Managing Technology Conversion:

How to Tame the Uncertainties
Case Studies and Analysis

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KTH Industrial Engineering
and Management

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Innovationsutveckling:

Att hantera osäkerheten
Fallstudier och analys

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Innovationsutveckling: Att kontrollera osäkerheten

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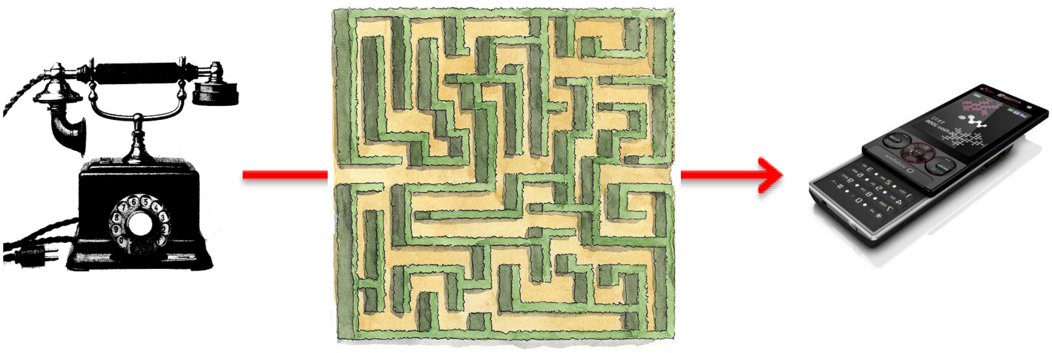
av

Hanna Ström



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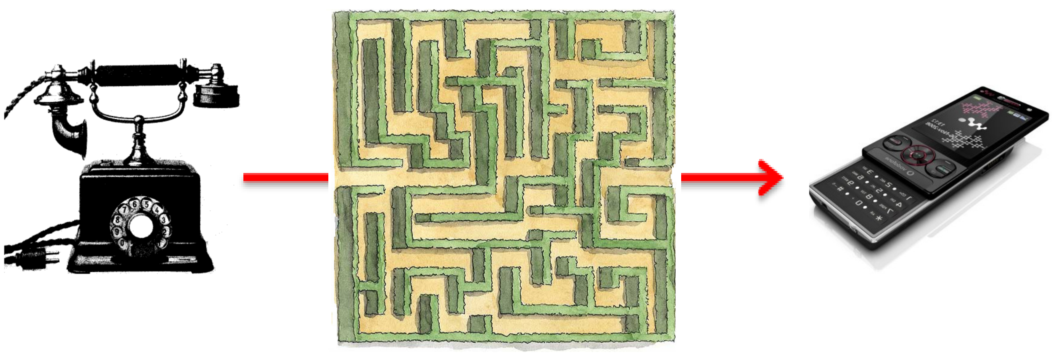

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Godkänt 2009-06-15	Examinator Staffan Laestadius	Handledare Staffan Laestadius
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Sammanfattning

Alla företag, oavsett storlek eller erfarenhet, strävar efter att överleva på en konkurrenskraftig marknad. Mycket tanke, energi och pengar läggs på att leta efter nästa stora innovation, det som kommer att föra företaget till en ny nivå och lämna konkurrenter bakom sig. För att vara framgångsrikt behöver företag inte endast finna nya teknologier utan även kunna utveckla dessa samt göra dem vinstgivande, en tröskel många snubblar på. ”Technology conversion” är en engelsk term för att föra samman existerande kunskap på ett nytt sätt för att skapa nya innovationer. Denna term fungerar som en samlingsterm för olika typer av innovationer som har stor inverkan på företags framtid. Dessa tar företagets produktportfölj till en ny nivå och ger tillträde till nya marknader.

Målet med examensarbetet är att finna vad som är hemligheten bakom lyckade fall av innovationsutveckling. Arbetets huvudfråga är därför: hur har företag framgångsrikt kunnat genomföra innovationsutveckling av typen ”technology conversion” och skulle en strategisk modell kunna utformas för att undvika de vanligaste hindren samt förutspå organisatoriska förändringar?

Examensarbetets fokus ligger på att finna likheter mellan företag som på ett bra sätt lyckats genomför innovationsutveckling av typen ”technology conversion”. Med utgångspunkt ur denna kunskap skapas en generell, strategisk modell för att hjälpa företag hantera samt utveckla större innovationer. De behandlade företagen är IBM, HP, ABB och Alfa Laval, stora företag i huvudsak aktiva på mogna ”business to business”-marknader. Avgränsningar har gjort för att göra studien mer relevant för Alfa Laval, arbetets uppdragsgivare

Resultatet av examensarbetet är en generell, strategisk modell som visar varför innovationsutveckling av typen ”technology conversion” kan uppstå och vilka huvudfaktorer företag behöver uppmärksamma då de överväger att genomföra denna typ av innovationsutveckling. Förändringar i företags organisationer studeras även, med tanke på både struktur och företagskultur. Resultatet är en användbar lista på frågor utformad för att se till att inga risker glöms bort.

Nyckelord: innovationsutveckling, technology conversion, plattformprodukter, IBM, HP, ABB, Alfa Laval

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Managing Technology Conversion: How to Tame the Uncertainties Case Studies and Analysis

Hanna Ström

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Abstract

All companies, no matter how large or small, new or old, strive to survive on a competitive market. A lot of thought, energy and money is put into finding the next big thing, the innovation that brings the company forward and leaves others behind. To be successful companies must not only discover new technologies but also be able to develop them and make them profitable, a threshold many stumble on. Technology conversion is a general term for bringing together existing knowledge in a new way in order to create innovations, which take a company's product range to a new level and access new areas of markets.

With the aim of discovering the secret behind prosperous cases of technology conversion, the main questions of this thesis are: how have companies been successful in carrying out technology conversion and could a strategic model be created to avoid the most common pitfalls and anticipate organizational changes?

The thesis focuses on finding similarities in companies that have been successful in carrying out technology conversion and also what stimulated the companies into doing this. Based on this knowledge, a general strategy is created to help companies develop and handle technology conversions. The investigated companies are IBM, HP, ABB and Alfa Laval, large companies active on mainly mature business to business markets. Limitations have been made to make the thesis relevant for Alfa Laval, the initiator of this thesis.

The result of the thesis is a general strategic model, illustrating why technology conversion may occur and what key factors a company need to pay attention to when considering technology conversion. Changes in the organization are also looked into, both the structure and the culture of the organization. The outcome is not a simple "one fits all" solution, but rather a useful check list designed to make sure no risks are forgotten.

Key words: technology conversion, innovation development, platform products, IBM, HP, ABB, Alfa Laval

Acknowledgements

This thesis would not have been possible to write without the help of a number of people. First and foremost I would like to thank Alfa Laval for letting me write this thesis. By letting me work freely and acting as a sounding board I was able to make the thesis my own. With their encouragement and constant flow of ideas this thesis has grown into something I hope will be of interest to both the academic and the non-academic world.

I would also like to thank prof. Staffan Laestadius at KTH, the Royal Institute of Technology, for guidance in the academic field and also for the feedback provided by him. Last but not least, I thank all the interviewees for letting me in on the “secrets” behind their successes.

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Abbreviations

ABB	Asea Brown Boveri
CEO	Chief Executive Officer
Cigré	International Council on Large Electric Systems
FDA	Food and Drug Administration
HP	Hewlett-Packard
IBM	International Business Machines
IEC	International Electrotechnical Commission
PC	Personal Computer

1. Introduction

This chapter introduces the topic of the thesis and explains why it is interesting to explore. It also gives a short description of Alfa Laval and presents the questions and objectives of the thesis. Lastly, thesis limitations and the outline of the thesis are presented.

1.1 Background

Successful companies have throughout history been forced to constantly push the limit for what they can deliver to stay competitive, regardless of which industry they are competing in. Rising customer demands and new competitors entering the market raise the level for what is considered to be a product of acceptable standards. In addition to this, many industries are experiencing shorter product life cycles, fortifying the pressure on research and development. Companies can therefore not restrict their research and development to existing products, although this might be what the customers are requesting in the present time (Bower & Christensen, 1994). Companies must also be open to new technology and new markets to be able to satisfy the future needs of the customers, even though this new technology at first may seem lower performing and promise lower margins (Christensen, 1997, p. xiv).

A company with talented employees can spot future trends and be innovative, drawing attention to both what customers might be looking for in the near future and to what competing companies are working on (Bower & Christensen 1994). But this does not imply that the organization knows how to develop the new ideas, especially when it concerns technology conversion.

Routines and standardization are based on traditional products. These are embedded in the organization and might not always be of assistance. On the contrary, when a company decides to develop a technology different from traditional products the routines might handicap the company (Henderson & Clark, 1990).

With this in mind, it is of interest to study how companies have been successful in carrying out technology conversion. How did IBM take the step from mainframe computers to personal computers? What made it possible for Hewlett-Packard to develop both a Laser Jet printer and an Ink Jet printer? How could ABB create a significantly improved solution by combining previously existing technology in a new way? What made it possible for Alfa Laval to create a new product on a new market with the help of existing knowledge and market needs? The term technology conversion is relatively new and does not carry a clear definition yet. The definition used in this thesis is: to use existing knowledge and technology to create products that are higher performing, replacing existing products and finding new markets. Many companies have attempted to take the step of technology conversion, few have succeeded (Overdorf & Christensen, 2000). What are the similarities in the successful cases? What did they do and why did they choose to do it? The thesis was commissioned by Alfa Laval, in order to increase their knowledge of technology conversion.

1.2 Alfa Laval

Alfa Laval AB is a Swedish company, founded in 1883 by Gustaf de Laval and Oscar Lamm. The company is active around the globe, selling its products in around 100 countries, and is a leading producer of specialized products and engineering solutions in heat transfer, separation and fluid handling (Alfa Laval, 2009). Alfa Laval mainly operates business to business, with a large number of industries as customers.

Alfa Laval is a key player on a range of relatively mature markets, where performance and reliability are important factors. The wish to stay ahead of the competitors is what keeps the company working to satisfy not only present but also future customer needs, which is why technology development is essential.

1.3 Thesis Objective

The objective of this master's thesis is to study how a range of companies have mastered technology conversion. Technology conversion is something most companies dream of carrying out, being able to take technology to the next level and present a product that could sweep the market of its feet. But wanting to do something successfully is not enough to succeed, which is why many have failed. The aim is to conclude which steps were taken and what large companies on mature markets, like Alfa Laval, must consider when deciding to carry out technology conversion. The effects of technology conversion on the organization will also be looked into.

1.4 Problem Definition

In order to fulfil the objective of this thesis two main questions will be investigated, the first broken down to two sub questions:

- How have companies been able to successfully carry out technology conversion?
    - Which factors encouraged the companies to carry out technology conversion?
    - What are the similarities in the implementations of technology conversion?
- How could a strategic model for technology conversion be created for a large industrial company like Alfa Laval?

The strategic model takes the form of a checklist, questions to be answered by a company when considering carrying out technology conversion. With the help of the answers the company can see where the risks lie and what they need to consider when choosing location for the development etc.

1.5 Thesis Limitations

The thesis will focus on companies that develop and market technological products, such as computers, printers, products for high voltage substations and products for chemical industries. These companies are multinational, large and active on relatively mature markets. As Alfa Laval operates mainly business to business, the focus on the companies studied has also been adjusted to this.

The thesis is also partially limited to companies already studied by researchers at universities and such, published in magazines and websites I have access to. The reason for using case studies conducted by others is explained below (2.3 Empirical Method). In consequence, half of the studied companies are American or US-based.

Technology conversion affects not only future products but also the existing product line. The consequences for the existing products would have been interesting to look further into, but has been restricted due to lack of information.

1.6 Outline

Chapter 1 introduces the topic of the thesis and explains why it is interesting to explore technology conversion. The chapter also gives a short description of Alfa Laval and presents the objectives and questions of the thesis. Lastly, thesis limitations and the outline of the thesis are presented.

Chapter 2 explains how the study has been conducted and why certain methods were chosen. The scientific approach can have a significant effect on the conclusions of the thesis, which is why it is clearly defined that the thesis is based on thoughts in the positivistic area. Further on, the theoretical framework and the empirical method are discussed, along with the validity and reliability of the gathered information.

Chapter 3 begins by defining what technology conversion is and what can induce it. Different types of innovations are described, most specifically disruptive innovations. Finally, it is explained why technology conversion should be carried out, illustrated by the risk matrix and also the effects of dominant design and platform products

Chapter 4 introduces four case studies. The companies illustrate different alternatives for developing innovations in large mature companies. The case studies of IBM and HP are based on previously conducted case studies and ABB and Alfa Laval on interviews.

Chapter 5 analyses how technology conversion could be carried out based on the four case studies presented in chapter four. The empirical results are put in context with the theory presented in chapter 3. The analysis evaluates both internal and external effects of the innovations. The analysis of the case studies is brought together in a general strategy for technology conversion, the strategy is also summarised in a checklist.

Chapter 6 presents conclusions drawn from the analysis of the four case studies. These conclusions are based on the general strategy for technology conversion in large mature companies. The chapter ends by suggesting further studies that could deepen the knowledge of technology conversions.

Chapter 7 lists all material used in the thesis in alphabetical order, divided into literature; articles; electronic documents and interviews.

2. Methodology

This chapter explains how the study has been conducted and why certain methods were chosen. The scientific approach affects both the gathering and interpreting of information, reflected in the theoretical framework and the empirical method.

2.1 Scientific Approach

The thesis research rests on a foundation in the positivistic area, knowledge has been sought through empirical studies, interviews and logical discussion. This approach is a direct consequence of my ontology and epistemology. My ontology, how I see the world, is that I believe there is an objective truth concerning technology conversion. Although, due to the time limit of the thesis I have restricted my research to four case studies and cannot claim to present the totally objective truth about technology conversions. In conformity with positivism, I consider knowledge to be independent of the person conducting the study and can therefore trust research carried out by others (Thurén, 2007). However, the knowledge naturally has to come from a source I find trustworthy and optimally be confirmed by a second source. My epistemology, how I believe knowledge is gathered, coincides with a common definition of positivism: knowledge is gathered through observations and logic (Thurén, 2007). By studying a wide range of companies in different industries in a qualitative fashion, I have acquired knowledge of how technology conversion has been carried out. When comparing these results with Alfa Laval, I have, with the help of logics, found similarities and been able to conclude which steps were of importance.

2.2 Theoretical Framework

Technology conversion is a wide concept, which is why theory in a range of areas is presented in this thesis. In order to understand the consequences of steps taken in the case studies one must first understand what technology conversion is and what induces it, which is why the shakeout theory is discussed. It is also important to know what kind of innovation the case study is an example of and what effect it will have on the company's product range. Technology conversions are, as is discussed in the chapter on the risk matrix, risky and no company would want to choose to take a risk if the market did not demand it to.

The long term effects of a successful technology conversion could be the creation of a dominant design and a platform product, on which an entire family of products can be based. If this is achieved, the company will have increased its competitive advantage over rivalling companies significantly.

2.3 Empirical Method

In order to gather relevant information about technology conversion, from reliable sources, one must use a methodical approach. For this thesis literature has been the main source of information, resting partly on two case studies (IBM and HP) performed by well known, prominent researchers such as Clayton Christensen, Peter Drucker and James Utterback. The reason for choosing to base the thesis on case studies already conducted, is that the time limit makes it very difficult to study the number of companies required to first find suitable companies and then to analyse how they carried out technology conversion successfully. The case studies have been selected with an eclectic approach, from a wide range of articles and literature in the area of economics, business and management.

These case studies do not explicitly deal with technology conversion, but with adjacent topics such as disruptive technology, radical and incremental innovation and business strategies. This is by no means a problem, as technology conversion is an intermediate phenomena and a wide range of case studies only add to the value of the thesis. By summarising the published case studies and articles a broad yet deep picture can be presented within the time frame of this thesis, a task otherwise too large. Furthermore, the researchers behind the case studies have had time to build relationships with the industries which enables them to go in-depth with large, well known companies. By using their case studies I gain access to this information.

2.4 Interviews

The case studies mentioned above are selected from journals specialised in business and management. The drawback with this approach is that these journals often focus on American companies and only in exceptional cases study Swedish based companies. In order to cover the Swedish market as well, a Swedish/Swiss company, ABB, and Alfa Laval has been selected to complement the American case studies. To gain information about these companies, interviews have been conducted with selected persons. The selection in the case of ABB was made by first deciding which ABB product to focus on, as it needed to be a case of technology conversion. The interviewees where then selected by how much insight in the development of the product and the product’s effect on ABB and its market. The two interviewees were a global product manager and a technical marketing manager, each interviewed one occasion per person. The in the case of Alfa Laval the interviewees were selected in the same way, the product’s sales and marketing manager and the technical expert.

