mobile service operators enter the market: Telia Mobile, RSL Com and Saunalahti.
1999. Mobile Tele 2 service provider enters the market.
MTV 3 [Finnish Commercial TV] ISP enters the market.
Elisa leaves the Finnet Group.
2000. Sonera is a market leader in all major businesses, number two in local landline voice. New entrants enter the market.

Jippii ISP goes public.
Sonera buys Turun Puhelin (a large local area landline Telco).
2003. ACN (mobile service provider) enters the market.
More players enter the B2B service operator market (also IT houses).
2004. Saunalahti [a large mobile service provider] exits Sonera's network; a price war between service/ virtual service providers and the incumbents ensues.
2005. ACN and Tele 2 exit the market.
Cisco enters the IP-PBX business arena threatening Sonera's PBX earnings.
2007. A large national competitor to Elisa and Sonera, the DNA company, enters the market.
Five large local telecom companies leave the Finnet Group.
B2B landline voice is still important, but there is no willingness to pay for it.
Packet/Bundle/Offering value/ user based business model is dominant but not profitable to telecom operators.
Services are becoming more complex; consequently sales, marketing and customer service investments are necessary.
2008. DNA starts to offer B2B services.
SaaS/ UC service providers enter to telecom/ ICT market; the telcos' business model is threatened [content can be produced with control gateways in the network, e.g. by such players as Google].
2009. Software companies, internet players, manufacturers, content distributors and telecom companies operate in the same industry.
Customers and markets.
1984. Microcomputers enter the market (e.g. IBM PC, Nokia MikroMikko).
–Networking idea appears in data services (corporate networks).
–Decentralized data processing appears along with networked personal data processing (Hewlett-Packard).
1985. The mobility trend starts in companies (Finland).
1989. Development of the contact center business.
1990. Open client/ server systems (Hewlett-Packard).
1995. The mobility boom starts in the consumer segment (Finland).
1996. Internet boom hits the market. Netscape (a US internet company and web browser) is founded.
1999. Internet and mobile players' stock valuations hit a high.
2000. Internet and mobile players' stock valuation is lifted by the financial sector. Market sentiment is at its peak.
2003. Consumerization phenomena (e.g. Skype).
2004. Full mobility trend hits Finnish companies.
2005. The Service Level Agreement (SLA) becomes a norm in telecommunications.
–Usage of mobile data is increasing with the arrival of push-mail in mobile, smartphones, USB devices to laptops, improved mobile data speed, and packet-based pricing.

2006. The Information Technology Infrastructure Library [ITIL] standard, a set of best practices for IT service management, spreads to the telecommunications sector in organizational buying behavior.
2009. Mobile data usage in laptops and mobile devices rockets with the arrival of the iPhone (i.e., better screens).
–New types of convergence applications emerge, e.g., IP-TV (Television usage with internet connection).
2010. Unified Communication and Cloud Computing trends emerge in the B2B segment.

3. Organization charts and units 1984-2010

1984-1987		
Radio Unit	Tele technical unit	Tele unit

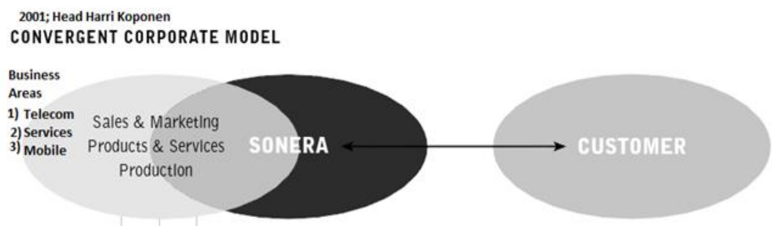
1987-1989		
Radioservices	Trunk network services	Datatransmission services
Mobile phone services, mobile value added	Trunk network building and development, local network activities support, basic services, corporate services	Data transmission, Telex, Telematics

