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FROM
MANAGING THE COMPLEXITY
TO
MANAGING UNDER COMPLEXITY



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

THESIS SUPERVISOR:

SCHWEIZER, Roger

THESIS AUTHORS:

BERGGREN, Olivia

SÖDERBERG, Johanna

ABSTRACT

- Problem** With the prevailing complexity that industrial organizations business field is exposed to there is a need for a more extensive comprehension of the phenomenon. Though current scientific research within management regarding complexity is rather a discussion of what it means for companies than how it should be mastered and managed in reality. This rather unexplored research gap between scientific awareness and the execution process lays the foundation of this thesis research.
- Purpose** The very purpose of the thesis is to contribute to the current scientific research of Management in general and in particular to the field of Complexity Management. By investigating how industrial organizations manage complexity in reality.
- Research Question** How do industrial organizations manage complexity of product offerings?
- Research Approach** With regards to our research purpose we chose a qualitative approach and conducted a case study. Furthermore we employed abductive reasoning, as we moved simultaneously within the range of both theoretical and empirical data it enabled us to answer our research question and reach the thesis purpose.
- Findings** Through our conducted research we found that in reality industrial organizations does not manage the complexity. Instead it manages under complexity through actions within set structured processes.
- Key Words** Management, Complexity, Product Offerings

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Gothenburg, June 12, 2013

Johanna Söderberg
Johanna Söderberg

Olivia Berggren
Olivia Berggren

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CHAPTER 1 - INTRODUCTION

This chapter provides an introduction to the chosen field of study. Presenting the background of our research, the identified problem area and the purpose of this master thesis. Further, the case study that lays the foundation of this research is presented. Finally, in order to clarify the research area the study's delimitations are defined and the thesis disposition is outlined.

1.1 Background

During the last couple of decades, a time consisting of paradigm shifts, there has evolved a field within the scientific research of management, namely *Complexity Management*. Due to global competition, well informed customers and constantly evolving technology the industrial organisations business field has become more complex and unpredictable (Hofer and Halman, 2005). Thus this ever changing business environment creates complexity for organizations which the researchers within the field of Complexity Management attempts to tackle as a business approach that handles investigation, evaluation and optimization of complexity within organizations (Marti, 2007). Merely increasing the company product offerings is not a guarantee for increased long run profits nor is it a guarantee for increased company competitiveness (Ramdas and Sawhney, 2001). Though, in order for industrial organizations to stay competitive it is necessary to develop and provide new products offerings. However, these efforts needs to correspond to the related costs and demand, a balance difficult to achieve, as when companies satisfies customers needs in a product offering the customers' expectations increases to a new level (MacDuffie et. al, 1996).

There is no question to whether complexity is a reality in industrial businesses (Hofer and Halman, 2005); however there is no existing commonly established standpoint within the current scientific research.

1.2 Problem Discussion

The field of Complexity Management is a relatively new and limited area within scientific research. As previously stated there is no generally accepted agreement of what Complexity Management entails regarding product offerings, however this does not imply that it is a scientific area that is characterized by contradictions regarding the view of the subject. It is rather quite common that the authors amongst the existing papers customize the very definition of complexity and then justifies what needs to be managed within that area (Ding, 2007). Regarding the relationship between product variety and complexity Rathnow (1993) addresses it by explaining that the benefits of products variant should be weighed against its costs to generate the optimal combination. Increasing the number of product variants

generates additional complexity and costs that are effective from the time when the product is designed as well as over the product's entire life cycle. Due to that Rathnow (1993) states that the product variety benefits cannot be harvested without an increase in complexity costs. However, he means the aim is not to reduce product complexity as much as possible but to find the ideal level of complexity that recognizes the benefits as well as the costs caused by the product variety.