The interviews were conducted in a semi structured way, with a beforehand constructed list of questions acting as a starting point for the discussions. To ensure the accuracy of facts and ideas discussed, the interviews were recorded and could be analysed afterwards.

2.5 Validity and Reliability

To make sure the conclusions of the thesis are considered trustworthy gathered information must be examined critically and found both valid and reliable. Validity means that the studies the thesis is based upon should measure relevant facts. In order to illustrate this, the four case studies are constructed in a way to make them comparable. Facts about the case studies are separated into market; organization and outcome of the technology conversion As mentioned above, the case studies do not deal with technology conversion explicitly, but types of technology conversion such as disruptive technologies. To cover a range of technology conversion, the case studies have been selected from different industries and are examples of different types of innovation.

Reliability means that the information should be trustworthy. This has been taken in account by only using articles published in well known magazines and websites, written by individuals with a background in the area. Among the authors are professors at Harvard Business School and other renowned researchers. The reliability has also been considered when selecting interviewees, focusing on persons who were active in the technology conversion as to avoid second hand information and hearsay.

3. Theoretical Framework

This chapter defines what technology conversion is and how shakeouts can stimulate it. The chapter also looks deeper into different types of innovation, most specifically disruptive innovation. Finally, it explains why technology conversion should be carried out, illustrated by the risk matrix and also the effects of dominant design and platform products.

3.1 Introduction

The objective of this chapter is to present a selection of theory needed to understand and evaluate the case studies presented in the following chapter. The subjects cover different aspect of technology conversion: why technology conversion occurs (shakeouts); how technology conversion occurs (classification of innovation; disruptive innovation); implications of technology conversion (risk matrix; dominant design; platform products).

3.2 Technology Conversion

There is no established definition of technology conversion, the concept seems relatively new to the world. What can be gathered from articles published on Alfa Laval products, is that technology conversion means to replace existing products with new, higher performing ones (Pringle, 2007). One of the mentioned articles describes a growing trend in replacement of traditional heat exchangers with more efficient products, in this case Alfa Laval plate heat exchangers.

Technology conversion can also be defined as using existing technology and knowledge to create new products, but does not confine itself to merely replacing products. As the improved technology might satisfy additional needs, the introduction of new products can also open doors to new markets. To sum up, the definition of technology conversion used in this thesis is: to bring together existing knowledge in a new way in order to create innovations, which take a company's product range to a new level and access new areas of a market.

In order to cover all aspects of technology conversion a range of concepts of innovation will be studied: incremental, radical, architectural, modular and disruptive. Effects of technology conversion, both on the market and on the organization will also be looked into. A successful technology conversion could lead to a dominant design or a platform product, which also are examples of effects on a market that must be taken in consideration when introducing new products.

3.3 Shakeouts

Technology conversions are stimulated by changes on the market and/or in technologies. Day (1997 a) defines two types of shakeouts, situations where the market changes and forces companies to adapt or exit. The first, *Boom-and-Bust syndrome*, occurs in cyclical businesses or emerging markets. The second, *Seismic syndrome*, typically occurs in stable, mature industries. Since this thesis focuses on how technology conversion can be carried out in companies like Alfa Laval, large and stable incumbent companies on a mature market, focus will hereafter be on the seismic syndrome.

Day (1997 a) presents four factors that can be disruptive to a stable and mature industry, inducing a seismic syndrome. *Deregulation* opens up a market and lessens the artificial constrains on competition. This can either mean new opportunities on an existing market or gaining access to a previously closed market. *Globalization* expands the scope, making it possible to compete in new geographical areas. This brings new opportunities to expand the market, but also the threat of an increasing number of competitors. A *technological discontinuity*, a disruptive technology discussed above, brings about a change in need of know-how and processes, which become outdated. Emergence of a *Competence Predator,* an innovator that develops business models which enable large economies of scale, can suddenly appear on existing markets and steal market shares from well established companies.

3.4 Classification of Innovation

Innovation is something most, if not all, companies strive for. Especially in seismic shakeout situations innovations help companies adapt and stay competitive. But in order to understand the effects of the innovation and how to handle it properly one must know what kind of innovation it is. With this knowledge the company can exploit the advantages of the innovation to its fullest and try to avoid pitfalls. Many have attempted to classify innovations, for some time innovations seemed to be only radical or incremental. Henderson and Clark have tried to create a freer model where innovations easier can be placed (Figure 1: Henderson - Clark Model of Innovation). This model differentiates the change in the core design of the product from the change in the way the components are integrated into the product. The later is called the “architecture” of a product.

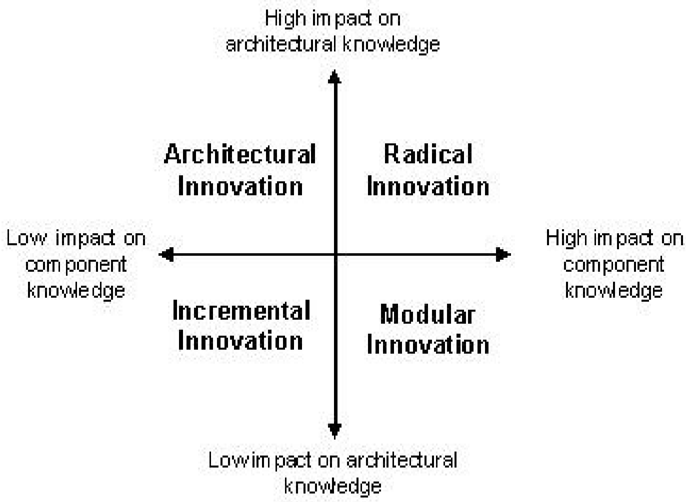

Figure 1: Henderson - Clark Model of Innovation

Incremental and radical innovations represent the two extremes of the model. An incremental innovation has few changes in neither the core design concepts of the architecture or the product. It is rather a continuous exploitation of an existing product (Henderson, Clark, 1990). This innovation develops along a straight line of increased performance without extensive changes and most often reinforces an established company’s ability to stay competitive (Figure 2: Incremental and Radical Innovation). An example of an incremental innovation could be Google’s division of search results in pictures, maps etc.

Radical innovation, on the other hand, includes changes in both the core design concepts and in the architecture. These innovations result in a leap of knowledge, leading to products whose performance significantly differs from previous products (Figure 2: Incremental and Radical Innovation). Radical innovations are considered more difficult to carry out because of the significantly increased need of knowledge, but bring the possibility to enter new markets (Henderson & Clark, 1990). An example of this could be the mobile phone.

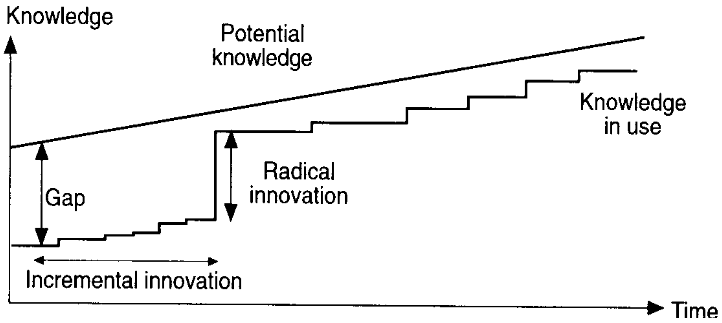

Figure 2: Incremental and Radical Innovation

Modular innovation changes the core design concepts, the components, of a product without changing the architecture (Henderson, Clark, 1990). In this case the company's architectural knowledge, how to combine the components, is unaffected, making it a less dramatic innovation than radical innovation. An example of this could be changing to a new blade in a fan, which does not change the architecture of the fan.

However, if a company changes the architecture of a product without changing the core design an architectural innovation is created. This kind of innovation is often triggered by a small modification of a component. Although the alteration of the architecture may not seem as a large alteration it can have a massive impact on the company and result in a leap not unlike the case of radical innovation. One example is the ceiling fan, if a company decides to take the next step and introduce small portable fans it would be an architectural innovation as it involves assembling the components differently (Henderson & Clark, 1990). The new product is different from the previous and the acceptance by existing customers might be hard to predict. This new product could be so different from previous products that it requires different sales channels and distribution, possibly attracting new customers. The danger lies in not realising that an architectural innovation is in fact not incremental.

Architectural knowledge, the understanding how the components are integrated into a whole, often affects a company's communication channels, information filters and strategies (Henderson & Clark, 1990). It is during the relatively stabile periods when a product is developing along the incremental trajectory (Figure 2: Incremental and Radical Innovation) that the architectural knowledge becomes part of the company. In consequence of this, an architectural innovation calls for changes in communication channels, information filters and strategies, which is why it is more difficult than incremental innovations. In radical or architectural innovations the architectural knowledge actually becomes a handicap, as it restricts the company to using ordinary channels and not finding new ways to solve problems (Henderson & Clark, 1990).

3.5 Disruptive Innovation

From time to time an innovation that is disruptive to other products or maybe an entire market appears, a so called disruptive innovation or disruptive technology. This kind of innovation can be seen as a case of technology conversion, as it can be the result of assembling established technology and knowledge in a different way and thereby gaining access to new markets and customers. A disruptive innovation can be radical, architectural or modular, but almost never incremental.

Disruptive technology is commonly characterised by initially offering lower performance than mainstream solutions, a performance that will increase rapidly (Figure 4: Disruptive Technology Compared to Market Needs). Despite this rapid increase disruptive innovation might never reach or transcend the level of performance equivalent to mainstream products. However, as soon as the innovation reaches the level of customer demand it can compete with mainstream products and should therefore be considered a threat. As can be seen in Figure 4: Disruptive Technology Compared to Market Needs and Figure 3: Improvement of Disruptive Technology over Time, disruptive technologies should be compared to the markets demands and not to existing mainstream technology. A competing company that launches a product corresponding to lower market demands must not necessarily stay there and come very quickly become a threat to companies with customers with higher demands.

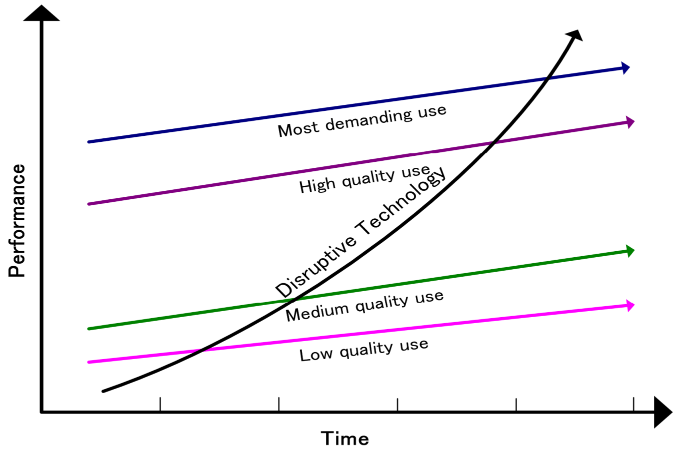

Figure 3: Improvement of Disruptive Technology over Time

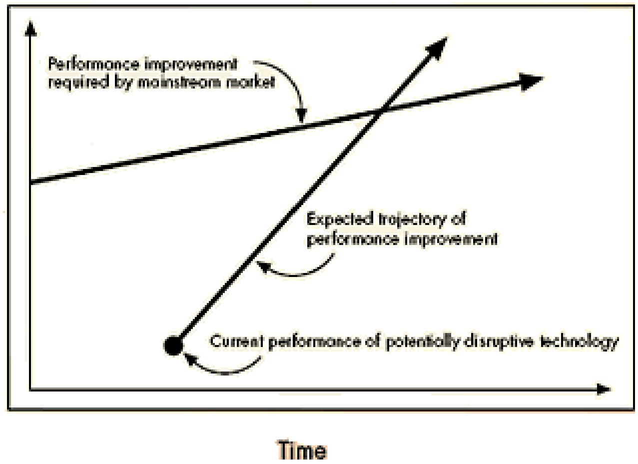

Figure 4: Disruptive Technology Compared to Market Needs

The other characteristic of disruptive technologies is that they are packaged differently, combining attributes the existing customers may not hold valuable (Bower & Christensen, 1995) (Christensen, 1997, p. 82). On the existing market there are certain metrics that are used to value products (Christensen, 1997, p. 75). As disruptive technologies often bring new attributes to the market it is difficult to paint a just picture of what the product can deliver and make it comparable to existing products. Many times disruptive innovations cannot compete while being measured in well established metrics, it is therefore important to find new metrics where it is shown that the attributes of disruptive innovations are visibly better.

Disruptive innovations can be separated in two categories (Christensen, Anthony, Roth):

- Disruptive innovations that compete in the low end of an established market
- Disruptive innovations that create a new market by targeting nonconsumers

By targeting the low end of a market, disruptive innovations appeal to the customers that could be satisfied with a simpler product than the mainstream products (Figure 5: Disruptive Innovation in Low End and New Markets). The simplicity of the disruptive innovation makes it possible to lower the price, an important competitive advantage. By competing with established companies' sustaining innovation, disruptive innovations reshape the market, forcing the established companies to migrate to higher levels in performance to keep the distance to disruptive innovations.

Disruptive innovations that target nonconsumers offer an alternative, more convenient solution to a problem. Since there are no equal products offered by the incumbent competitors on the established market, the disruptive innovations create a new market on their own. This also means that the disruptive innovations can be measured with metrics appropriate to them and not to be restricted to the metrics set by the mainstream products.

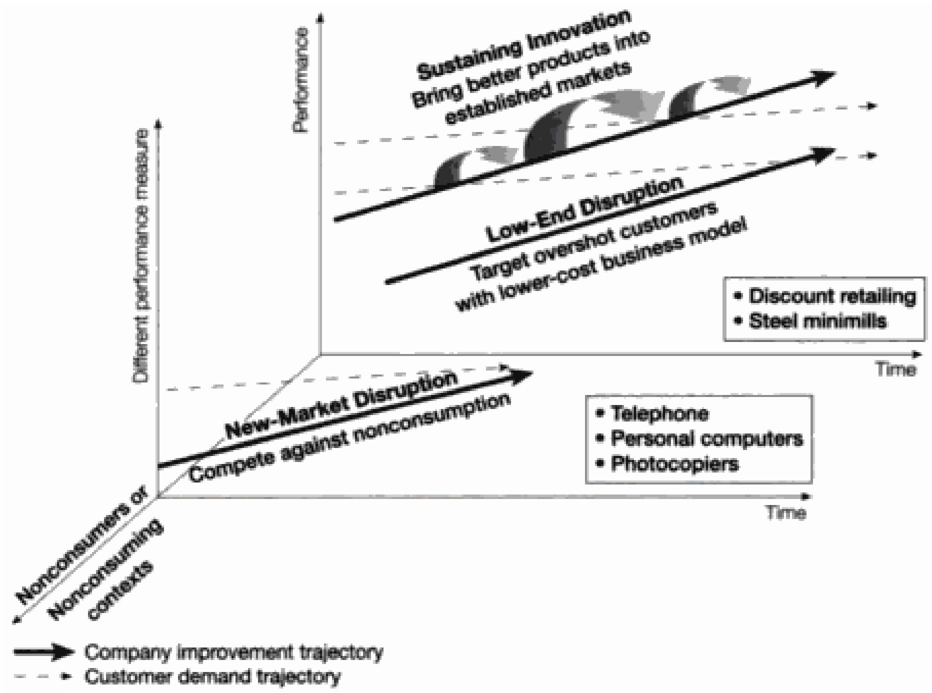

Figure 5: Disruptive Innovation in Low End and New Markets

Disruptive technologies can revolutionise an industry, but are often introduced by new entrants and not by existing companies (Bower & Christensen, 1995). The incumbent companies struggle to keep up with the development of incremental innovations and fail to see the future in the disruptive innovations, eventually leading to loss of their coveted market position (Paap & Katz, 2004) (Bower & Christensen, 1995). Paap and Katz (2004) argue that one reason for the difficulties of developing disruptive innovations in incumbent companies is that these innovations are internally seen as threats to the organization and its practises. This can be recognized from the previously described architectural knowledge. A common thought is also that the companies too closely monitor and adjust to existing customers' needs and feel they cannot afford to take their eye of the ball long enough to develop a disruptive technology (Bower & Christensen, 1995). It is by adjusting to present customers that the company can keep the present sales up, making it tempting to ignore the disruptive innovations.