1990	CUSTOMERS		
BUSINESS SERVICES *Major accounts *Yritysverkot Oy *Data services *Telex services *Telematic services *Enhanced services *Business systems R&D	MOBILE COMMUNICATIONS *Mobile telephone services *Radio services *Paging services *Telepoint	BASIC NETWORKS *Trunk network services *International	REGIONAL SERVICES *Ahvenanmaa *Eastern Finland *Central Finland *South-Western Finland *Pirkanmaa *Southern Finland *South-Eastern Finland *Lapland *Oulu *Vaasa *Customer premises equipment *Cable TV *Information and Operator services
Telecom Research Centre	Telecom Engineering		

1994	Aulis Salin, Head			Sales and Marketing (Aimo Eloholma			
Basic net-works (Juhani Vienola)	Mobile communi -cation services (Aimo Koski)	Value adde d servi-ces (Heik-ki Äy-väri)	Access network s and special areas (Mikko Pirinen)	Consumer (Mauri Metsäranta)	Small & Medium sized comp. (Eila Rummukainen)	Busines s (Pekka Takala)	Network s (Jukka Kämäri)

1998	Aulis Salin						
Mobile communications (Matti Makkonen)	International operations (Kaj-Erik Relander)	Sonera Solutions (Jukka Leinonen)	Business and Residential services (Jukka Kämäri)	Network services (Eila Rummukainen)	Media communications (Juha Varelius)	Sonera Systems (Jaakko Nevanlinna)	Construction and Maintenance (Pekka Kuustonen)

2000	Head Kaj-Erik Relander
Mobile & Media (Kaj-Erik Relander) *Sonera mobile operator business/ domestic/global (Matti Makkonen) *Sonera Services (Juha Varelius) *Sonera Enabling Technologies (Harri Vatanen)	Telecom (Aimo Eloholma) *Sonera Entrum Ltd (Aimo Eloholma) *Sonera Carrier networks Ltd (Jaakko Nevanlinna) *Sonera Solutions Ltd (Arvo Kukko) *Telering Ltd (Aimo Heikkinen) *Primatel Ltd (Pekka Kuustonen)

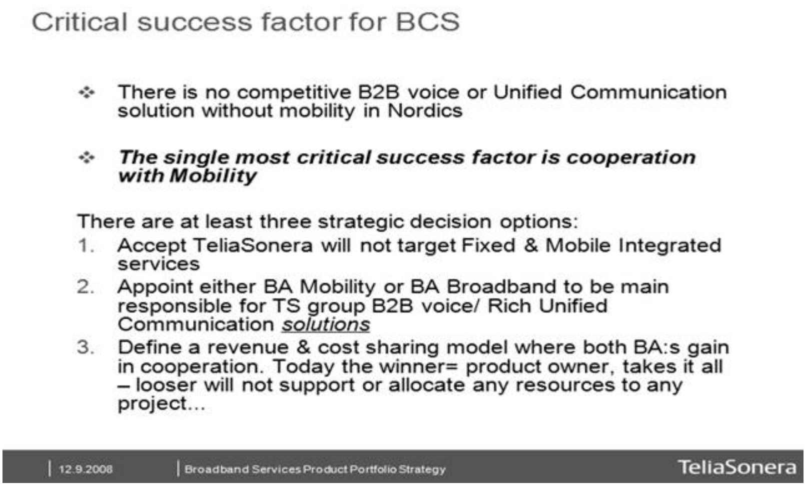


2002	Anders Igel				
Marketing, Products and services (HQ)	Networks and Technology (HQ)	Sweden	Finland	Norway, Denmark and Baltic countries	International

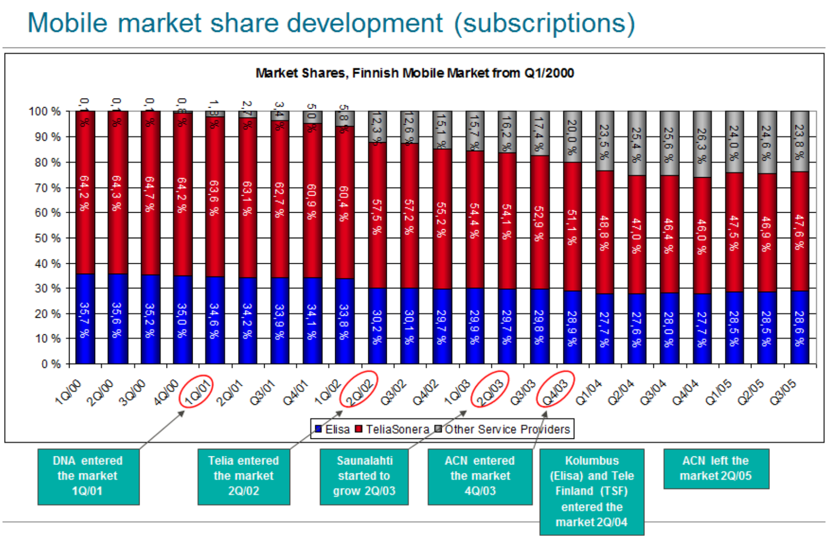
2006	Anders Igel		
Mobility services (Kenneth Karlberg)	Broadband services (Anders Bruse)	Integrated Enterprise Services (Juho Lipsanen)	Eurasia (Erdal Durukan)