Further quite commonly, complexity is viewed from two perspectives; external and internal, amongst management researchers. Schuh and Schwenk (2001) expresses that the business market is highly complex in its very nature, as the current market needs are dynamic i.e. affected by plenty of aspects such as change in customer demands, competitors' performance, environment and political regulations. Moreover, Schuh and Schwenk (2001) explain that in order to fulfil and correspond to these diverse demands, organizations respond by developing their product portfolios and introduce a variety to their products. This according to Schuh and Schwenk (2001) creates an internal complexity. This as it affects not only the product complexity, but has an impact on the entire company and is spread to all functional areas such as production, product development, logistics and sales and is therefore referred to as internal complexity (Kaiser, 1995; Bliss, 2000). As the products in most cases are necessary instruments for achieving sustained profits and long-term survival they need to be designed to cope with both internal and external complexity implications (Bliss, 2000). Johnson and Kirchain (2006) presents his view of the complexity regarding product variety from another angle, stating that the main issue is often related to the problem regarding the lack of capability to trace back all costs to the initial variants. Additionally, they explain that the low volume variants often require more resources. As a result the high volume variants financially support the low volume which provides an uncorrected cost situation and money drain as some variants are being sold with no profit (Johnson and Kirchain, 2006). This means that the great majority of the product variety does not contribute to the overall profit, but instead limits it. In line with that the product portfolio increased the complexity costs are not equal among the different variants (Schuh & Schwenk, 2001). This was already highlighted by Abell and Hammond in the year of 1979 that handling an increased amount of unique components raises costs due to lower efficiency, larger inventories, complicated product structures and greater number of components to deal with. This phenomenon is, in short, explained by Bliss (2000) that in line with increased components companies loses control of managing the complexity. Commonly agreed among researchers, almost needless to state, priorities within companies tend to differ among people at different departments. Closs et al. (2007) states that whilst the research and development favour new technology the financial department focuses on keeping the costs down whereas the marketing department tries to capture customers attention. In a long term

perspective it is impossible to only focus on customer needs, technology or less manufacturing costs. The priority struggle does further easily lead to sub optimization (Closs et al., 2007). With a deeper insight of the complexity problems and their related costs sub optimization can be avoided. The result is to manage the balance between effectiveness and internal efficiency and thereby also generate profit increase (Abell and Hammond, 1979; Closs et al., 2007).

Thus, there is research conducted of management complexity regarding product variety however it is rather a discussion of what it means for companies than how it should be mastered and managed in reality. This rather uncharted research gap between scientific consciousness and the execution process lays the foundation of this thesis problem area. Additionally, this very gap intrigued us to explore how organizations actually manage complexity.

1.3 Research Purpose and Question

The purpose of this thesis study is to contribute to the current scientific research of Management in general and in particular to the field of Complexity Management, by providing a real life example of how complexity is being managed. As to aid our study we are in the need of a specifically formulated research question to support the progress of our study and enable us to achieve our purpose. Thus, as to address this problem area and stay in line with our purpose we have utilized the following research question:

How do industrial organizations manage complexity of product offerings?

1.4 Case Introduction

With the very purpose of our thesis in mind we had the pervasive belief from the start that we were in need of insights from the actual business world, as to set a foundation for our study. Thus, we chose to conduct a case study investigating how an industrial organisation manages complexity of product offerings hence enabling us to distinguish authentic characteristics. This choice was done due to the rather recent focus from a scientific perspective in contrast to the awareness within the business world, regarding product offerings and the increased challenges implied in handling product offerings in a global market. The selected company, which we found to be appropriate to build our case upon, regards a large, global and well-established manufacturing company. Furthermore, as to more easily identify how organizations manage complexity we chose to conduct our study on one specific division within the organization, which we hereinafter will refer to as Division X.

Since Division X handles a great amount of product variants and manages sub sequential complexity, this case supports our research proposal. Due to the amount of

confidential information that we have been given during interviews, our case company wished to be anonymous in order to ensure not to provide its main competitors with inside information.

1.5 Delimitations

In order to fulfil our purpose of this research we found that the most appropriate decision was to delimit the study by focusing on complexity of product offerings and exclusively present the perspective of a product manager.

1.6 Thesis Disposition

This study has been divided into six chapters, each of which is presented below.

Chapter 1 Introduction	This chapter provides an introduction to the overall content of the chosen subject. Presenting the background, the problem discussion, the thesis purpose and our research question as well as the delimitations of the research.
Chapter 2 Methodology	This chapter presents our selected research approach, research method and a description of how our empirical data was gathered. It's being finalized with our reasoning's of the quality of the research.
Chapter 3 Theoretical Framework	This chapter presents and explains the chosen theories that we have studied in order to have a profound basis of our study. The theories will later in Chapter five be discussed in correlation to the empirical data.
Chapter 4 Empirical Findings	This chapter our empirical findings are presented which was obtained from the respondent from our conducted case study.
Chapter 5 Analysis	This chapter provides a discussion and reflections, with our research question in mind, upon how the empirical data that we collected corresponds and/or differs from our selected theoretical framework.
Chapter 6 Conclusion	The final chapter presents our research conclusion by answering our research question and thereby fulfilling our very research purpose. Further it provides a discussion of criticism to research and the thesis contribution. This is followed by a section addressing managerial implications and finally we present suggestions of further research.