Overdorf and Christensen (2000) present three ways to develop disruptive innovations:
- Creating new organizational structures within corporate boundaries in which new processes can be developed,
- Spinout independent organization from existing organization and development within it the new processes and values required to solve the new problem,
- Acquire a different organization whose processes and values closely match the requirements of the new task.

When a company decides to develop new processes within corporate boundaries it is important to create a team dedicated to the task at hand, physically located together. There is always a risk that the team members will be distracted by other matters than the project, which is why this strategy is difficult to succeed with.

Spinout organizations are, according to Overdorf and Christensen (2000), suitable in two situations: when a company's metrics for projects makes it impossible to delegate resources to the project, perhaps because the profits seem insignificant, or when a different cost structure is needed to be profitable. With a different cost structure it is possible to set a lower price, enabling entry to the low end of the markets. When deciding to develop an innovation in a spinout organization it is important that it has the support and attention of the CEO, otherwise it cannot be guaranteed that the new organization acquires the needed resources and freedom (Overdorf & Christensen, 2000). Spinouts are created to promote innovation development and creativity, but the main organization also wants to profit from these improvements. If the control is too loose it can be difficult for improvements to migrate from a distant spinout to the main organization (Kanter, 2006). To get the most out of spinouts it is important to create good connections between the organizations.

By acquiring another company, an organization can get knowledge of products and/or processes. If it is considered less appropriate to develop an innovation in the organization it can be convenient to have it be developed in an acquired company with skills in processes concerning innovation development. Keeping the acquired company separate from the main organization makes sure that the acquired processes are unaffected.

3.6 The Risk matrix

Technology conversions are often seen as risky. A company launches a new product, sometimes a complete new product line, which contains the results of the latest developments. It is not known how the product will be received on existing or new markets as it differs from previous products. There may also be uncertainties concerning the technology of the product, will the company run into problems developing and manufacturing the product? Day (2007 b) argues that a successful company must carry a portfolio of different types of projects, a mix of both small projects involving incremental innovations and larger projects with more radical or disruptive innovations. He illustrates the different types of projects and their probability of failure with a risk matrix, drawing attention to the underlying reasons for the different levels of risk. One can also choose to illustrate the sizes of the different projects by larger or smaller bubbles in the matrix.

According to Day, companies should evaluate their projects along two dimensions:

- How familiar to the company the intended market is (x axis)
- How familiar the product or technology is (y axis)

(See questions in table, Appendix A)

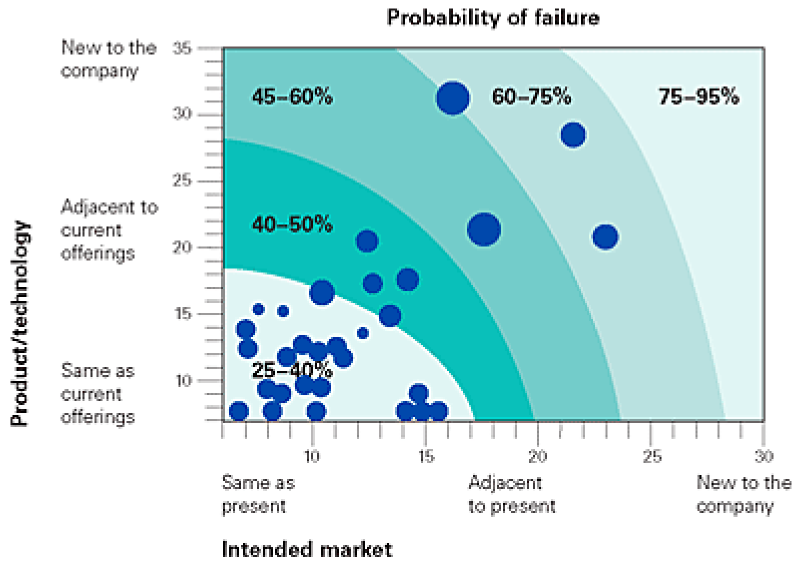

Figure 6: Risk Matrix

A product launched on a familiar market is placed to the left in the matrix. A product based on familiar technology is based low in the matrix. As follows, low risk projects are placed on the lower left side and high risk projects are placed high on the right side (Figure 6: Risk Matrix). Most companies have a majority of their projects in the low risk zone and are reluctant to back a high risk project, as is illustrated by the bubbles in Figure 6: Risk Matrix (Day 2007 b). The low risk projects secure the continuous improvement of a company's products by incremental innovation and aim to satisfy customer needs of today. But only the high risk projects offer a company the competitive edge necessary to survive, bringing the company new technology that might satisfy future customer needs and give entry to new markets (Day 2007 b).

> "To get more success, you have to be willing to risk more failures"
> (Kanter, 2006)

Radical and disruptive innovations do not have to be placed in the high risk area of the risk matrix. Depending on the company's technical and market knowledge and capabilities these types of innovations could also be considered low in risk. Technology conversions can be both high and low in risk, as will be shown in the analysis of the case studies.

Clark and Wheelwright (1993, p.243f) define five types of development projects according to the extent of product change and extent of process change (Figure 7: Types of Development Projects).

- Projects of the a-type are incremental and would typically be placed in the lower left quadroon in the risk matrix since they do not bring about significant changes. Derivative products are examples of a-type projects.
- Projects of the b-type are the above mentioned platform products which take the company to a higher level in both product change and process change. These are therefore not considered safe projects and are typically placed to the right and above the incremental projects in the risk matrix.
- Projects of the c-type involve radial innovation and result in important breakthroughs. As a consequence of this, radical innovations are placed in the high risk are of the risk matrix, on the right upper side.

- Projects of the d-type involve creation of knowledge. These projects act as precursors to commercial development projects and are often conducted separately from the main organization. D-types are highly risky and are most often placed in the upper right quadroon of the risk matrix.
- Projects of the e-type involve alliances with partnering companies, typically more advanced projects than type a but can involve development of all types. By having a partner, a company can gain resources and knowledge otherwise unavailable. As projects of the e-type can range from incremental to radical, they can hold different positions on the matrix according to the level of risk.

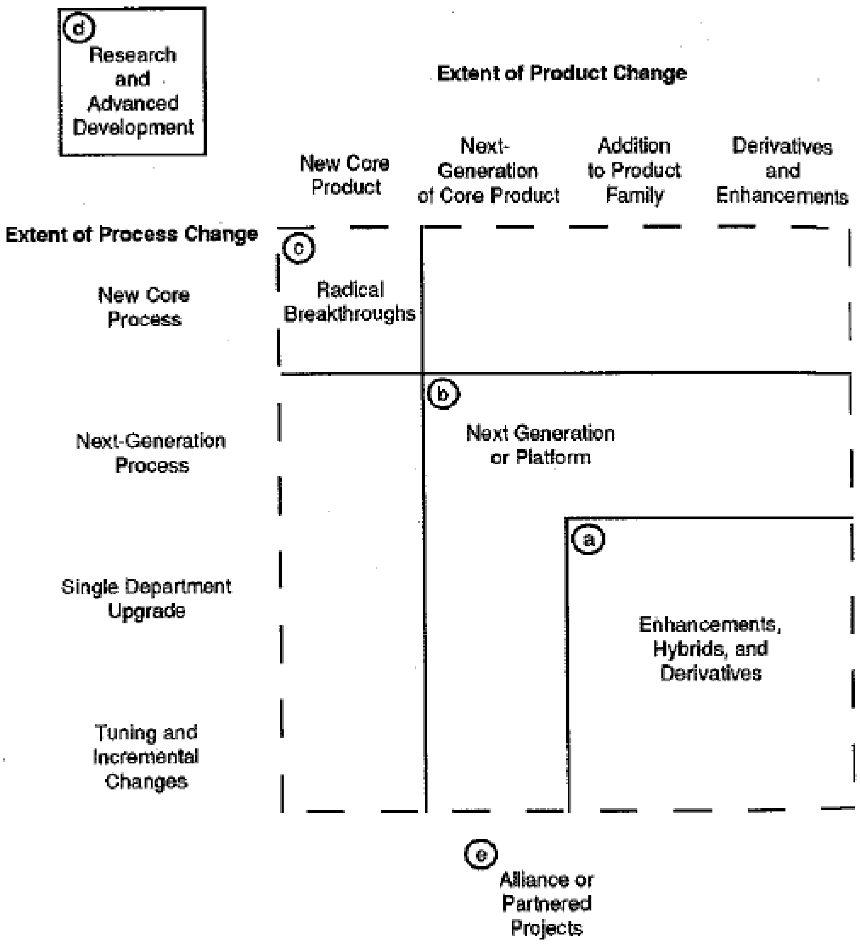

Figure 7: Types of Development Projects

The project types defined by Clark and Wheelwright can be compared with the types of innovation classified in 3.4 Classification of Innovation. The level of risk can be said to increase from incremental innovation to radical and disruptive, with modular and architectural innovations in between.

3.7 Dominant Design

Innovations can, in time, become so called dominant designs. This is a scenario most companies wish for. Dominant designs are the result of experimentation and competition and come to define what a product should look like and how it should operate (Utterback, 1994, p. 25). Dominant designs are usually new products, which bring together individual innovations that have already been accepted by the consumers on the market (Utterback, 1994, p. 24).

Attributes previously seen as competitive advantages are integrated in the product and no longer act as a competitive edge. One example is the remote control, once a competitive advantage in the television set industry but is now considered a part of a television set. A dominant design is also characterised by the loyalty of the market place and the fact that competitors and innovators must adhere to it if they want to succeed (Utterback, 1994, p. 24).

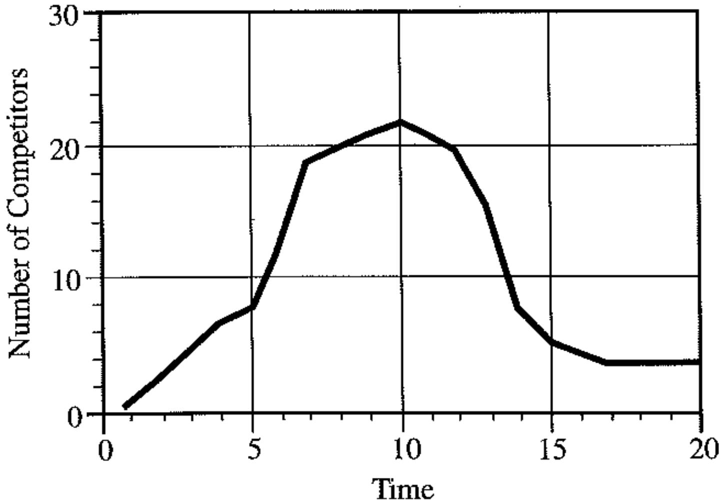

Figure 8: Dominant Design and the Number of Competing Firms

If a competitor goes its own way, not accepting a product to be a dominant design and therefore not adhering to the design, it must either find a niche market or exit the market due to decreasing sales (Day, 1997). The customers in a mainstream market will not buy a product that does not live up to the standards of the dominant design.

On new markets there exist an increasing number of companies, each with a unique solution. The new market attracts new companies, entering the market with different products. These products gravitate toward a dominate design, which the companies then must adapt to in order to survive in the industry (Figure 8: Dominant Design and the Number of Competing Firms). Once the dominant design has emerged the competitive situation changes, the consumers no longer want different types of products but are interested in improved versions of the dominant design. It should be pointed out that this is based on research conducted in the USA and does not have to apply to the rest of the world. In Japan the situation differs from Figure 8: Dominant Design and the Number of Competing Firms. On the contrary, it is common that the number of companies increases once the dominant design has arisen (Utterback, 1994, p. 48).

If it were possible to recognize a dominant design at an early stage, it would be possible for companies to invest in the right projects from the very beginning. Utterback (1994, p. 49) discusses if this could be possible but argues that it is in fact not, except in retrospect. What are the forces behind a dominant design, beside the technical aspects? It is not enough to launch a product that brings popular attributes together. Utterback claims that there are four factors that determine if a product will become a dominant design (1994, p. 27f). *Collateral assets* (brand image, market channels and customer switching costs) enforce a product as a dominant design. This factor is positive for an incumbent company, fortifying the company's product. *Industry regulation and government intervention* can lead to dominant designs if they, for example impose a standard. *Strategic maneuvering at the firm level*, using partners and networks to help establish a product as a dominant design. *Communication between* *producers and users*, observing how products are being used helps determine which features are important to customers.

3.8 Platform Product

A successful technology conversion could result in a new platform product, from which a new product family could be formed. Platform products, also known as next-generation products, can be defined as:

> "Appliance or equipment (such as Palm's Palm Pilot and Sony's Walkman) whose basic design and some components are used in several products of a product family." (BusinessDictionary)

Platform products combine significant improvements with the preceding generation's product in a way no customer has yet thought of (Tabrizi & Walleigh, 1997) (Clark & Wheelwright, 1993, p. 248). They can also incorporate features from competing products, not unlike the case of dominant design, to create a competitive product.

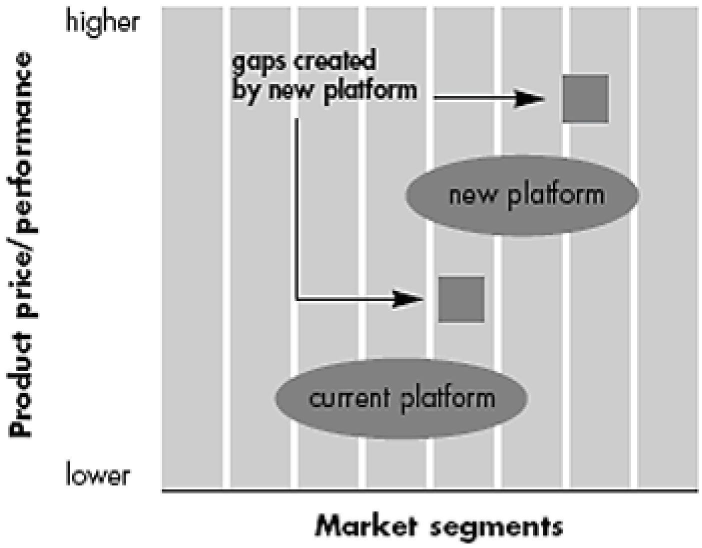

Figure 9: Platforms and Gaps They Create

The characteristic of a platform product is that it acts a base for an entire family of products, securing a route of development of future products. A new platform usually takes the company up a step in performance and price, but must convince customers that this new platform is significantly better than the old platform or any of its derivatives (Clark & Wheelwright, 1993, p. 248). When launching a new platform gaps can also be created on the market where competitors can launch products (Figure 9: Platforms and Gaps They Create). In order to fill these gaps derivative products should be developed simultaneously (Tabrizi & Walleigh, 1997). The derivative products also act as a bridge between the old platform and the new, making the transition easier for old customers at the same time as the new platform answers to the future needs of both old and new customers (Figure 10: Product Family Evolution, Platform Renewal and New Product Creation) (Tabrizi & Walleigh, 1997) (Clark & Wheelwright, 1993, p.246). The key to a successful strategy for platforms is to plan ahead, developing new generations and new platforms before the existing platform is outdated (Figure 10: Product Family Evolution, Platform Renewal and New Product Creation).