2009	Lars Nyberg		
Business Area Mobility services	Business Area Broadband Services	Business Area Eurasia	Sales Division Business Services

4. Critical success factors for Business Communication Services 2008.



5. Mobile market share development 2000-2005.



6. Mobile EBITDA rates 1997-2005, Sonera Finland

Year	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11
EBITDA-%	44	44	47	47	50	47	45	43	20	26	32	31	33	31	32

7. ENS SWOT 2003

Opportunities * Increasing demands for efficiency, independence of time and place -> opportunity for wide range of communication centric services * Growing outsourcing trend and customer´s awareness of service opportunities -> services gain ground in expense of in-house solutions * Telecoms and IT convergence as well as technology development (terminals, broadband) offers expanded business opportunities in services * IP voice enables us to compete in new, formerly regulated situations. * SME segment is underserved and offers major potential for operators * Service packaging and ease of use	**Threats** * Regulation & competition legislation will cause structural changes in business environment -> rapid revenue/profit erosion, tighter competition * New competition like systems integrators and specialized VAR´s or technology vendors penetrate into telecommunication services * Disruptive technologies enables new competition (eg. VoIP) or new cost structures * Lack of competences and resources in software and IT areas -> sales, development and production * Inability to combine customer orientation and product/process approach to maximize customer satisfaction and cash flow
Strengths * Unique position as "new Telco" -> capability for customer-oriented, integrated service concept development * Wide know-how of various technologies and ability to implement and integrate * Credibility as leading player on the market: broad customer base, well positioned product mix, trustworthy image * Experience and learning from the most advanced Telco market in the world. * The best coverage pan-Nordic/nationwide: services, distribution and maintenance. * Profitability of business enables inputs to the product development.	**Weaknesses** * Product development process too slow * Ability to turn competences to work from vertical product dimension toward integrated services * Lack of resources in mobile internet development and software/IT areas * B2B and related product strategy communicated too vaguely * Market credibility in IT intensive service areas -> critical mass not reach yet * Partnering is crucial in new product development and sales, but lack of partnering culture and partner management skill exists today

8.Leading the convergence, internal strategy, 2008.

Leading the Convergence

- Players from different backgrounds are entering the market for IP-based communications
- The company that leads the convergence can shape the market in a desirable way

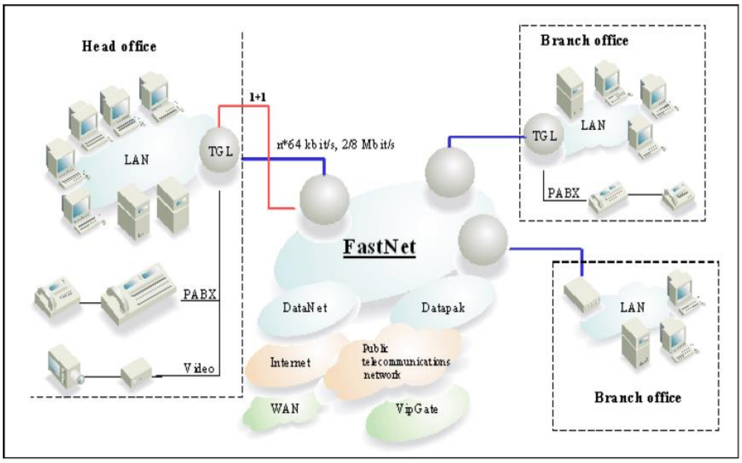
→ Operators face a threat that other IT companies define the dominant designs, and conquer the customer interface