CHAPTER 2 - METHODOLOGY

This chapter presents and asserts the chosen research approach and method which we decided to use throughout the research. The utilized method is described and explained as well as the underlying reasoning by our decisions. It motivates the used abductive approach and qualitative method. It explains the choice to execute a case study and presents the procedure of the conducted empirical research. Further, it presents the proceedings of the theoretical framework and the conducted analysis. Thereafter we enclose this chapter with the research limitations and the quality criteria. To note, the methodology chapter was placed prior to the theoretical one as we believe that it provides an understanding of our choice of theoretical framework.

2.1 Research Approach

With respect to our thesis purpose, to examine how industrial organisations manage complexity of product offering, we thereby chose the qualitative approach as our research question entails factors that are difficult to measure in a statistical way (Merriam, 1998). Moreover, we moved simultaneously within the range of both theoretical and empirical data; this in order to enable us to answer our research question and reach the thesis purpose. Hence, we employed an abductive reasoning as both the research theoretical and empirical perspective evolved throughout the study as we gathered and analysed our data (Kirkeby, 1990).

As we particularly wanted to examine *how* complexity is managed in a real-life context we sincerely believed that the most appropriate method was to achieve this by accomplishing a case study. This opinion was fortified further by the statement of Yin: “A case study is an empirical inquiry which investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 1984, p. 23). Additionally by conducting a case study it provided us with the opportunity to hold an in-depth interview with our respondent, thus obtaining knowledge and strengthening our comprehension and further enabling us to answer our research question. Ghauri (2004) strengthens these aspects and the appropriateness of case studies, stating that case studies provide eminent possibilities for the researcher to question the respondent until adequate answers and interpretations are obtained. Thus, we believe that our choice to execute a case study was the correct method for us as to attain a valid outcome of our thesis.

2.2. Choice of Case

As stated in the previous section we argued that, in order for us to achieve the very purpose of our thesis, we were in the need to conduct a case study. Thus we set out in an early stage to allocate a suitable case company for our study, which needed to fulfil following criteria, being an industrial organization that had met complexity and the subsequent issues regarding product offerings and additionally actively managing the complexity. Initially we encountered challenges obtaining a case company, which is common within this kind of research approach. We contacted several companies which complied with our set search criteria, amongst of which many were interested to partake though due to the time limitation of the thesis and the necessity to meet not long after the initial contact they were not able to partake as our case company. Finally, we found an industrial company which met our set requirements and within which one product division was a suitable object for our case study. The decisive factor for our choice of case company was in the end accessibility, the respondent's availability and willingness to participate within our set time frame this described by Merriam (1998) constitutes as convenience sampling. Moreover, we initially gathered data that was of apparent relevance for our research problem. However as the study progressed with our ongoing research, meeting with our supervisor and respondent, it resulted in that found data led to further data (Merriam, 1998).

2.3 Data Collection

With our thesis purpose in mind we sought to understand the field of Complexity Management, this to be achieved by applying our research question. We settled early on that the foundation of our research would constitute of qualitative interviews with employees that worked with managing complexity. Enabling us to obtain an in-depth comprehension of how it manages complexity of product offerings in its division. Thus, the thesis primary data regarding our empirical data was exclusively received from one of our conducted interviews. Since, the purpose of our thesis presents us with the need of a real-life context as previously mentioned it was of our belief that our study required human experience and expertise.

The participant that provided us with the primary data was the Product Manager of the Division X that constitutes our case study. The interview with the Product Manager extended little over an hour. Further we also interviewed a Sales Unit Manager however we decided, though interesting data was obtained from that interview, that it did not contribute to the purpose of our thesis thus we have *not* utilized it in the empirical section. Notable is that the interview with the Sales Unit Manager might have affected our view of complexity management indirectly. We believe that the Product Managers participation in our study was of

utter importance for us, enabling us to achieve our thesis purpose. Since, the respondent has a profound background in the case company and has the authority but most importantly works on a daily basis with what constitutes the research problem of this thesis.