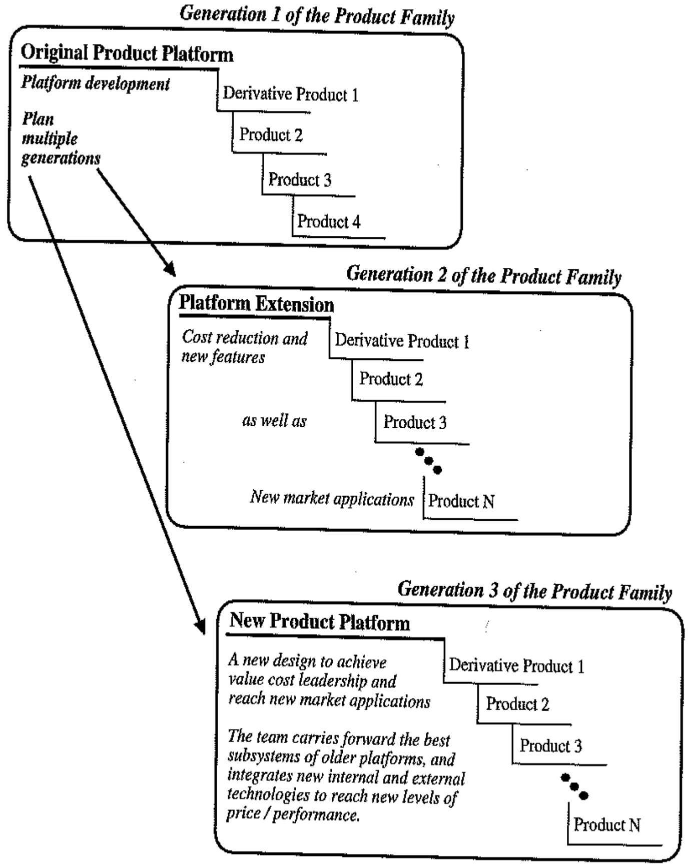

Figure 10: Product Family Evolution, Platform Renewal and New Product Creation

Product development based on platforms is not just an advantage when it comes to the market, it is also favourable when it comes to manufacturing as a larger number of products are based on the same technology (Meyer 1997).

Apart from manufacturing advantages platforms can also be used to reach larger portions of the market, different market segments and tiers within them. Meyer (1997) presents four of strategies for platforms to reach adjacent market segments (Figure 11: Strategies for Platforms). The market is first divided in a grid, horizontal representing different market segments and vertical representing different tiers of performance and price.

The first strategy is to launch a different platform for each market segment, resulting in little sharing of manufacturing processes and thereby only a small advantage in manufacturing costs. The second strategy is to broaden the platform horizontally to reach a larger number of segments in the same tier of performance and price. This strategy brings about an advantage in manufacturing, as all products connected to the platform share processes and systems. The third strategy involves up- or downscaling, reaching across all the tiers of the market segment, offering products with a varying performance and price. This is one way of securing high or low end markets by offering derivative products. The fourth and last strategy is called the "beachhead" and combines horizontal and upward vertical leverage. This strategy involves both improvement of performance, and therefore an increased price, and addition of features to attract customers in other market segments.

When a company chooses a strategy for their platform, they also chose where to leave gaps. For example, the first strategy leaves the lower tier open for competition. Other companies could enter the market in these gaps and later move on and try to take over the other market segments. This is an additional way of showing that it is important to plan derivative products when planning the platform product.

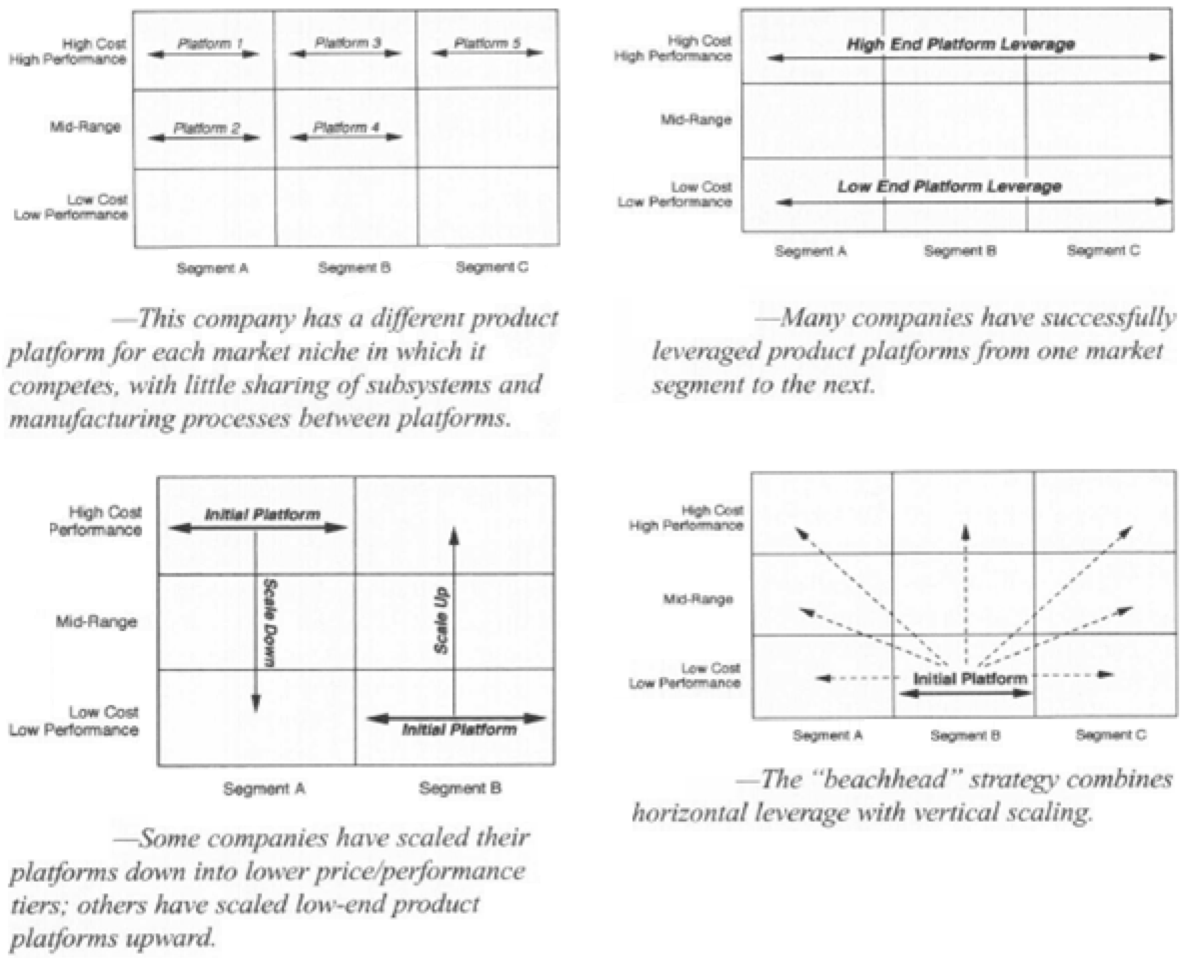

Figure 11: Strategies for Platforms

3.9 Cognition of Technological Paradigms

Technology conversions most often result in stepping from one technological paradigm to another. What is a technological paradigm and what consequences can it have for a company? How is the organization affected by technology paradigms?

A technological paradigm focuses the knowledge and the energy of the employees on developing a technology along a specific technological trajectory, which defines the direction of development by excluding possibilities outside the trajectory. One consequence of this is that the efforts are highly focused, more efficient and take the company higher along this trajectory without disturbance. Another consequence is that possibilities outside the trajectory are not even considered, even though they might be interesting. By stepping from one technological paradigm to another the company also steps to another technological trajectory, with a different direction of development. Despite earlier efforts in the old paradigm, moving to a new technology paradigm means that the development starts from almost the beginning.

Radical innovations are an example of moving to a new paradigm, previous incremental development cannot help with the development of the new radical innovation. (Dosi, 1982)

Moving to a new technology paradigm therefore means that all employees must take part in the move in order to adapt to the new trajectory and not try to develop the new technology along the old trajectory. As stated by Dosi (1982,) this is especially difficult when the old paradigm was powerful as the employees had been very true to development in a certain direction. As a consequence, it can be said that although technology paradigms help focus the efforts in development of a technology they also hinder the development of new technology paradigms by making it difficult for employees to take in new technologies.In other words, hindering the cognition of new technological paradigms Companies use technology paradigms to drive development, but by doing so also create boundaries that they need to break in order to create new innovations and stay competitive.

For companies with multiple technologies, the paradigms create communities within the organization united through the technology. A company consisting of two technology paradigms therefore has two different professional communities, each true to its own development trajectory. (Constant, 1980) These two communities cannot easily be combined, as they are “trained” to exclude possibilities outside their own trajectories.

4. Empirical Case Studies

This chapter summarises four case studies. The companies illustrate different alternatives for developing innovations in large mature companies. The case studies of IBM and HP are based on previously conducted case studies and ABB and Alfa Laval on interviews.

4.1 Introduction

This chapter begins by presenting four companies that have been successful in carrying out some kind of technology conversion. By looking at the different courses of action, alternative routes for pursuit of technology conversion can be sensed. What were the surrounding situations like in the different cases? Why was the market changing? Characteristics the companies have in common are that they have held a prominent position on a mature market, but have still needed to make a change in order to survive.

4.2 Case Study 1: IBM

The empirical data in the case study of IBM is to a great extent based on the case study published in Christensen's "The Innovator's Dilemma, The Revolutionary Book That Will Change the Way You Do Business" (1997).

IBM was the main supplier of mainframe computers during the 1970's, reaping large profits in a lucrative business. In the beginning of the 1980's the market changed, forcing companies in the computer industry to either adapt or exit. What sets IBM apart from other computer companies in this time period is that it successfully survived the wave of a rising disruptive technologies, the personal computer, that came to dominate the computer industry. What did IBM do that others did not? How could IBM carry out technology conversion in a way that they not only survived but eventually endorsed the existence of the personal computer?

4.2.1 Market

The computer industry is characteristically continuously evolving, from the emergence of mainframes to minicomputers to personal computers (PC). When the minicomputers first entered the market IBM ruled it out as a too poor computer solution to be attractive to their customers and therefore not profitable (Christensen, 1997, p.126). What they did not consider was that there might be other potential customers. It may have been this miscalculation that acted as one of the main driving forces for IBM to take the emergence of PCs seriously, in contrast to other companies in the computer industry. IBM not only accepted that PCs were real, but started two competing teams within the company to develop a simple IBM PC (Drucker, 1994). Due to this fast response to change, IBM is one of the world leading companies in the computer industry.

4.2.2 Organization

In the 1980's, when IBM decided to pursue PC development, the mainframe business was still the company's cash cow and could therefore not be left behind (Drucker, 1994). The company chose to expand the business to both mainframes and PCs, but on different locations. The IBM PC Division was set up in Florida, separating itself from the main office in New York. This geographical difference meant virtually no resources were shared between the two offices, letting the PC Division organization develop independently.

4.2.3 Outcome of the Technology Conversion for IBM

The PC Division could measure progresses along metrics relevant to the PC industry, with its own cost structure and even its own sales channels (Christensen, 1997, p.127). The resulting IBM PC quickly gained market shares and dominated the PC market, giving the company a prominent market position and granted the PCs IBM's approval. The IBM PC became the dominant design of the PC industry, joining familiar elements such as keyboard, TV monitor etc. without actually adding any technological breakthroughs (Utterback, 1994, p.25). Competing companies made "IBM compatible" products, further enhancing the IBM dominance (Utterback, 1994, p.15).

4.3 Case Study 2: Hewlett-Packard

The empirical data in the case study of Hewlett-Packard is to a great extent based on the case study published in Christensen's "The Innovator's Dilemma, The Revolutionary Book That Will Change the Way You Do Business" (1997).

Hewlett-Packard (HP) is a large multinational company active in three fields: The Personal Systems Group, The Imaging and Printer Group and The Technology Solutions Group. The Printer Group went through a significant change in the 1980's as the laser jet and ink jet printers were launched. These two printers were not only new technologies that would bring the company forward on the printer market, but also came to compete with each other.

4.3.1 Market

The printer market had been dominated by the dot matrix printer for some time when HP launched the Laser Jet printer in 1984. This new technology was the result of a discontinuous development of the dot matrix technology (Christensen, 1997, p.135). The new printer was not revolutionizing, but succeeded in reaching one of HP's goals: a prominent position on the printer market. At the same time, the low end of the market was dominated by Asian companies. As a result of this, HP became interested in developing a cheaper printer to compete with the Asian competitors. In 1978 HP had started researching the Ink Jet printer, which was launched only a few years after the laser jet printer (HP, 2009).

4.3.2 Organization

The ink jet printer was initially a part of the organization in HP's printer division in Boise, Idaho (Overdorf & Christensen, 2000). The company tried to place two types of printers under one roof, assuming they were alike in all ways that mattered. But because the printers were so different, both in technology and market, HP decided to separate them and placed development of the ink jet printer its own division in Vancouver, Washington (Overdorf & Christensen, 2000). In this autonomous division HP members had to find a way of working that would make it possible for them to develop a qualitative but cheap ink jet printer for the PC market. Alongside developing a new product, a team within this division also had the objective to develop processes to achieve speed, teamwork and design for manufacturability (Clark & Wheelwright, 1993, p. 812). This development of products and processes simultaneously was a new way of working for HP. The alteration of the design for manufacturability resulted in fewer parts and an integration of part design and tooling design, which reduced the lead time significantly (Clark & Wheelwright, 1993, p. 812). All this was needed to reach the HP goal of producing and launching a printer for $1000 or less.

To understand why the two printers could not reside in the same organization one must understand the differences in the technology and the effects of these differences. The laser jet printer was considerably faster than the ink jet printer and printed with higher resolution for a lower price per page (Figure 12: HP Laser and Ink Jet Printer's Development of Speed). The ink jet printer was, on the other hand, smaller and a less expensive machine in comparison (Christensen, 1997, p. 134).

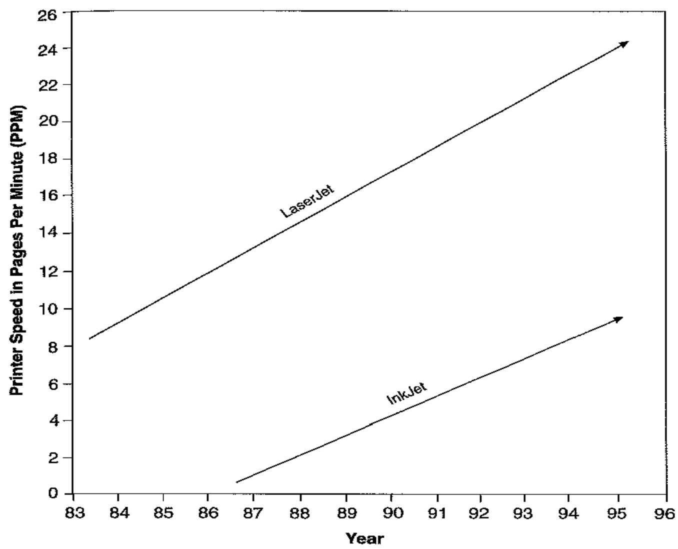

Figure 12: HP Laser and Ink Jet Printer's Development of Speed

The HP organization is characterised by a strong company culture they themselves call "the HP way". This involves dedication to affordable quality and reliability and a view that the company exists to make technical contributions for the welfare of humanity (Collins & Porras, 1996). HP has worked hard to incorporate the HP way of thinking in all its businesses and employees.

4.3.3 Outcome of the Technology Conversion for HP

The outcome of the technology conversion in the case of HP is, among other things, the fact that HP was now competing against its own products. Although the ink jet printer may never print as fast as the laser jet printer Figure 12: HP Laser and Ink Jet Printer's Development of Speed, it became fast enough for the market needs. The effect of this being that the ink jet printer could compete with the laser jet printer in one of the old metrics and may therefore be taking some of the laser jet printer's customers. In response to the competition laser jet has retreated to the high end of the printer market, offering high quality to a high price. In the beginning of the 21st century HP celebrated to shipment of the one-millionth laser jet printer and the two-millionth ink jet printer. This indicates that although the ink jet printer is not as fast as or can deliver a high resolution as the laser jet printer it is still a success (HP, 2009).