- Leading players also need to be credible in the customer's eyes

→ The image of a market leader has to be built by aggressive migration

- Operators have significant advantages in
  - Managing the whole communication channel from end to end
  - Building on features that rely on the underlying infrastructure

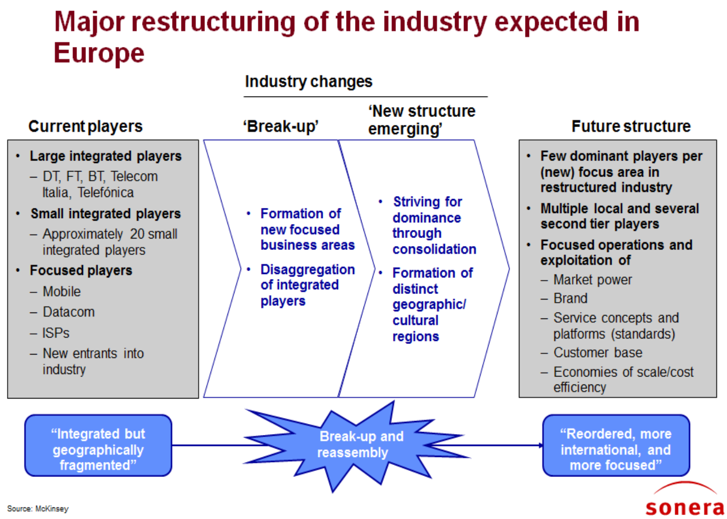
9. FastNet structure.



10.Enterprise Management Team 1999 scenario work

	Scenarios		
Uncertainty factor	Public Policy as Driver	Technology as Driver	Offerings as Driver
Legislation	• Public policy driven • Social cross subsidy • EU regulation	• Technology driven • Patent taxation • Dominant players set rules	• Offerings driven • Value added taxation • Regulation at its minimum
Technology and convergence	• Legislation sets rules for technology • Industry consolidation prohibited	• Fast development of dominant technologies • Technology driven convergence	• Technology as a commodity • Solution and service driven convergence
Customer needs and structures	• Separation of networks and services • Service obligations and price regulation • Multinational markets	• Technology shapes structures • Generic services and global markets	• Network economy • Several different earnings logics • Diversified services and global markets

11. Telecom players' consolidation scenario 1999.



12.Case facets coding

Level of exogenous science usage. Main sources: (Teece, 2007).

High score (7): There is an active research community network that the case company uses when generating ideas. The progress of science is commercialized by an operator and plays an important role in the market and in a products' success. Low score (1): Research community play no role in productization, science progress is no success factor for products from the operator point of view.

Level of internal R&D and selection of new technologies. Main sources: (Teece, 2007). High score (7): R&D is actively undertaken by an operator and/or together with the science community and device vendors. R&D plays a significant role in a products' success, and there is active technology selection and many pilot-projects. Low score (1): R&D is bought as a turnkey solution from vendors and has a minor role in the products' commercial success. No pilot projects are made, operations are reactive and also cost-efficient.

Level of external supplier and complementor usage (end device and software). Main sources: (Teece, 2007). High score (7): Terminal devices and external software vendors (mobile handsets, PCs, software programming skills) play a strong role in operator's productization and service experience. Low score (1): Terminal devices and external software vendors (mobile handsets, PCs, software programming skills) have no strong role in operator productization and service experience.

Level of external supplier and complementor usage (network hardware). Main sources: (Teece, 2007). High score (7): Network end device (routers, PBX, telephone switches, transmission protocols) vendors have a strong role in telecom operators' productization and service experience; the operator does technological specs (which define the features of the product) with the vendors. Low score (1): Network end device vendors have a minor role in the telecom operator's productization and service experience; the telecom operator chooses standardized solutions.

Level of market orientation. Main sources: (Kohli and Jaworski, 1990; Narver and Slater (1990)- i) customer orientation; ii) competitor orientation; and iii) interfunctional coordination. High score (7): Organization-wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization-wide responsiveness to that intelligence (Kohli and Jaworski). Low score (1): No organization-wide generation of market intelligence pertaining to current and future customer needs, no dissemination of the intelligence across departments, and no organizationwide responsiveness to the dissemination.