Prior to the interviews we had had mail correspondence with the participants giving a short introduction to the subject and certifying that one of the respondents was actively working with managing the complexity of product offerings. After received advice from our thesis supervisor we decided to conduct an open interview (Yin, 2009). As we had prior to the interview studied a great deal of theory regarding complexity in general and complexity management in particular we had attained an extensive comprehension of the theoretical field and thus did not want to direct the respondent and risk hampering the authenticity we were after. As Ghauri (2004) stated it is authenticity rather than reliability that is the main issue regarding qualitative research when conducting a case study. Additionally, we are of the opinion that by having a face to face meeting we were able to take in both the verbal and nonverbal communication thus increasing the assurance of the empirical data quality. The interview set up was so that we asked the respondent an open question and during the interview we every now and then interposed with questions and also recapped statements to confirm our understanding, this all to attain a great comprehension of how complexity is managed at Division X.

Secondary data has been absent in our case study depart from our respondent providing us with the company model used for the process to introduce a new product offer to the market. Though as the case company desired to be anonymous we have not included the model figure though we utilized it when compiling the empirical findings. Furthermore, as to the largest extent avoid the impact of personal bias and improve the investigation potential (Voss, Tsikritsis & Frohlich, 2002) we were both present and during the interviews to receive the best possible outcome of data collection.

2.4 Research Process

The process of our research began with the search and compilation of acknowledged theory regarding complexity and complexity management. We had two meetings with IT consultant Tomas Nyvall whom introduced and thought us about complexity and its effects on organizations. Fairly soon we realized that the scientific field within complexity was rather comprehensive though young and unstructured, which directed us towards a research question. We then conducted our case study on Division X and as we had gathered empirical data we confronted our theoretical understanding with the gained insight from reality, thus leading us back to theory. We then complemented the theoretical framework with areas we had found was utilized at the Division X but was lacking in the existing theory. Additionally,

regarding the research question we set a preliminary one at an early stage. Though as the research progressed and due to empirical data and dialogue with our thesis supervisor we reformulated and specified the question during the research process. Further on we compared our empirical findings and the set theoretical framework in the analysis chapter. Enabling us to derive conclusions and thus realize the purpose of our thesis.

2.5 Limitations

The primary limitations affecting this study are the restriction in both time and scope. Due to that, we chose to build the case study upon one company and more specifically one division. A further aspect restricting this study is the fact that the empirical data is compiled from one conducted interview with one respondent. A second interview was sought for but unable to take place due to the respondents busy schedule and the researchers time restrictions. Thus, presenting us with the possibility to more accurately carry out our research however with the disadvantage of the result potential being perceived as biased. However the one respondent, hereinafter entitled Product Manager, had a vital part regarding complexity management and was thereby a critical participant as to fulfil our research purpose. The interview provided us with the advantage to collect a detailed data but also the disadvantage of inadequate reliability. Though as our aim was not to generalize but to see how complexity is managed in a real-life context, reliability is secondary to authenticity. Despite the limitations of our research we believe that our findings contribute to the current scientific literature in both Management and Complexity Management. Since there are several scientific researches that demonstrate the problematization regarding Complexity Management, hence there is a gap showing how complexity is being managed. We believe that by illustrating a real life example providing an insight in how industrial organizations manage complexity of product offerings will give a comprehensive understanding of the topic and further provide a foundation for further research within the field.

2.6 Quality Criteria

2.6.1 Reliability

The goal of reliability, explained by Yin (2009) is to reduce and minimize bias and errors related to the study. We are conscious of the fact that one interview affects the reliability of our thesis. Though we argue that the primary data we gathered is of high quality as the respondent actively works with managing complexity on daily basis. The extent to which research findings can be replicated namely reliability (Merriam, 1998) is in our study secondary to authenticity in regards to the purpose of our thesis. As the way Division X

manages complexity today might change, thus repeatability is not a relevant determinant. Thus, of more importance is as we decided upon a qualitative approach that reliability arises when the results is in accordance with the collected data, rather than to which level the findings can be replicated (Merriam, 1998). We further accurately gathered and selected the data that was useful for the study to be of great value and quality thereby also verify reliability of our result.