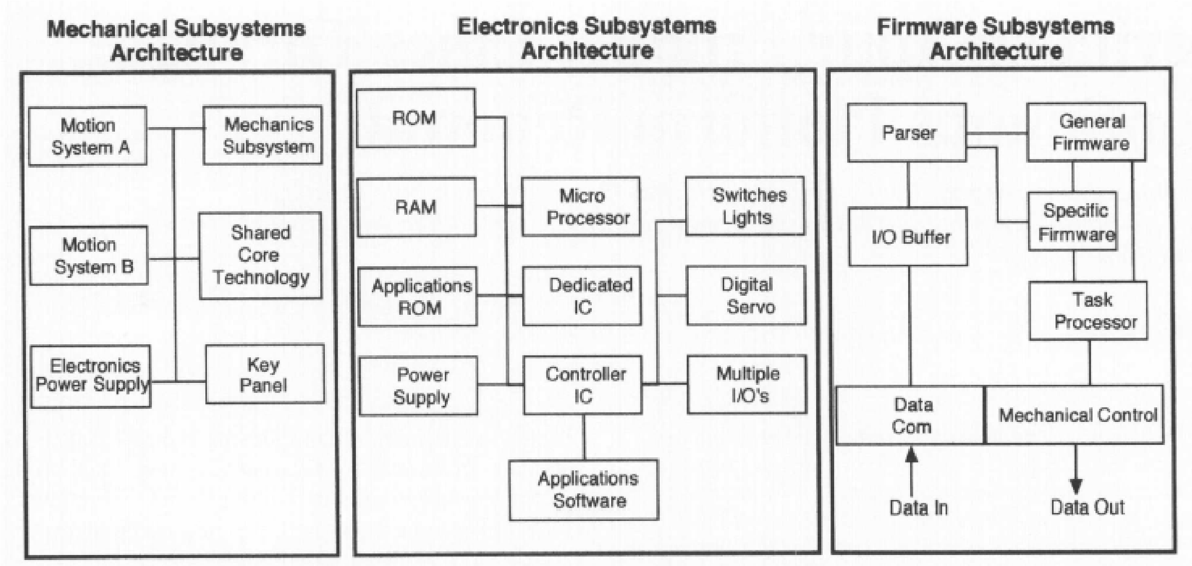

Figure 13: HP Ink Jet Platform Architectur

Another outcome of HP's technology conversion is a new product platform for ink jet printers, called Deskjet. This printer consists of subsystems, shown in Figure 13: HP Ink Jet Platform Architectur, which have remained throughout the development of ink jet printers. By constructing subsystems HP could update the printer easier, without having to reinvent the whole printer (Meyer, 1997). The development of the Deskjet is illustrated in Figure 14: Product Family Map for HP's Deskjet Printer. Deskjet first entered the market with the "500" platform. The map shows the life of a platform, the start of development to the end of commercial sales. In order to keep the platform attractive and up to date, enhancements were made continuously. HP introduced colour printing, dual pens and portable printers. But enhancing a platform is not enough. To stay competitive HP introduced to more platforms, called "600" and "800". As can be seen in Figure 14: Product Family Map for HP's Deskjet Printer, these were developed simultaneously during the same period enhancements were made to "500".

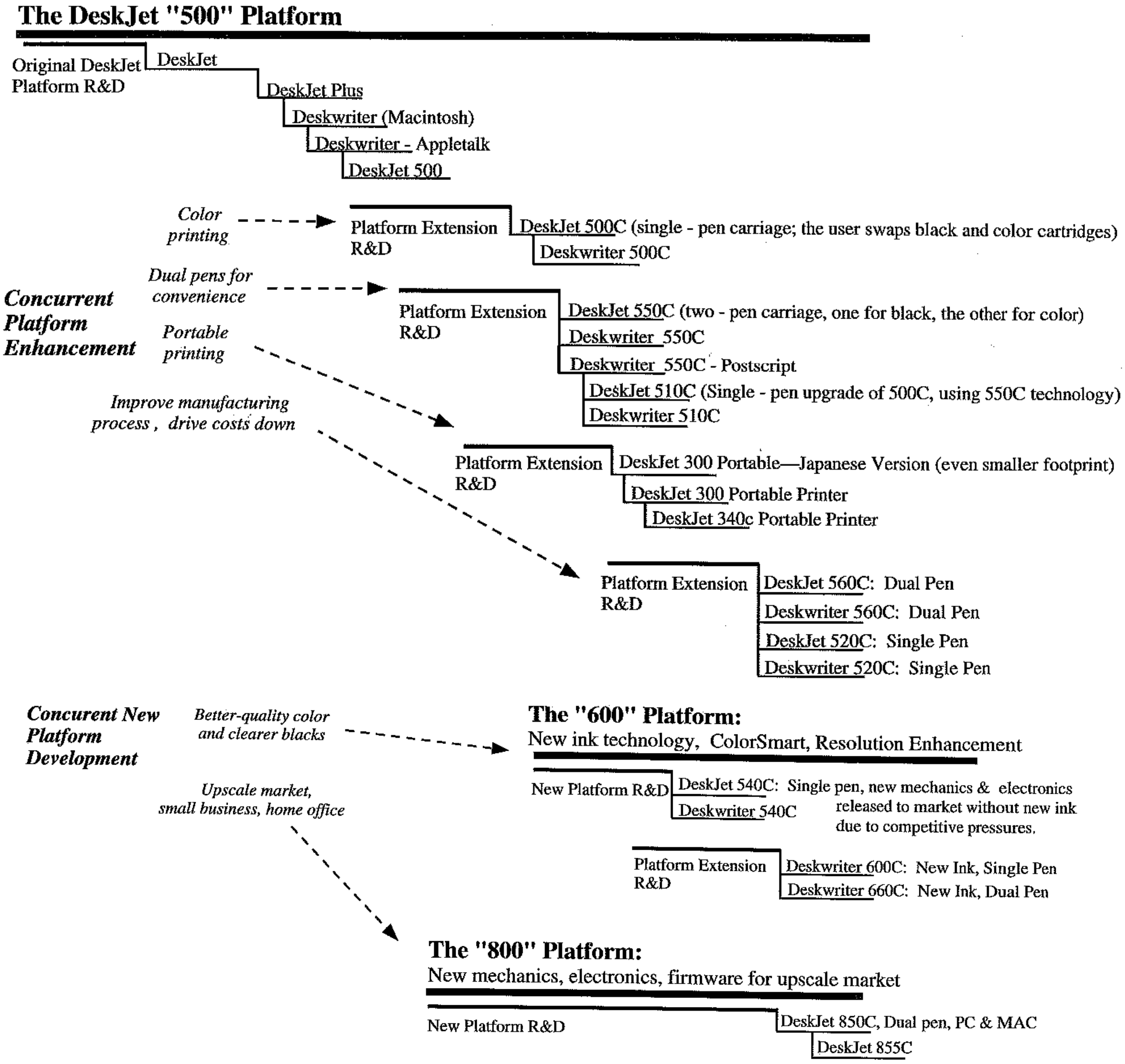

Figure 14: Product Family Map for HP's Deskjet Printer

4.4 Case Study 3: ABB

ABB (Asea Brown Boveri), is a multinational engineering company mainly active in power and automation technologies. The company is large in both size and influence, it is one of the most dominant companies on the power systems market (a ABB, 2009). In 2000 ABB delivered their first disconnecting circuit breaker called Combined, a combination of a disconnector and a switch for high voltage substations (H.-E. Olovsson, Global Product Manager, 23-04-2009). This case study is based on interviews conducted with a global product manager and a technical marketing manager at ABB.

4.4.1 Market

Before the emergence of Combined (Figure 15: Combined), high voltage substations had been using separate switches and disconnectors to turn off and disconnect electrical currents for decades. The disconnectors were initially developed to enable maintenance on the switches, which were the most demanding in maintenance at the time. As the switches were improved, the disconnectors became the bottle necks of the substations, causing costly blackouts (H.-E.

Olovsson, 23-04-2009). Power companies, such as Vattenfall, realised the need for new equipment in the substations and published a list of wished improvements in the Cigré journal (C.-E. Sölver, Technical Marketing Manager, 05-05-2009 & Cigré, 1998). The upgrading and extending of the Swedish power network increased the interest in new solutions. In order to initiate development of new technologies that could solve the problems of disconnectors and switches, a number of engineering companies were contacted by Vattenfall. ABB, as apposed to competing companies like Siemens, decided to try to develop a product according to the power companies' needs, starting by forming a research group with members from both ABB and Vattenfall in the early 1990-ies. Combined can therefore be seen as a commissioned product (C.-E. Sölver, 05-05-2009).

Figure 15: Combined

The Disconnectors are simple in design, making it easy for companies to manufacture cheaper copies competitive to ABB's products. Efforts were made by ABB to change the cost situation by moving the manufacturing of disconnectors to Poland. But as this was not effective enough, the disconnector unit was eventually sold off (Figure 16: Organization ABB Ludvika). The surfacing of Combined coincided with selling of the ABB disconnector unit, reducing the problem of competitive cannibalism within ABB (H.-E. Olovsson, 23-04-2009 & C.-E. Sölver, 05-05-2009).

4.4.2 Organization

The development of Combined took place in ABB Ludvika, and was to begin with placed in the Switches unit (Figure 16: Organization ABB Ludvika). Soon ABB realised that Combined was not just a new kind of switch, to sell Combined the customer had to be convinced to buy not just a new disconnector but to create a new kind of substation. In other words, ABB had to communicate and sell a concept, not just a single product. The Switches unit was not a suitable environment for this, as they concentrated on developing and marketing single products and not entire systems. A new unit within High Voltage Products was created, named Integrated Substations. This unit concentrated on developing and marketing Combined, working separately from the rest of the High Voltage Product organization. In creating the new unit, personnel was selected from Switches and Marketing along with other units. Although separated from Switches, Integrated Substations used Switches for the manufacturing of Combined. (C.-E. Sölver, 05-05-2009)

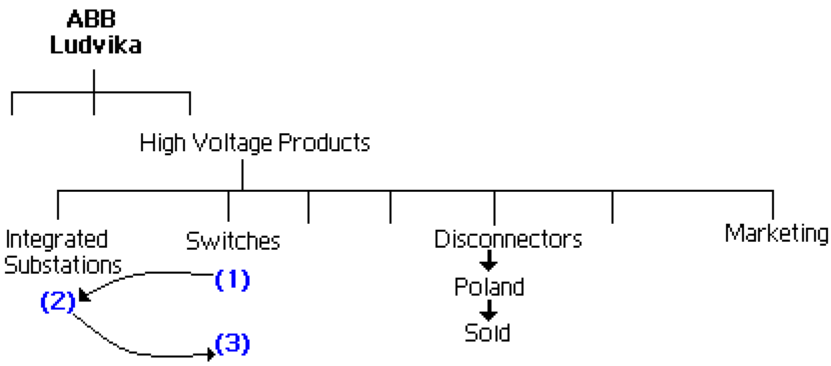

Figure 16: Organization ABB Ludvika

Despite the concentrated efforts in Integrated Substations, Combined took its time in finding its customers. When Combined did not reach the calculated number of sold products in time, ABB chose to dissolve Integrated Substations in order to reduce costs. Combined was moved back to Switches and treated equal to other products, the members of Integrated Substations were also moved back into their previous units. (ibid)

4.4.3 Outcome of the Technology Conversion for ABB

As mentioned above, the disconnectors were simple in design and easy for other companies to copy. By creating Combined, ABB got rid of the problem of cheaper copies and also created a product that replaces disconnectors in substations.

The market of products in the electricity business is conservative and restricted. The norms and regulations for substations are carefully monitored and set by organizations such as IEC (International Electrotechnical Commission). For ABB to be able to sell a product, the IEC must have created a norm for the product, otherwise no customer could buy it. This was an obstacle ABB had to overcome and therefore spent approximately 4 years convincing IEC that a norm for disconnecting circuit breakers was needed. In 2007 IEC passed the norm needed, giving ABB the final acknowledgement they needed to prove that the product lived up to standards (C.-E. Sölver, 05-05-2009). Combined has been a success in Sweden and in Rumania and the goal for ABB is to spread the innovation to other countries by selecting and targeting specific countries at a time. Development is at the present time focusing on adapting Combined to the American market, as the technical requirements differ from the European (H.-E. Olovsson, 23-04-2009). An effect of the progress of Combined is that competitors previously not interested in developing similar solutions, such as Siemens and Areva T&D, now are developing and marketing similar products although not in a product range equal to ABB's (ibid).

Although ABB has marketed Combined for ten years, no long term effects have yet been discovered in the parts & service unit of the organization. This could be explained by the long period that spare parts are offered, 15 years in the case of ABB (ibid).

Beside the benefits of the design of Combined, the product also increases the energy efficiency and reduces the amount of carbon dioxide released into the atmosphere. Because of this Combined was awarded the Swedish power network's environment award in 2007 (b ABB, 2009). Since Combined was launched on the market, it has become the standard solution when building or renovating Swedish power grids (H.-E. Olovsson, 23-04-2009). Figure 17: The Power Transmission Network in North-western Europe, shows transformer and switching stations in Sweden. Most of these are using or will be using Combined in the near future, illustrating the large number of Combined in Sweden.

The ABB Combined is, as mentioned above, a combination of switch and disconnector. The new design not only offers better protection of the inner parts of the product than previous solutions, but is also more compact, resulting in substations with up to 50% smaller footprints (b ABB, 2009). The owners of the substations can therefore reduce costs on material when building the substations. As a result, Combined competed with both disconnectors and switches.

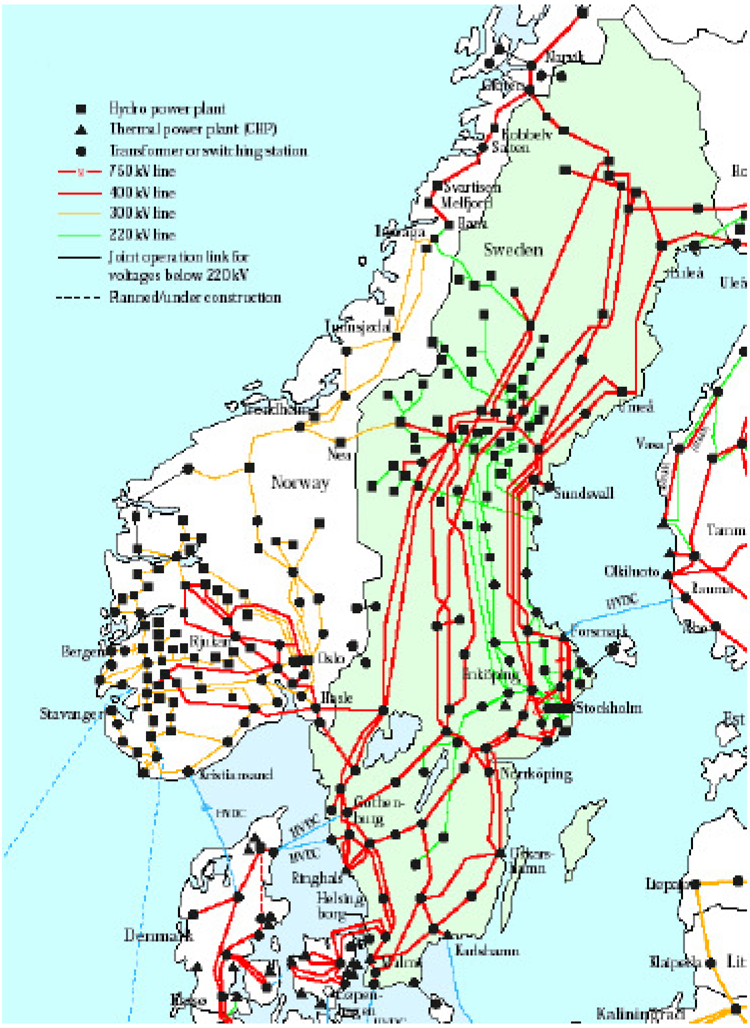

Figure 17: The Power Transmission Network in North-western Europe

4.5 Case Study 4: Alfa Laval ART®

Alfa Laval launched a continuous plate reactor in November 2007, marketed under the trademark ART®. The plate reactor enables continuous chemical reactions, creating a flow of chemical products. This is the opposite of the traditional batch technology, which produces batches of chemical products at a time. The company had previously not had any products of this kind, making the plate reactor both a new innovation and a new experience. This case study is based on interviews with the sales and marketing manager involved and a manager with the role of the technical specialist.

4.5.1 Market

There are times when Alfa Laval has chosen to place the development of a product outside the regular structure of the organization. The Alfa Laval plate reactor is an example of this (Figure 18: ART® Plate Reactor PR37). This is a continuous plate reactor designed for the chemical industry, mainly pharmaceutical, fine and speciality chemicals. It is not an incremental innovation, but rather considered to be a radical innovation within Alfa Laval (M. Jönsson, Sales & Marketing Manager, 02-04-2009).

Figure 18: ART® Plate Reactor PR37

The Alfa Laval plate reactor was launched on a market dominated by batch-technology, a traditional way of creating a chemical reaction that has not changed significantly over the years. The disadvantages of the batch-technology are that a single reaction can take hours, the quality of the products varies and it is not possible to monitor, steer or adjust the reaction during the process. The batch-technology also produces more waste than necessary. These are problems the plate reactor can solve, offering customers a significantly improved process (M. Jönsson, 02-04-2009 & T. Norén, Manager, 02-04-2009). Alfa Laval chose to make the plate reactor scalable by growing in size and not by number of products, as many competing companies are trying to do (M. Jönsson, 02-04-2009).