Level of top management/ Investors role. Main sources: Jaworski et al. (2000), Tripsas and Gavetti (2000), Gattani, G (2006). High score (7): Top management/ Investor vision and strategy lead productization, centralized decision making, visible political action, and active market and market-structure making. Low score (1): Top management vision and strategy have a minor role in productization. Productization is operative management by middle managers. No role in political action and no target to be a market maker.

Level of complementary asset usage in the seizing phase. Main sources: Teece (1986), Stieglitz, N., Heine, K. (2007), Suarez, FF (2004). High score (7): Specialized and co-specialized assets (for example customers, distribution, service, and complementary technologies) play an important role, and company has used these assets to create synergy. Low score (1): Generic assets are used only in a minor way, and there is no synergy.

Level of standards usage. Main sources: Palmberg and Martikainen (2003). Shapiro and Varian (1999). Srinivasan et al. (2006). High score (7): Standards play an important role in the birth and management of dominant design. Standards enhance and fasten dominant design emergence, and the company has learned from the standardization process and defined its standards. Low score (1): Standards play a minor role in the dominant design's birth and management. Standards do not enhance and fasten dominant design emergence, and the company has not learned from the standardization process and has not defined its standards.

Level of network externalities usage. Main sources: Srinivasan et al. (2004), Suarez FF (2004), Arthur, B.W. (2001), Dranove, D. and Gandal, N (2003), Majumbar, SK., Venkataraman S. (1998). High score (7): Network effects play an important role in products' diffusion, and company has made use of network effects in productization. Low score (1): Network effects play a minor role in product's diffusion and company has not made use of network effects in productization.

Modularity. Main sources: Jacobides, Christensen, Afuah. High score (7): A company has modular production and open interfaces to third parties. Low score (1): A company has integrated production and has closed interfaces to third parties.

Dominant logic. Main sources: Miller, D., Friesen, PH. (1977). High score (7): Organizational differentiation high. The degree of difference between organizational divisions in terms of their overall goals, marketing, and production methods, and decision making styles are high. The more disparate the divisions, the higher the score. The value is reasoned together for how differentiation has affected the particular project; if a project has organizational differentiation, it may suffer from resources. Source: Miller and Friesen (ibid.) Low score (1): Organizational differentiation low. The degree of difference between organizational divisions in terms of their overall goals, marketing and production methods, and decision-making styles. The more unitary the divisions, the lower the score. The value is reasoned together with how the differentiation has affected the particular project; if a project has low organizational differentiation, it may benefit from resources. Source: Miller and Friesen (Ibid.)

Ecosystem. Main sources: Srinivasan et al. (2006). High score (7): High number of firms in the value net; an ecosystem and partners are needed in service creation. Low score (1): Low number of firms in the value net; an ecosystem and partners are needed in service creation.

Convergence. Main sources: Adner, R. High score (7): Company appreciates convergent products. It has convergent products and offerings. Low score (1): Company does not appreciate convergent products and offerings , and company does not have convergent offerings. Also Miller and Friesen (1977), Integration of decisions. Are actions in one area of the firm complementary or supportive of those in other areas (i.e., divisions, functions) or are they conflicting and mutually inhibiting? High integration results in (or from) a concerted and well-coordinated strategy, while low integration might be manifested by fragmented or clashing tactics (e.g. acquiring new companies when there is an inadequate ability to finance or run them and selling products that compete against each other), ibid. p. 277.

Innovation type. Source: Abernathy and Clark (1985). Domain of innovative activity. 1. Technology/ Production (Design/ embodiment of technology, production systems/ organization, skills (labor, managerial/ technical, materials/ supplier relations), capital equipment, knowledge and experience base, Ibid. p. 5). 2. Market /Customer. Relationship with customer base, customer applications, channels of distribution and service, customer knowledge, modes of customer communication. (Ibid. p. 5). Architectural innovation: Disrupt existing/ create new markets/ customer linkages. Disrupt/ obsolete existing technology/ production competence. Niche creation innovation: Disrupt/ create new markets/ customer linkages. Conserve/ entrench existing technology/ production competence. Regular innovation: Conserve/ entrench existing technology/ production competence. Conserve/ entrench existing markets/ customer linkages. Revolutionary innovation: Conserve/ entrench existing markets/ customer linkages. Disrupt/ obsolete existing technology/ production competencies.