2.6.2 Validity

Collecting our data through an open interview allowed for at ease interview setting and made it possible for us to interpose and ask follow up questions, with the purpose to clarify our questions and to avoid misunderstandings. During the interview we both took notes and recorded the entire interview, as a source of evidence and to assess the validity of this study. The collected data was, soon after the interview documented and can be traced back to the interviewee. Furthermore, we have throughout our research process had regular communication with our supervisor, Roger Schweizer, for valuable inputs in order to enhance the quality of the research. Validity is according to Mehrens and Lehman (1987) explained as truthfulness and if it measured what it intended to measure. Thus with that we argue that our mentioned efforts have established measurements to ensure the thesis validity.

CHAPTER 3 – THEORETICAL FRAMEWORK

The following chapter presents the selected theoretical framework consisting of legitimate research literature and articles. Seeing to that our study is of abductive sort, the need for further theories has evolved in line with that our research has progressed. We initiate the chapter by presenting the current scientific view of complexity followed by Complexity Management theory. Thereafter, we complement this chapter by introducing Product Development and Strategy Implementation theory. Thus we have incorporated different fields of research that all relates to our research question, enabling us to make an accurate analysis of the empirical study. Hence, the framework aids the purpose of our thesis to see how industrial organizations manage the complexity of product offerings.

3.1 Complexity in its Contexts

Complexity is a widely used term which there is no generally accepted definition of. Though, a comprehensive definition of complexity is the focus of differentiation, the number of relevant dimensions and the integration among these dimensions (Streufert and Swezey, 1986). To set complexity in context, Galsworth (1994) explains that a product is considered complex when there are only a few shared items among its variants and plenty of unique items. Strengthened further by Hobday, (1997) stating that complexity as a term can also be used to reflect the amount of customized items. Moreover, complexity can be considered as several methods to reach the same result. To exemplify there exists plenty of different methods in how to fasten a component such as clips, screws, clamps etc., depending on what choice of product variant (Dommartin, 1999). From a manufacturing system point of view Ulrich (1995) states that complexity can arise from variety of inputs, outputs and the transforming process.

3.2 Complexity Dimensions

Wilson and Perumal (2010) present three different dimensions of complexity: *Product, Process and Organizational Complexity*. Each complexity dimension has an impact on the other and the authors' states that to be able to handle complexity in one dimension is pointless if you are unable to attack the issue in the context of the other dimensions.

3.2.1 Product Dimension

In accordance with the concept of complexity, the dimension of *product complexity* is a common term without a generally accepted definition. Due to the simple reality that what is product complexity for one might differ greatly between, but also within, different industries

and market segments as it likely has different demands on its products. Wilson and Perumal (2010) describe product complexity as the variety of and within the products or services you offer your customers. Not enough variety will leave a company struggling to compete, but too much variety will saddle a company with cost, impairing its ability to deliver and in some cases frustrating its customers with too much choice. All variety adds costs to a business, but not all of it is sufficiently valued by customers. Product complexity regarded from two perspectives. On the one part it is necessary to fulfil the requirements of a complex market (Bohne, 1998). That is, if an advanced product with plenty of characteristics is demanded by the customer as well as a great level of product variety then there is a need to develop a complex product. This kind of product complexity is necessary in order to create a product which the customers value (Bohne, 1998). On the other part product complexity can be negative (Bliss, 2000). This occurs when the level of complexity for a product surpasses the level of complexity demanded by the market. Consequently unnecessary complexity is generated meanwhile no additional customer value is added. Bliss (2000) points out that products nowadays are becoming increasingly complex, making organizations lose control over the degree of product complexity. With the amount of complexity increasing unintentionally the product complexity does not correspond to the complexity demanded by the market no longer. To be able to assess whether one is dealing with necessary or unnecessary product complexity it is essential to be able to measure product complexity. The measures of product complexity are used to research the impacts of product complexity on e.g. lot sizing, inventory stock levels or production process complexity. The general idea is that the less product complexity created the better it is for the company's operations. This is supported by Sum et al (1993) explaining that less product complexity results in lower inventory levels, less complex material flows and lower production costs. Since product complexity is generally regarded as having negative impacts on the company's operations it should be reduced to the amount of unnecessary product complexity which is needed to fulfil market demands (Sum, et al.,1993).