For Alfa Laval this product was initially considered to be a risky project to invest in. Although the market was not new to the company, this new product is so different from the dominating technology that the customers should be treated in a new way. They must be convinced that a continuous plate reactor is something they could benefit from. In order to gain the confidence of the market, Alfa Laval has chosen to start with the pharmaceutical and speciality chemicals companies (M. Jönsson, 02-04-2009). These companies are looking for new technical solutions that can bring their products to the next level, e.g. medicines adapted to the individual etc. In 2004 FDA released guidelines for Process Analytical Technology, stating that pharmaceutical companies should look for alternatives to the batch-technology. The guidelines encouraged companies to use the latest pharmaceutical manufacturing and technology (FDA, 2004). The concept of the plate reactor hade already been thought of and developed by Alfa Laval years before these guidelines were issued, but had not yet been commercialized. These facts, along with intense concept communication within Alfa Laval finally made it possible for the company to make the decision to commercialize the plate reactor concept (T. Norén, 02-04-2009).

4.5.2 Organization

The development of the plate reactor takes place in a separate unit within Alfa Laval, with its own dedicated members accompanied by in-house consultants from different parts of Alfa Laval. The reason for creating a new, separate unit for development of the plate reactor was that this product did not fit in anywhere else in the Alfa Laval organization (M. Jönsson, 02-04-2009). By placing the development in Tumba and not in Lund, where the company's heat and mass transfer operations are located, the development was not held back by traditional thoughts on heat and mass transfer. By choosing the site in Tumba, the development was also moved closer to the company's life science unit (T. Norén, 02-04-2009). In order to develop freely, the plate reactor required its own team of dedicated members, as the end product was not known in detail when the development was initiated (T. Norén, 02-04-2009). The business strategy of the unit was to benefit from the full Alfa Laval organization while acting as a specialist unit in reactor technology (M. Jönsson, 02-04-2009).

4.5.3 Outcome of the Technology Conversion for Alfa Laval

Since the product has not been on the market for more than a few years it is difficult to see any long term effects for Alfa Laval. ART® is one of Alfa Laval's trade marks and is used as a product brand. Traditionally, the company has chosen to keep Alfa Laval as the main brand and has been selective in creating trade marks. Beside this one, Alfa Laval only has a few other trade marks. Although there is no product family within the trademark at the present time, it has been treated in a way to make it possible to launch a family of products in the future (M. Jönsson, 02-04-2009). Hence the creation of the trademark. The outcome of this is yet to come, as both the Alfa Laval organization and its customers get used to this new trademark.

The Alfa Laval plate reactor was first launched on the Western European market and has the intention to move stepwise into different geographical markets. By moving stepwise Alfa Laval hopes to avoid launching the product without sufficient market support. In the first part of 2009 Alfa Laval will continue the launch in Northern America. (M. Jönsson, 02-04-2009)

The Alfa Laval plate reactor was rewarded the Innovation Reward of the ACHEMA exhibition in Frankfurt, May 2009, in the category of plant engineering and process (Hening, 2009).

5. Analysis

This chapter analyses how technology conversion could be carried out based on the four case studies presented in chapter four. The empirical results are put in context with the theory presented in chapter three. From the analysis a general strategy is created.

5.1 Introduction

The analysis is carried out by company, each case study bringing new aspects to the case of technology conversion. This chapter has the intention to connect the theoretical framework with the empirical findings and draw conclusions about each company studied. These conclusions are later on organized into a general strategy for technology conversion. In order to organize the analysis it is divided into three parts, innovation, strategy and organization.

5.2 Analysis - IBM

5.2.1 Innovation

The IBM PC was the result of a disruptive technology, a technology that would come to push the previously lucrative business of mainframe computers to the back of the computer market. The IBM PC also granted the PC industry IBM's approval, attracting more computer companies to join in the development of the new technology. By taking part of the development of this new disruptive technology, IBM caught the next wave of technology and made it a part of IBM instead of something to overcome. This new wave of technology created an opportunity to stand out in an otherwise relatively stable industry. This created a seismic shakeout situation where companies were forced to adapt or to go under.

5.2.2 Strategy

In terms of the platform strategies presented in 3.8 Platform Product, IBM chose to launch the PC on a new market in a lower price tier. This is illustrated in the first strategy in Figure 19: Platform Strategy IBM. As can be seen, the mainframes and the PC started out in different segments of the market. The mainframe customers were not interested in the PC as it could not perform like mainfraimes. The result was not only an entryway to a new market but a filling of a gap, preventing new competing companies from entering the growing market from below.

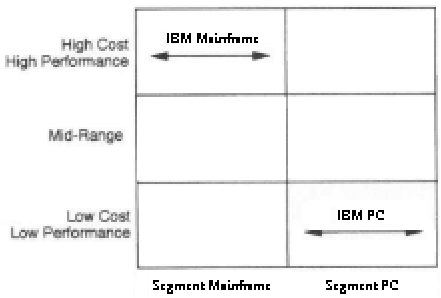

Figure 19: Platform Strategy IBM

Before the PCs emerged on the market, IBM was the dominating company on the computer market with a well known brand. When the company moved into the adjacent PC market the brand name was still important and signalled the customers that the IBM PC had the same quality as other IBM products. This advantage gave IBM a head start over newly established companies.

The development of the IBM PC was most certainly considered risky at the time, and could have been placed somewhere in the area of the black dot in the risk matrix as shown in Figure 20: Possible Risk Matrix for the IBM PC. The market was almost entirely new to the company, although in the same industry. Without detailed knowledge of customers needs and wishes it is difficult to create a product that will be accepted on the market. The development of the IBM PC would therefore most probably have been placed far right in the risk matrix. The technology was also significantly different from previous IBM products, and therefore raised the probability of failure further. If IBM had created a risk matrix before it decided to create its own PC, the company may have been intimidated by the resulting matrix. The IBM PC did most likely have a high probability of failure, but also large benefits if the development was successful. In order to create large profits in a new area, a company must be willing to take some risks.

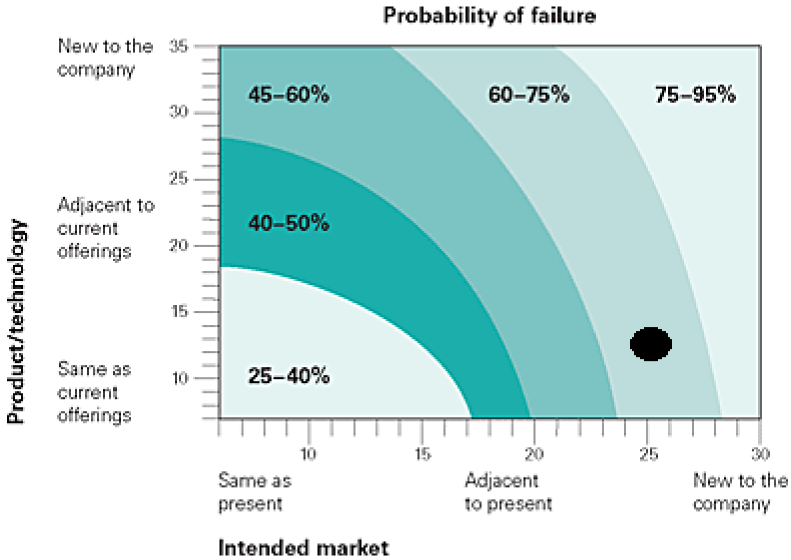

Figure 20: Possible Risk Matrix for the IBM PC

In retrospect it is apparent that the IBM PC became the dominant design of PCs, which is also pointed out by Utterback (1994, p. 15). This dominance was not created by IBM alone, the fact that other companies marketed IBM compatible products made it easy for the customers to choose IBM over other brands.

5.2.3 Organization

When IBM chose to be a part of the PC industry, it was not possible to drop everything else. Newly established companies started from scratch, with no other costly organization than the one supporting the new PCs and could invest everything in this. For IBM the mainframe business was the main source of funds and could therefore not be ignored, funds were needed to support both the new PC division and the mainframe division. Drucker (1994) argues that the fact that IBM tried to combine the two actually prevented the company from optimizing both businesses. This may be true, as it can be difficult to house two different technology paradigms under one roof. But IBM had separated the divisions and it is possible that it was the decline of the mainframe business that was the main reason for waning interests in the mainframe business. The market simply wanted PCs, this pull resulting in a rapid development of the technology. New computer companies may have been more flexible and swift moving, but IBM had a history in the computer industry and should therefore have some technical skills and management skills the new companies had not achieved yet.

As mentioned IBM chose to develop the IBM PC in an independent spinout division separate from the main office in New York. By separating the different computers as divisions within the organization and also geographically, no employees were shared between the two divisions. A common predicament is otherwise that employees active on both projects prioritise according to their own view of what is important. In the early stages, when the PC was significantly lower performing than the mainframe, it is not difficult to understand that employees would have chosen to devote their time to the high performing mainframes. For this reason alone it can be considered a wise choice to develop the IBM PC in a spinout division. But the separation of the divisions is not enough, the CEO and the board of the company stand by the new technology and promote the employees to do their best. If the employees see the new technology paradigm as a threat, which is most likely as they were part of the powerful paradigm of the mainframes, they will not be willing to prioritise it and may even see the employees devoted to the new technology as threats and to some extent traitors. It is therefore important to market the new technology within the company, to make everyone understand that this is the future.

IBM chose to have two teams working on an IBM PC, from this one could see two main advantages. The first is that IBM in the end had two options to choose from, making it possible to wait until late in the development to see which one suited the market. The second advantage is a consequence of the first, as there were two competing teams it is natural that they pushed each other forward. No team would have wanted to be the losing team and would therefore have worked as hard as possible to deliver the best IBM PC possible. Although this strategy means the development costs were doubled during one period of time, it is likely improvements from the losing teams PC could have been made use of in the winning teams PC.

A further advantage of the spinout division is that it made it possible for the PC division to create its own cost structure. The mainframe division had large costs, as it was a large organization and marketed high priced quality products. The PC market was, on the other hand, a place for computers considerably cheaper than mainframes. This meant that the revenue margin on each machine was lower than on the mainframe market. Had the PCs been measured with the same margin metrics as the mainframes, no projects of development would ever had made it past the board. The margins were simply too low, according to metrics on the traditional mainframe market. But the new PC division was smaller than the mainframe division and could be structured in a way to make lower margins acceptable.

5.3 Analysis – Hewlett-Packard

5.3.1 Innovation

When HP chose to develop both ink jet printer and laser jet printers it was a time when no one knew which type was the best and would come to dominate the market. What was known was that they competed with each other. Many may have thought it foolish for a company to create its own enemy, as the constantly improving ink jet printer attracted customers otherwise destined for the laser jet printer. HP was and still is experiencing cannibalism. But if HP had chosen to ignore the new technology, inferior as it may have seemed at the time, chances are that other companies would have developed this new technology and brought it to the market.

This would not only mean that the HP laser jet printer would be losing customers to the ink jet printer, but to a competing company. The conclusion of this is that HP created a barrier of entry for new companies by investing in the ink jet printer technology.

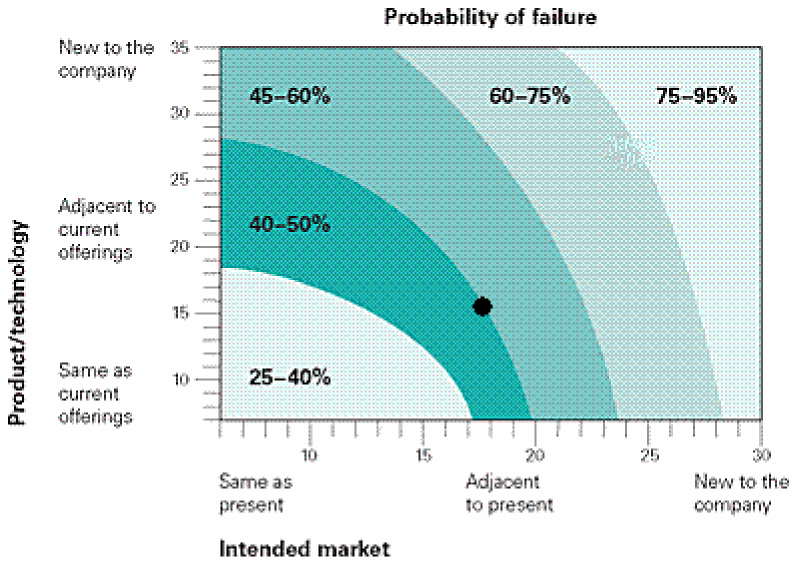

Figure 21: Possible Risk Matrix for the HP Ink Jet Printer

With the background presented in the empirical chapter, the created risk matrix could look like Figure 21: Possible Risk Matrix for the HP Ink Jet Printer. This illustrates that fact that HP needed to increase both the knowledge of the market and of the technology to be successful.

As has been discussed previously, the laser jet printer was initially superior to the ink jet printer and in some areas continues to be so. But as the latter printer improved significantly over time it could be seen as a disruptive technology, although it has not entirely disrupted the market for laser jet printers. This new technology caused a shakeout on the market, of a seismic syndrome type, typical on mature and stabile markets.

5.3.2 Strategy

For HP the launch of the ink jet printer gave access to the lower price/performance tiers of the printer market, tiers previously dominated by Asian companies. The combination of laser jet and ink jet printers made it possible for HP to cover a deeper range of the market. By offering an ink jet printer in the same price range as the Asian companies, HP had a significant advantage as their printer were manufactured in the United States and did not have to pay for overseas transportation. HP also had the advantage of an established brand name, well known in the printer industry.

Ink jet may have started out as an attempt to cover a lower tier of the market, but the successful platform product DeskJet resulted in a beachhead strategy illustrated in Figure 22: Platform Strategy HP Deskjet. DeskJet started in the lower tiers and with improvements and new platforms spread across the market to cover not only the lower tiers. This upward movement on the market pushed the laser jet printer ever higher, as it was forced to offer even higher quality and speed to remain top of the line.

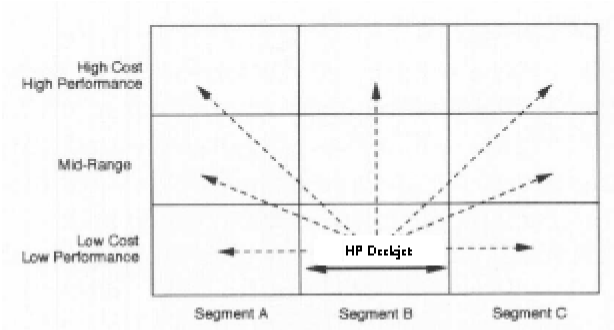

Figure 22: Platform Strategy HP Deskjet

5.3.3 Organization

HP chose, after trying to develop ink jet printers within the main organization, to place the development in a spinout division. The ink jet printers required a different cost structure, as the case of the IBM PC, to be measured appropriately to the part of the printer market it was intended for. The laser jet printer's characteristics were quality, speed and a correspondingly higher price. The ink jet printer, on the other hand, had the objective to be a cheaper alternative.

During the development of the DeskJet platform products HP started working and thinking in a new way. To stay competitive, the employees developed new platform products simultaneously, before the first product platform was finished. By doing this improvements and innovations could be launched as a part of the old platform and then, if successful, incorporated in the new platform. An example of this is the dual pen first introduced in the DeskJet "500" and later in "600" and finally made standard in the "800" (Figure 14: Product Family Map for HP's Deskjet Printer).

HP integrated part design and tooling design to reduce manufacturing costs, in order to reach the stated goal of offering a printer for $1000 or less. This resulted in a printer with fewer parts, which reduced the lead time. But this might not be the only consequence of fewer parts, the number of spare parts needed is also reduced. The question is how HP was affected by the decrease in spare parts, as sales of parts and service is a large source of income for many manufacturing companies (Cohen et al., 2006). If HP wanted to maintain the level of revenues from the parts and service part of the organization, the company must either raise the margins for each part and services offered to consumers or decrease the service in order to cut costs.