Closed industry. Competition not feasible due proprietary technologies, legislative regulation does not allow competition.

Semi closed industry. Competition limitedly feasible due general technologies, legislative regulation does not allow competition to some extent.

Open industry. Competition feasible due transferable technologies, legislative regulation allows competition.

Global exogenous innovation. Innovation diffuses globally and is created outside a focal firm or incumbent industry.

Local exogenous innovation (de facto standards). Innovation is adapted and modified to a local market from external sources to a focal company or incumbent industry.

Local endogenous innovation. Innovation is created by a focal company or incumbent industry.

Technology influence on competences (D=disrupt, E=enhance, M=mix). Source: Tushman and Anderson (1986). Disruption. New skills, abilities and knowledge are needed. Enhancement. Improvements are build on existing know-how.

Market preference type (Incremental=I, revolutionary= R, convergence =C) Converging preferences in the market (Adner, 2002). Revolutionary. New technology and new market created.

13.Case facets numerical values

Case	launch	Case type	Innovation	Science	internal R&D	R&D &Science	MO	Top mgt. role	Complementarities	Modularity	Ecosystem	Dominant logic	Convergence	ILC	Sub ILC
9800	1987	R&D & Market	Arch	4	5	4.5	6	4	6	3	5	4	5	Intro	Intro
Telesampo	1987	Top mgmt. & market	Arch	6	6	6	2	6	3	2	2	6	3	Intro	Intro
9700	1988	R&D & Market	Arch	5	6	5.5	5	4	6	5	6	4	5	Int	Int
Datanet	1989	R&D & Market	Arch	7	7	7	6	4	5	4	6	6	5	Intr	Intr
Fastnet	1991	All	Rev	5	6	5.5	7	5	5	4	6	4	5	Intro	Intro
Vipgate VPN	1992	Top mgmt & market	Rev	3	5	4	7	5	5	4	4	2	6	Intro	Intro
GSM	1993	All	Rev	5	6	5.5	5	5	5	4	5	1	4	Intro	Growth
Privatel	1994	All	Arch	5	6	5.5	6	5	5	5	4	1	6	Intr	Intr
Vipgate concept	1995	Top mgmt & market	Reg	3	4	3.5	7	5	6	5	5	3	4	Intro	Growth
(CID)	1995	R&D & Market	Niche	5	6	5.5	5	4	5	5	4	5	4	Intro	Growth
TeleSampo Internet	1996	Top mgmt & market	Rev	3	4	3.5	5	6	3	3	3	5	4	Growth	Growth
MobX	1997	R&D & Science	Rev	6	7	6.5	2	2	3	3	2	5	3	Growth	Growth
Sonera ZED	1999	Top Mgmt	Arch	3	5	4	3	7	3	3	3	5	3	Growth	Intro
ComSol	2004	Market Orientation	Rev	2	6	4	6	4	6	5	5	3	7	Mature	Growth
iPhone	2008	Market Orientation	Arch	2	2	2	7	5	5	3	5	2	5	Intro	Growth
UC	2009	Market Orientation	Arch	2	3	2.5	6	3	3	3	3	7	7	Intro	Intro