3.2.2 Process Dimension

Regarding processes, various process stages can entail several and perhaps difficult to comprehend interactions, these interactions represent process complexity according to Buchanan and Bessant (1985). Furthermore, within the scientific literature it allows the definition of process complexity to be divided into two components: detailed and dynamic complexity (Bozart et al., 2009; Sterman, 2000). Detailed complexity explains the different amount of components or parts involved to create a system. Whereas, the dynamic complexity concerns the unforeseeable response within systems to new inputs. Complexity within the process affects the whole supply chain and results in higher manufacturing costs

and impacts scheduling optimization (Bozart, 2009). Additionally, Wilson and Perumal (2010) explain process complexity with the amount of processes, process steps and handoffs that it takes to executing and deliver the outcome of a product. The previous linear process from the industrial era is no longer the general way of how to operate. The process complexity has expanded with, for example, new process steps in line with the expansion of channels and product variety which easily can consume an unbalanced amount of time and costs that impacts the organization (Bozart, 2009).

3.2.3 Organization dimension

As stated above organizations are impacted by the different processes and product varieties. According to Dooley (2002) organizational complexity can be described as the level of differentiation that exists within different departments or business areas that represents the organization. This is incoherence with Wilson and Perumal (2010) explanation of organizational complexity by the number of facilities, assets, functional entities, organizational units, systems that are involved in the executing process of the organization.

Organizational complexity often accumulates due decisions, at management level, to expand the organization's product portfolio. To exemplify managers attempt to maximize scale as well as to attain and maintain a close customer relationship often generates a complex matrix structure, duplicated costs at various levels and absence of clearly defined accountabilities. Dooley (2002) explains that though every managerial decision might make perfect sense at the time, few organizations assess the impact these decision has on the general organizational complexity.

3.3 Complexity Management

How to manage the above mentioned complexity and attain a balance between the market benefits of greater customized solutions and the accompanied internal costs is yet a great challenge. This prevailing issue is what is being tackled within the scientific field of Complexity Management. To clarify, as stated in the introduction Complexity Management is a business approach that handles investigation, evaluation and optimization of complexity within organizations (Marti, 2007). Since complexity has an impact on the value chains business processes, Marti (2007) states that it is of essence for management to have a holistic approach i.e. utilize complexity management.

As previously mentioned in the problem discussion Complexity Management can be divided into external and internal aspects. The external complexity is in line with customer's requirements of more and more specific and individualized demands of products offerings. To satisfy the market need companies offers a greater variety and expand the product

portfolio to reach their customers by offering more customized products, services and solutions. Part from the direct impact on product complexity, the external impact affects the whole organization i.e. production, product development, logistics and sales and causes thereby internal complexity (Schuh and Schwenk, 2001; Kaiser, 1995; Bliss, 2000). Furthermore, as the individualized demands are not likely to decrease this emphasizes that the external influence of complexity will remain (Bliss, 2000). The internal complexity, can however be reduced by having the product and process performance being optimized (Müller, 1998). Thus, from a complexity management perspective, mass customization represents the equalization of external and internal complexity and thus the determinant for attaining the optimum compromise between the two (Marti, 2007). Importantly to note is that within the field of mass customization the emphasis lies on strategic elements on the implementation of how to actually produce customized products for a mass market. Whereas, within Complexity Management product architecture and quantification of complexity are also of essence.

3.3.1. Tools for Managing Complexity

Complexity Management is utilized in order to optimize complexity of *per se* products and this theoretical section presents actual tools to accomplish this. The Quality Function Deployment (QFD) is a tool that aims to derive technical product specifications from customers' needs and wants. There is no set procedure of implementing QFD, most organizations and or divisions would customize its QFD tool. Though, there are common features and procedures amongst how the procedure of using QFD takes form, explained here next (Johnson, 2003). Generally QFD starts by attempting to answer the question of what customers wants and thus specify customer requirements thereafter the recognized requirements are to be weighed and determined the suitability to the application of context. Further an evaluation of its competitors is carried out from a customer perspective, revealing opportunities for improvement of one's own product as well as clarifying the strategic positioning of the product. Leading to the process of identifying and specifying the technical requirements. Then within the QFD comes the part where acknowledged customer and technical requirements meets, the functional areas as R&D, marketing, sales and production (Seghezzi, 2003). Further, there is the need to consider and establish correlations of the technical requirements and thereafter a new competitor evaluation regarding the product is conducted though now from a technical point of view. Hereafter the technical requirements are to be addressed and weighed, if they are needed or not. The next proceeding of the QFD tool is to from engineering's perspective indicate the technical difficulty of meeting the technical requirements. Last but not least based on the comparison of the company's own

and the competitor's products, target values for the technical requirements are to be defined (Johnson, 2003).