One of HP's prides is the "HP way" of thinking, taking pride in offering high quality products and making technological contributions to the welfare of humanity. With this in mind, one might think it would be easier for employees at HP to adopt new technologies and take pride in developing them. As the managers try to encourage this way of thinking in the day to day life, HP might not need to make as large investments in marketing of a new technology within the organization as other companies. If this way of thinking binds the employees together as is claimed by HP, the technology conversion of ink jet printer could have been enhanced by keeping the employees connected and involved in each others work. Maybe HP achieved an organization where laser jet and inc jet printer could share not only the brand name but also a culture despite the fact that they belong to two different technology paradigms and are geographically separated (Figure 23: HP Organization). At the same time one must consider the impact of developing a simpler technology in a company that prides itself in taking technology to the next, often more complex level. Did the "HP way" help the employees look beyond the simplicity of the ink jet printer? Or was there a cultural crisis, which contributed to the decision of placing development of the ink jet printer in Vancouver? Based on the empirical data, there seems to have been a cultural crisis, as the products competed against each other and needed to be separated geographically.

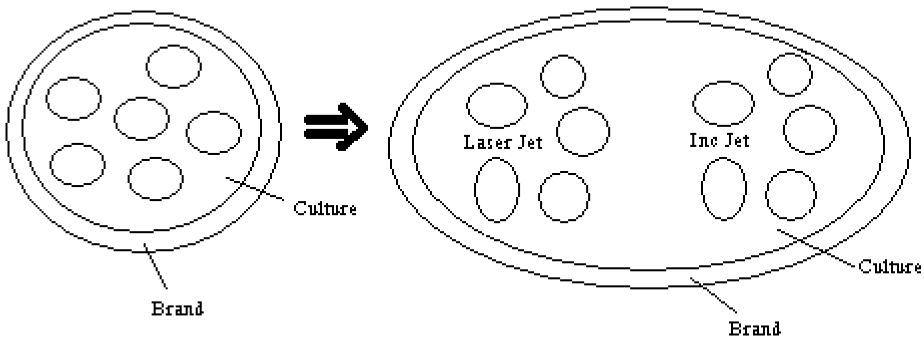

Figure 23: HP Organization

5.4 Analysis – ABB

5.4.1 Innovation

Combined is the result of two existing innovations combined in a new way, a true technology conversion according to this thesis' definition. The innovation in itself can be seen as an architectural innovation, as the core components of the product are not significantly different from previous disconnectors and switches. The assembly of the components differs and has created both advantages and drawbacks for ABB. For example, the new design does not include a visible disconnection of the power lines. This has in the past been an important feature as it is possible for the maintenance crew to see that the line is disconnected and they are safe to work on it. One of the obstacles for ABB is to convince customers that Combined offers the same level of safety even though it is not possible to see the disconnecting of the power circuit. On the other hand, an important advantage of Combined is that it has a significantly smaller footprint and enables building of smaller substations. Both advantages and drawbacks have been considered when communicating with customers. In the case of the lack of visual disconnection of the circuit, ABB have stressed the point that it is the level of safety that is important and not the visual disconnection in itself. In addition to this, ABB has emphasized the visibility of the earthing in Combined.

As a disconnecting circuit breaker, Combined competes with both switches and disconnectors, products ABB develops and markets. As the plain switches are not entirely alike Combined, they are somewhat protected. The disconnectors are on the other hand simple in design and a situation of cannibalism would have arisen, had not the disconnector unit been sold off as a consequence of cost reductions. If the development and marketing of Combined continues to improve, it could be disruptive to simple switches and disconnectors in high voltage substations.

5.4.2 Strategy

The electricity industry is by nature conservative and restricted by many regulations, which has influenced the strategy of Combined. The product must fulfil and uphold certain standards, which has had an effect on development and manufacturing costs. ABB typically offers products in the upper tier of the market, products high in performance and price. Combined is a continuation of this high tier strategy and is priced corresponding to the earlier solution, two disconnectors and one switch. The trouble lies in convincing the customers that they are paying for this package solution and not just a switch, as the compact design might suggest that Combined is. ABB's strategy for Combined, to use it as a platform and move into upper tiers of the market in new countries, can be illustrated by Figure 24: ABB's Platform Strategy. In this picture the segments represent countries. As technical requirements differ in different geographical areas, recent developments have opened up a new market in North America. This could create a seismic shakeout on this new market, as ABB now can enter and compete where they were previously prevented.

Regulations and electrical currents restrict the product solutions, making it difficult to create smaller or cheaper versions of Combined. This prevents Combined from moving into lower tiers of the market, which is also of no interest to ABB. At the same time these regulations and the fact that customers need to be convinced of this new concept, act as a barrier towards companies trying to compete with cheaper products. Products within the family of the Combined platform are adapted to technical aspects such as the amount of current flowing through them and not so much to customers demands on size etc. ABB uses Combined along with other products to stay competitive in the upper tier of the market, Combined enhances the ABB brand by adding to the product portfolio in the already established market tier. According to ABB Combined is the standard solution in Sweden, and competitors have recently launched similar products. The implication of this is that disconnecting circuit breakers are congregating towards Combined, which is becoming the dominant design.

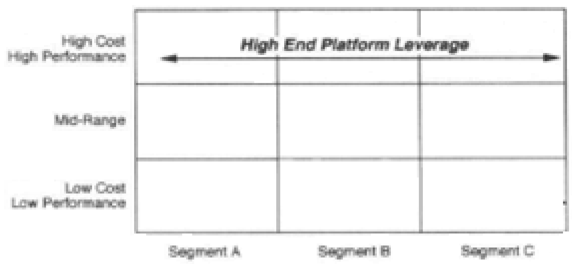

Figure 24: ABB's Platform Strategy

5.4.3 Organization

The initiative to move the development and marketing of Combined to a new organization within ABB High Voltage Products in Ludvika was a considerable investment for ABB. This can be interpreted as a leap of faith in the new technology, that the risks of producing a product without an established norm by IEC were outweighed by the possibilities of the market. As can be illustrated with the risk matrix, ABB was familiar with both the market and some of the technology (Figure 25: Risk Matrix for the ABB Combined). When placing Combined in the risk matrix, the IEC was weighed into the market. The plan behind the creation of Integrated Systems was that it should organise its own marketing, becoming a spinout-like organization situated within ABB in Ludvika. The spinout organization was not needed to separate two technology paradigms, as in the other case studies. The technology behind Combined belongs to the same paradigm as traditional switches and connectors, although it differs in many aspects. The other units in High Voltage Products shared a marketing unit (Figure 16: Organization ABB Ludvika). The reasons for why Combined took too long in reaching a satisfying number of units sold are surely complicated, but the outcome was the integration of Combined into the Switch unit where the development once had begun.

This raises a number of questions. Was this a sign that the innovation did not have enough support of the CEO and board members? The employees once selected to work entirely dedicated to Combined were moved back into their old unit, did this have an effect on the company culture and sense of fellowship? Today Combined is considered to be a success within ABB, but the employees may have thought differently when Integrated Systems was dissolved.

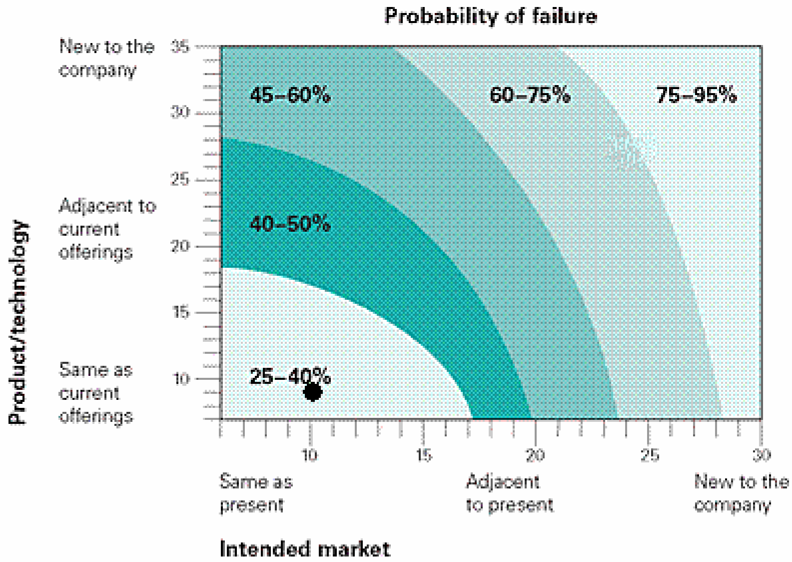

Figure 25: Risk Matrix for the ABB Combined

5.5 Analysis - Alfa Laval ART®

5.5.1 Innovation

The Alfa Laval plate reactor was the result of combining existing Alfa Laval technology in heat and mass transfer with knowledge of the chemical industry and its needs, the product itself regarded to be a radical innovation within Alfa Laval. Although the company already possessed knowledge of heat and mass transfer, much more knowledge was gained when adapting this and putting it to use in the chemical industry. With this in mind, along with the fact that the product is something the company has not offered before, fortifies the thought of characterising this as a radical innovation. When considering the different aspects of the product, it seems to fall under the category of disruptive innovations as well. As the product is introduced on the market, there is a strong possibility that it will drive the previously dominant batch technology out of competition.

Radical innovations are often seen as risky, as the product often differs much from the product portfolio of the company. But when applying the risk matrix to the case of the Alfa Laval plate reactor, a risk matrix with relatively high change of success was formed (Figure 26: Risk Matrix for the Alfa Laval Plate Reactor).

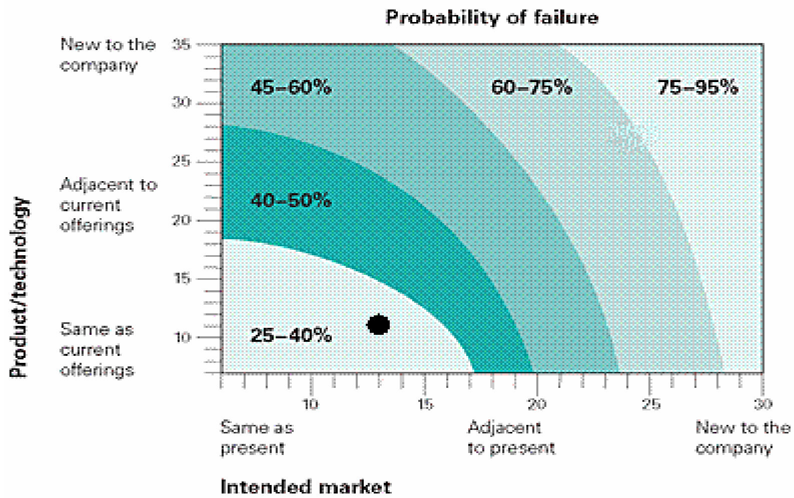

Figure 26: Risk Matrix for the Alfa Laval Plate Reactor

5.5.2 Strategy

As the Alfa Laval plate reactor entered the market it took up competition with a well established traditional technology that had not gone through significant changes for decades. With this as a starting point it could be easy to fight competition, but it also means that not all customers were ready for the new technology. The reason for choosing pharmaceutical companies and speciality chemical companies was that Alfa Laval considered these industries to be more open to new technologies. Among other things, recommendations from FDA forced these companies to search for and be more open minded towards new solutions, creating a natural starting point for the launch of the plate reactor. The recommendations from FDA are an example of the forces behind the seismic shakeout on this market, forcing companies to adapt to a new situation. By entering on these markets Alfa Laval finds the weakest spot for market penetration, as it is easier to convince the customers that they need this new appliance. With these customers as references, Alfa Laval can spread the new technology across the market (Figure 27: Possible Strategy for the Alfa Laval Plate Reactor). Alfa Laval has the intention to expand into new geographical markets by moving stepwise and in so building up a sales organization in each area. By interpreting what is presented about the market where the plate reactor is launched, it seems that this approach is possible because competitors do not have products equal to the plate reactor concept. Because there is no race Alfa Laval can take the time to build up an adequate market support in every region. Although, it is possible potential customers operating in regions where the product is not launched yet may find this strategy too slow.

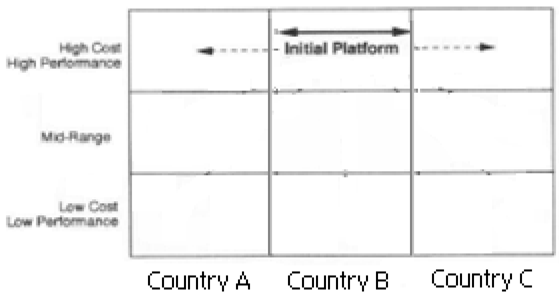

Figure 27: Possible Strategy for the Alfa Laval Plate Reactor

Alfa Laval is a premium brand, residing in the upper tiers of the market. This is a result of an overall company strategy, to offer high quality products to a reasonably high price. The plate reactor is a continuation of this strategy, becoming yet another product to be spread in the upper tiers of the market. The Alfa Laval plate reactor is at the present time one product, but could develop into an entire product family. How this family of products will spread across the market is not yet known.

5.5.3 Organization

The development of the continuous plate reactor took place within a separate organization within Alfa Laval with its own dedicated members, much like a spinout organization (Figure 28: Alfa Laval Reactor Technology in the Alfa Laval Organization). The company's decision to invest in and organize a separate unit could be considered a token of faith in the product but also a sign that new innovations are welcome even though they might not fit into the organization. The new unit did not come from an existing unit but was entirely new, which could be explained by the fact that this technology did not belong to the existing technology paradigm. The spinout was separated from other heat and mass transfer units geographically, an approach recognisable from the case studies of IBM and HP. Although not separated by a distance equal in size, the effect was all the same: freedom to think without interference from people who know a lot about how heat and mass transfer technology usually works, people who thick along the heat and mass transfer technology trajectory. If the concept communication within the company is successful in creating understanding about the innovation and its possible benefits, efforts can be made to make development possible. On the other hand, it could also be interpreted as a need for restructuring of the development part of the organization to make room for extraordinary innovations. These innovations are most often what sets a company apart from others and should therefore naturally be a part of the organization if possible and not exceptions to the rule of how innovations are developed. Although, innovations belonging to a new technology paradigm often need to be separated in order to develop along their on trajectory.

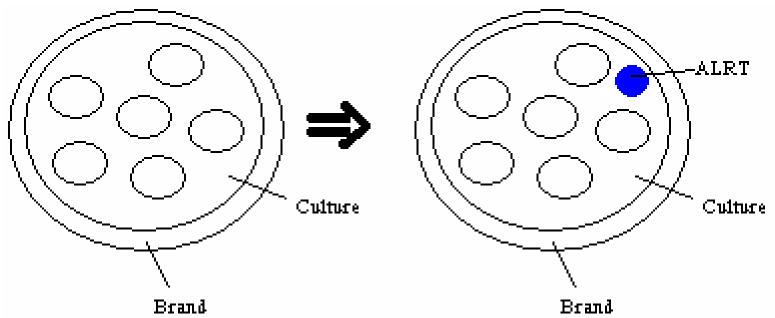

Figure 28: Alfa Laval Reactor Technology in the Alfa Laval Organization

5.6 General Strategy

By analysing IBM, HP, ABB and Alfa Laval this thesis has brought forward certain steps the companies have taken in order to carry out technology conversion. Similarities between the companies can be interpreted as steps important when it comes to successfully carrying out technology conversion. In order to create a strategy for a general company of similar size and industry, a summary will be presented below.

5.6.1 Market

A company considering investing in a technology conversion should begin by examining the underlying market situation. What is creating the need for a technology conversion? Is it the emergence of a new technology or perhaps demands from customers?

Both IBM and HP had successful products on the market before deciding to invest in a technology conversion, they dominated segments or tiers of their respective markets. The technology conversion gave them access to other parts of the market but also meant that their previously lucrative market shares risked losing in value due to declining customer interest (IBM) or cannibalism (HP). A company considering technology conversion should be aware of this, and not believe that the value of their market shares will be unaffected by a technology conversion. In order to handle this obstacle, the company should calculate what they stand to lose and make it their goal to gain in the new market tier/segment what they stand to lose in the old market tier/segment. First thing is to localise where in the market their previous products belong. The next step is to decide in which direction the company wants to expand, with the help of the overall company strategy (Figure 29: Localising market presence and future strategy). In the case of the Alfa Laval plate reactor, the company did not have a product in the line of this product and therefore in a way did not exist on that segment of the market. When deciding where Alfa Laval wanted to go on the market, they decided to take on pharmaceutical, fine and speciality chemical companies. When carrying out these first steps, one should consider where competitors exist on the market. If your company dominates in the higher tiers of the market and competing companies are penetrating the market from below with simpler and cheaper products, it might be interesting to consider expanding in lower tiers in order to create barriers of entry. This could of course lead to cannibalism, the previously successful products losing customers to the company's new products.