Case	de jure standard role	Network externalities	Competences inhouse / Internal	network hardware importance	devices ,software importance	operator driving the market	Closed industry (1=yes/ 0=no)	Semi-closed industry	Open industry	Global exogenous	Local exogenous (de facto standards)	Local endogenous (1=yes, 0=no)	Tech.influence on competences (D=disrupt, E=enh, M=mix)	Two or more industries together (1=yes/0 =no)	Market pref type (Incr=I, radical= R, convergence =C)
9800 service number	5	2	6	5	3	7	1	0	0	0	1	0	E	0	R
Telesampo	4	2	5	5	3	5	1	0	0	0	1	0	D	1	C
9700 service number	4	3	6	5	3	6	1	0	0	0	0	1	E	0	R
Datanet	3	5	5	6	2	6	1	0	0	0	0	1	D	0	R
Fastnet	3	5	5	6	2	6	1	0	0	0	0	1	E	0	R
Vipgate VPN	3	5	6	6	2	7	1	0	0	0	1	0	E	0	R
GSM	6	6	6	6	4	7	0	1	0	1	0	0	M	0	I
Privatel	3	6	7	5	2	7	0	1	0	0	0	1	E	0	C
Vipgate concept	5	5	6	5	2	6	0	1	0	0	0	1	E	0	I
Corporate number (CID)	4	5	7	5	2	7	0	1	0	0	0	1	E	0	I
TeleSampo Internet service	3	2	5	4	3	4	0	1	0	0	0	1	D	1	C
Mobicentrex	5	2	7	6	2	6	0	1	0	0	1	0	M	1	R
Sonera ZED	3	3	2	4	4	3	0	1	0	0	0	1	D	1	C
Sonera Communication solution	3	5	5	4	4	5	0	0	1	0	1	0	E	0	C
Mobile iPhone	1	3	1	1	7	2	0	0	1	1	0	0	D	1	C
UC	2	5	2	3	6	3	0	0	1	0	1	0	M	1	C

14.Interview questions

Round 1. 9/2009-12/2009. Product area: (B2B) Communication Business (Mobile/ Data/ Fixed Voice) – 1990-2010

Industry change (technology, regulation, customers, product definition)

- Industry life-cycle description
- The concept and change in value creation
- Sonera's key resources and critical success factors
- Marketing strategy ; (How is this strategy understood)?
- Innovation types used in Sonera (Moore typology)
- Path dependency- How would you describe your organization's ability to learn from its history (resources, customers, processes, projects)?
- Functional management- How would you describe the most important processes undertaken in Sonera and their dependencies?
- How has the substance of your customer offerings changed?
- Convergence- how would you describe it and its effect over time?
- Feedback and controlling/controls (feedback controls?) What are these measures and how have these changed?

Round 2. General questions/ product specific.

Value proposition of the product, key resources, and key processes

- Substitutes and complements for the product; competitors
- Actions made to case products for a life-cycle picture (Moore); Production, Product, Sales innovations; Development of segmentation
- Is there a dominant design and how would you define that design? How is dominant design acquired and how can it be measured? What is the target? The change process in the B2B Integrated Communications area?
- What are operators' most important/ largest factors of production, and related life-cycle development?
- Operator/ vendor/ service partner roles (What is the value network)?
- Technological disruptions- How would you classify these? Competence complements/ supplements; Competence destroying/ enhancing disruptions?
- What is the driver of the life-cycle migration of production?

Round 3. Specifications.

Below are the definitions of dominant design. Describe whether you have experienced dominant design, based on the criteria below or other reasons.

- Dominant design exists in a technological class when the majority of designs have the same technologies for the core components.
- The shift occurs from radical to evolutionary product innovation and product architecture is stable.
- 50% market share is present for at least 4 years
- The emergence of a dominant design apparently changes the nature of competition (within the corresponding industry).
- Example of a dominant design: the Windows operating system (dominating OS/2 and Mac)

- Your product: Why has that offering been successful or not?(internal factors- business case/ management cognitive factors/ processes/ system seller/ system integrator working model; external factors- environmental factors)- evidence and metrics)
- How is it possible to create a dominant design? (Causal mechanisms [why a particular design approach rather than another emerges as the dominant design], e.g. the best technological compromise, economies of scale and (scope)- first mover advantages, network externalities, strategic maneuvering (coalitions, R&D collaborations, pricing, licensing, or other)
- How and in what dimensions is the sustainability and protection of dominant design possible? What is the role of architectural innovation in systemic business? What is the role of modularity and interdependence in systemic business? What is the role of current customers in managing dominant designs? Is dominant design tradable? Can dominant design emerge already at the vendor level? What are operators' strengths (market making? investment policy? forecasting? benchmarking?)
- What trade-offs do business logics bring to dominant design management? What do good margins make available? How can a business proactively manage a life-cycle?

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