Burn (1990) explains that the very strength of the QFD tool is that it requires engagement from team representatives from different disciplines that together ascertain a united view on how to best present customer requirements. The acknowledged downside of the procedure of QFD is that it is a demanding one; (Seghezzi, 2003) stresses that the required amount of marketing and technical data needed to be gathered and be pieced together results in practical implications. Though, Griffin (1992) points out that the tool of QFD can serve essential ungraspable benefits, for example cut cross-functional obstacle and thus ease potential changes in corporate culture. However QFD does not put emphasis on the product architecture and strategic aspects nor does this tool consider quantification of product complexity. The Quality Function Deployment is a structured tool that is a part of the management of complexity when there is need to gather and quantitatively evaluate customer requirements.

Additionally, within complexity management product complexity can be addressed by Product Modularization. In contrast to QFD, Product Modularization integrates product architecture. Here products are defined as modular's which constitutes of numerous rather independent modules that utilizes common decoupled interfaces with the result of functioning as an integrated whole (Balwin & Clark, 1997). From a complexity management perspective the purpose of utilizing product modularization is to enhance the development process, improve the capability to adjust to business environment changes and also cut cost as the interdependencies are reduced between modules of a product (Thomke & Reinertsen, 1998). The tool that supports the development of modular products within this area is referred to as Modular Function Deployment (MFD). There is no given MFD procedure though there is a standard practice. In line with QFD the initial stage within MFD is to, from a market perspective, identify customer requirements. Thereafter the acknowledged customer requirements are to be divided into different functions and focus shifts to choose appropriate technical solutions for each function. Additionally the different functions are assessed in regards to module drivers, which differ within different organizations. If found that functions share similar module drivers, then an investigation is conducted to see if the functions can be integrated into one single module Erixon (1998). As stated previously there are no set procedures for the tools of neither QFD nor MFD though both can be utilized as to manage the complexity attached to developing products.

3.4 Product Development

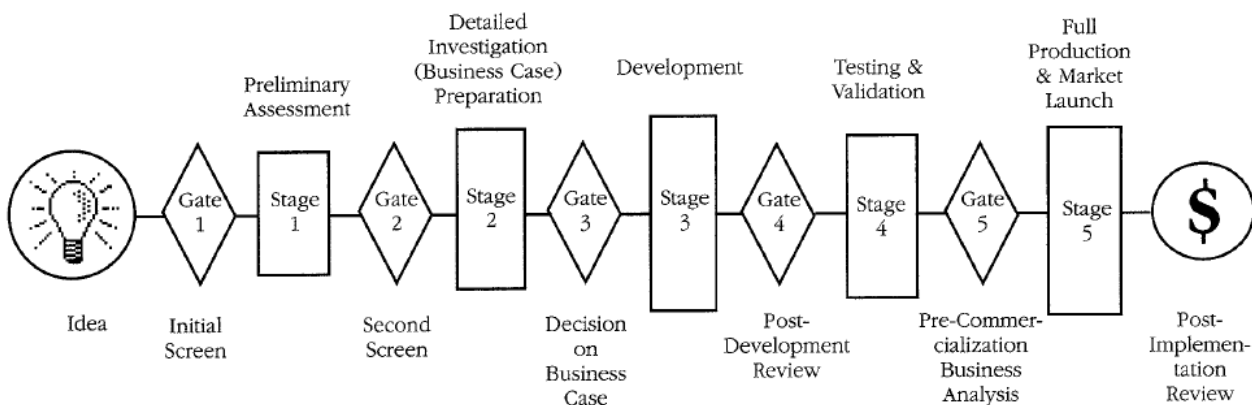
The scientific field of Management defines product development as a set of activities that transforms the concept of a market opportunity into a product offered for sale (Krishnan and Ulrich, 2001). New product offerings are main competitive tools within many organizations, which have made product development a key necessity in order to strengthen or maintain desired market position. Innovative firms further practice development to increase customer demands or to create new markets (Bhimani and Mulder, 2001). Thus, product development is among the essential processes for success, survival and renewal of organizations, particularly for firms in either fast-paced or competitive markets. Thus, product development is a potential source of competitive advantage for many firms (Noble, 1999)