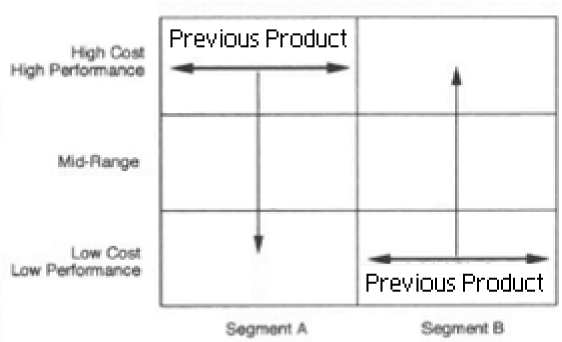

Figure 29: Localising market presence and future strategy

Companies that have made it their distinctive token to exist only in the upper tiers of the market, offering high quality products at a high price, usually avoid expanding in lower tiers as it becomes difficult to defend the high prices in the higher tiers. IBM granted the PC the industry's approval and came to be connected with the development of PCs, it expanded the IBM brand to include the PC market as well. The IBM token of high quality computers came to include PCs instead of loosing in power when moving into a lower tier. This was a successful move from a business to business market to a business to customer market, which separates this case study from the others.

5.6.2 Development

When deciding whether or not to invest in a new technology, a company should investigate not only the market potential but also what kind of innovation the new technology is. This could be of help when developing the new technology and set expectations to an appropriate level. A risk matrix can illustrate the probability of success and also where the uncertainties lie. Is it the market that is unknown or is it the technology itself? By establishing where the difficulties lie, the company can make an effort of investigating and minimizing obstacles in the most urgent areas. If the company knows it is developing a radical innovation and not an incremental innovation, it becomes more obvious that routines and procedures previously successful might not be of assistance in this case. The company would be more open to other ways of solving problems along the way of development (Figure 30: Types of Innovation and Company Openness). Beside the risks of market uncertainties and technology, the company should also consider the risk of other companies developing the new technology. How much harm could be done if a competing company launched the new technology instead? Could your company still compete with its products or would it loose all market shares? The answers of these questions could make a risky project seem less of a risk than letting competitors have free range.

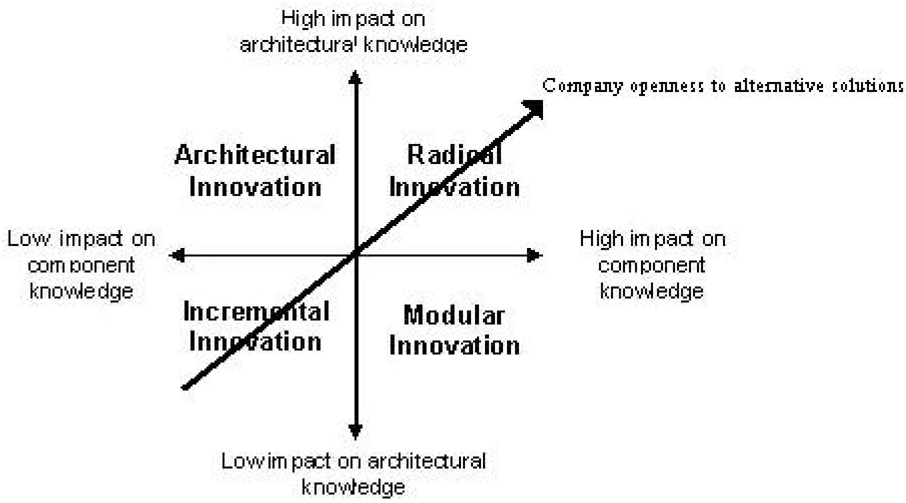

Figure 30: Types of Innovation and Company Openness

Large mature companies cannot put all other products aside when deciding to develop a new technology, as the case study of IBM showed. The existing product line is often what brings in the money needed for the technology conversion. In other words, should a company carry out a technology conversion of a radical type, incremental development of existing products may look like Figure 31: Incremental Development Simultaneous with Radical Innovation. If a company chooses to replace the existing product line with the products resulting from the technology conversion, this incremental development of existing products will stop and the products will be removed from the product portfolio.

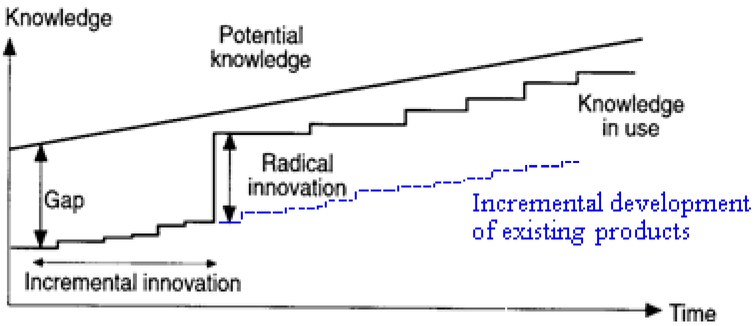

Figure 31: Incremental Development Simultaneous with Radical Innovation

5.6.3 Organization

When it comes to practicalities IBM, HP and Alfa Laval made the decision to develop the new technologies on a site geographically distant from the head office of the company. ABB, on the other hand, chose to create a separate unit within the organization on site. Spinout organizations have both advantages and disadvantages and should not be used as a standard procedure for developing technologies that, at first sight, do not fit in with the rest of the organization. When evaluating the situation, one could use the criteria presented by Overdorf and Christensen (2000). Does the new technology require a different cost structure? Does the new technology require its own dedicated resources? And last but not least, does the new technology have the support of the CEO and the board of the company? If these criteria are fulfilled, a spinout organization is a good option. Also, the level of freedom needed to develop without interruptions is an important criterion. A spinout organization does not have to be located far away, but needs clearly defined perimeters to stay autonomous. Only then can the members be truly dedicated to the task of developing the new technology, and not risk prioritising other tasks.

As can be seen in Figure 32: Possible Organizational Changes, a technology conversion could result in the creation of a new unit or possibly a division of the organization. IBM went from being an organization developing and marketing mainframes to focusing on both mainframes and PCs, the distribution between these not as equal as in the figure. The new technology grew and took more and more space in the organization and the old technology was reduced. These are only two ways in which an organization could change when carrying out a technology conversion.

When carrying out a technology conversion, the organization is often affected as can be seen in the case studies presented. Naturally, the development part of the organization goes through changes when a new unit is created or room is made in existing units for the new technology. Other parts of the organization are also affected, in varying degrees. A new sales unit might need to be created, which might lead to a reduction in the previous sales unit as in the case of ABB. When developing products with a significantly reduced number of parts, one might think that the parts & sales unit of a company would be affected. But when reviewing the case studies, no company has shown indications of this. One reason could be that the companies studied mainly operate business to business and offer spare parts for their products for many years (e.g. 15 years for ABB). Any effects caused by the reduction of parts will appear after a long period of time, in which other factors could affect this part of the organization.

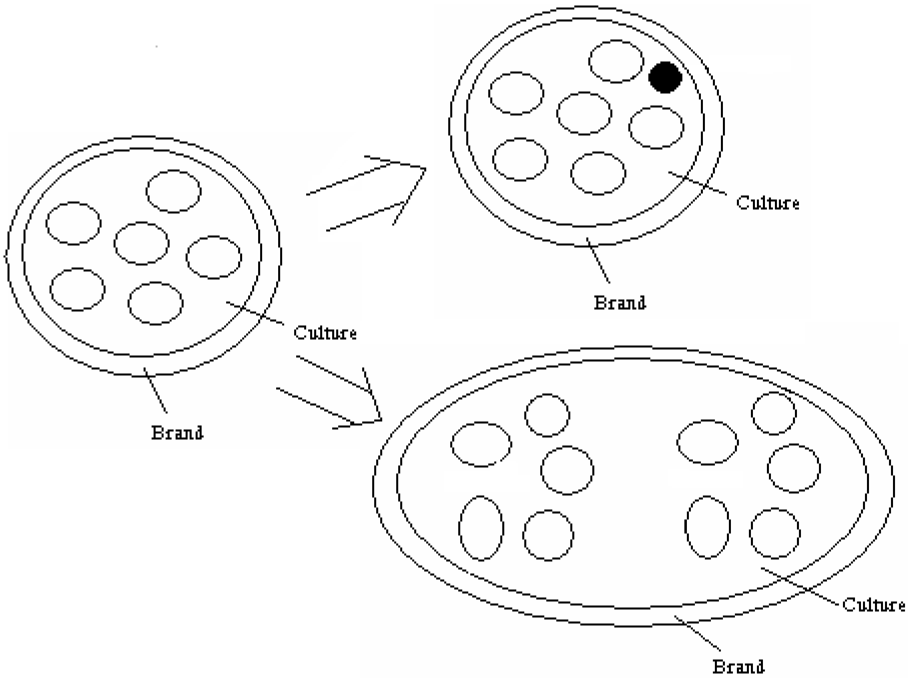

Figure 32: Possible Organizational Changes

5.6.4 Summary General Strategy

The objectives of this thesis are to conclude what companies should consider when deciding to carry out a technology conversion and to create a strategy for a general company. The insights obtained through analysis of a number of case studies are summed up in a checklist to be used as a strategic guide and to remind companies that a large number of factors affect the outcome of a project of this size.

1. Is a technology conversion needed?

   Why should the company carry out a technology conversion and what could it gain by doing this? The company should begin by examining what forces lie behind it, is a new technology emerging on the market or are customers requesting other products etc.?

2. What kind of innovation does the technology conversion involve?

   Is the innovation radical, disruptive, architectural or modular? What kind of impact can the company expect?

   a. How will the new technology be received? Will it be difficult for the employees to understand the new products, e.g. the sales personnel? Will it be difficult for the customers to understand the new product? By understanding what kind of innovation the company is dealing with, it can make a plan for communication of the innovation.

   b. How probable is the success of the innovation?
      Use a risk matrix to illustrate where difficulties for the company may lie. This

enables action against risks and also taking calculated risks.

3. What does the company stand to lose and to gain by carrying out technology conversion?

   Will the technology conversion result in a new product line? Will the company gain access to a new market? Will the new technology strengthen the company's position on the market? These questions could be answered by looking into the market strategy.

   a. Where on the market is the company situated today?
      Where does the company hold a strong position on the market? How does the company categorise itself today, as a premium brand company?

   b. Where does the company want to go on the market?
      Does the company want to broaden geographically or enter lower/higher tiers of existing markets? What areas could be gained by a technology conversion?

   c. Where are the competitors on the market?
      Does the company want to fight this competition by moving up/down the market tiers?

   d. How is the brand name affected by a technology conversion?
      Is the brand name strengthened by adding a new technology to the product line? Is the company prevented from entering lower tiers of the market in order not to damage the brand name? If so, could a sub brand be created?

4. How could the company's organization be affected by a technology conversion?

   a. Where in the organization could the new technology be developed?
      Will the existing development unit allow the technology to develop freely or does the new technology need its own dedicated team members? Is there a need for a spinout organization and are the criteria for spinout organizations fulfilled?

   b. How will the structure of the organization be affected?
      Will units be reduced or expanded in size? Will new units be created and existing units dissolved?

   c. How will the culture of the organization be affected?
      Will the new technology strengthen the company culture by being yet another example of high performing/cheap/simple etc. products, although significantly improved? Or will it break the norm of the company's products by being significantly different in performance and price? If so, how will the employees respond to this new product and how could the reception be facilitated?

By answering these questions, companies get more information about the situation and can make better use of their own project management tools etc.

6. Conclusions

In this chapter conclusions drawn from the analysis are presented and the questions of the thesis are answered. The chapter ends with reflections and suggestions for further studies.

6.1 Final Conclusions

By studying a number of companies that have been successful in carrying out technology conversions different situations have been displayed, illustrating that there is no typical situation for technology conversions. To answer the question on how these companies have been able to carry out the technology conversion in a successful way, the simplest answer must be that they were able to read the situation and act accordingly. This is not a question of luck but rather the result of organizations that possess a combination of routines, processes and yet freedom to think and act in a new way. The case of the Alfa Laval plate reactor, acting upon FDAs guidelines, shows how opportunities on the market can be taken advantage of to launch existing ideas. It is not enough to interpret the situation before the technology conversion takes place. As ABB shows, it is important to evaluate the market and the situation within the organization during the entire length of the process. This made it possible for ABB to integrate the spinout organization of Combined into the rest of the organization, in order to fulfill economical demands.

The factors underlying the technology conversion have differed between the case studies presented, but all emit the notion that the new technology was a step necessary for the companies' survival as prominent competitors on the market. As a result of the analysis of the case studies, the following factors are seen to be the main influencers when the companies decided to carry out technology conversion:

- IBM: The company saw what had happened when the minicomputer had emerged on the market. In order to catch the next wave of computer technology and not fall behind competitors, IBM invested in the development of PCs.
- HP: The laser jet and ink jet printer technologies emerged in proximity of each other on the market. Due to the fact that there was no telling which would be the dominant technology and the increasing number of Asian competitors, HP chose to develop both technologies.
- ABB: The company's customers contacted a number of competing companies and requested a new solution to the problem of disconnectors and switches. This coincided with the upgrading of the Swedish power grid. By acting on the customer's wishes, ABB was given the possibility to develop a product no other competing company could offer and launch a new product on a market with growing needs.
- Alfa Laval: The FDA set new guidelines for the pharmaceutical and fine and speciality chemicals companies to invest in new technologies, which created an opening on the market of reactor technology. This made it possible for Alfa Laval to commercialize an already developed technology and launch it on a market.

The development of a technology conversion was not risk free and probably needed a fair amount of communication within the company before it could start, as was surely the case for IBM's PC development. This stresses the importance of being able to interpret the market situation, but also the importance of risk taking. With the right tools, such as a risk matrix, one can see where the risks lie and which calculated risks one can take.

In all the companies studied, some kind of spinout organization was created for the development of the innovation. This similarity indicates that technology conversions thrive in freedom and independence that characterize these types of organizations. Other similarities are the need for in-house communication and the support from the CEO and company board.

When looking for a general strategy for technology conversions it was discovered that there is no "one size fits all" solution. Instead, a checklist summarizing similarities found in the case studies and conclusions draw act as a strategic guide on how to approach technology conversions and how to avoid the most common pitfalls. The list of questions forces the company to ask difficult questions, questions proven to be of importance in the case studies.

6.2 Reflections

The thesis has grown and been adjusted throughout the process, with the objective to investigate successful technology conversions held in mind. Only four companies where chosen as examples of how innovations can be developed, which could lead to a deceptive view of how innovation development is conducted. The selected companies are also active on industries that are share similar characteristics. On the other hand, the selected case studies concern technological companies and thus represent the area Alfa Laval is active in. This could make up for the limitation and at the same time offer a deeper study of the technological industry.

6.3 Suggestions for Further Studies

- International technology conversion, does it differ between countries? (US, Japan, Europe)
- Is it easier or more difficult to carry out technology conversion in industries which more rapid development? (mobile phones etc.) Do these companies have experience that helps them be more open minded and accept new solutions quicker, or is it the same as in "slower" industries where companies such as Alfa Laval are active?

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8. Appendices

Appendix A

	Intended Market					
	…be the same as in our present market		…partially overlap with our present market		…be entirely different from our present market or are unknown	
Customers' behavior and decision-making processes will…	1	2	3	4	5	
Our distribution and sales activities will…	1	2	3	4	5	
The competitive set (incumbents or potential entrants) will…	1	2	3	4	5	
	…highly relevant		…somewhat relevant		…not at all relevant	
Our brand promise is…	1	2	3	4	5	
Our current customer relationships are…	1	2	3	4	5	
Our knowledge of competitors' behavior and intentions is…	1	2	3	4	5	
					TOTAL (*x*-axis coordinate)	

	Product/Technology					
	…is fully applicable		…will require significant adaptation		…is not applicable	
Our current development capability…	1	2	3	4	5	
Our technology competency…	1	2	3	4	5	
Our intellectual property protection…	1	2	3	4	5	
Our manufacturing and service delivery system…	1	2	3	4	5	
	…are identical to those of our current offerings		…overlap somewhat with those of our current offerings		…completely differ from those of our current offerings	
The required knowledge and science bases…	1	2	3	4	5	
The necessary product and service functions…	1	2	3	4	5	
The expected quality standards…	1	2	3	4	5	
					TOTAL (*y*-axis coordinate)	