3.4.1 Product Development Process

According to Rosenau (1988) the product development process has progressed from being managed and moving sequentially through strategic planning and concept generation, development, and commercialization to a process that recognizes and manages the overlapping nature of the different phases of product development. Currently within the field of new product development processes there exists various amount of models, though the basic progression of process activities are quite alike. Commonly the product idea is assessed early on in the process, with the market opportunity and customer needs in mind. If these dimensions are positively assessed the idea is thereafter refined, its technical feasibility is investigated and the design phase starts to take place. A trend has emerged during the last two decades, where structured approaches regarding how to manage new product development processes are frequently established and embraced. One of which is presented by Cooper (1990) as he proposes a seven stage *new product development process* ranging from idea to launch. Here, in advance, the innovation process is separated into different stages, each of which compounds of prescribed, related and often parallel activities. This approach is what Cooper (1990) refers to as stage gates which operates as a quality check and fundamentally demands specific criteria to be compiled before authorizing the project to be continued. The amount of stages and gates varies among companies, however in common is that the purpose is to attempt to manage risks and increase efficiency by establishing a well arranged development process that necessitates questions to be tackled at the start of the process.

To illustrate Cooper (1990) presents an overview of a general stage-gate system, which is common within manufacturing companies, see the figure 1 featured below.

An Overview of a Stage-Gate System



Source: Figure 1, An Overview of Stage-Gate System, Cooper, (1990) p. 49

The *New Product Process* evolves from the generation of an idea, which then is submitted to Gate 1, the *Initial Screen*. This phase involves a first gentle screening where different criteria must and should be met as to see that the idea is in line with the organization's core business, resources and strategy. Thereafter it is time for the *Preliminary Assessment*, Stage 1, here the development and manufacturing feasibility as well as possible costs and execution time is to be evaluated. The recent gathered information is reassessed when moving onward to Gate 2, the *Second Screen*. Then comes Stage 2, *Detailed investigation (business base) preparation*, which is where the project needs to be clearly defined. The attractiveness of the product idea need to be verified as this is the final stage prior to product development. Additionally, customer needs must be viable both from a technically and economical perspective. Hereafter it is time in the process to take a decision on the business case at stage 3 prior to the *Development Stage*. The project is scrutinized once more as this is the last phase where the project can be stopped prior to involving great costs. If the project passes this gate it moves on to *Development* in Stage 3 where detailed tests, marketing, operation plans and financial analysis are involved as to develop the product further. At Gate 4, *Post Development Review*, the product and projects attractiveness is once more checked upon as well as that the progress corresponds to the set quality requirements. The next stage tests the entire viability of the project, namely Stage 4, *Testing and Validation*. At this stage several activities are engaged such as product quality and performance testing, trial production, test sales and financial analysis. After Stage 4 the project reaches Gate 5 the *Pre Commercialization Business Analysis*. If passing through this gate the project can no longer be killed, thus the gate focuses on the prior gathered results and financial projections. If decided to let the project proceed the operations and marketing plans are reviewed once more and then approved for implementation in Stage 5. Once in

Stage 5, *Full Production and Market Launch*, the marketing launch plan and the operations plan are followed through. Finally at some point after the project's product has been commercialized the project and product's performance is reviewed, which in Cooper (1990) model is referred to as the *Post Implementation Review*. This describes a structured approach of how to manage new product development processes.

3.5 Strategy Implementation

The view of strategy has evolved over time from being something organizations has, to also increasingly being viewed as something organizations practice (Hambrick 2004; Jarzabkowski 2004). Further, as stated by Roos and Von Krogh (1998), organizations works differently thus there is no given method when it comes to strategy. Johnson (2011) elaborates further regarding strategy and explains that strategy regards an organizations course and magnitude in the long run, with the objective of creating advantages to the company. This to be achieved by employing the accurate utilization of resources in a competitive milieu, as well as to correspond to market stakeholders' anticipations. Regarding implementation Hrebiniak and Joyce (1984) explains it as activities designed to control executions with respect to the intended outcomes, the activities concerns organizational structures, control systems and actions from key employees. To illustrate the correlation between strategy and implementation Roos and Von Krogh (1998) explains strategy as a linear process, which involves a formulation, implementation and execution. Whereas, implementation is explained as related actions to be conducted in a company with the purpose to achieve the desired strategy.

Furthermore, Harrington (2006) states that the process of implementing programs, policies, strategies and action plans is an iterative process, namely Strategy Implementation. This allows organizations to manage its resources and benefit from opportunities in the competitive business environment. Moreover, Thompson (1992) emphasises that it is of essence that organizations are united with proficient colleagues, towards objectives, as it requires dedication and incentive to attain specific objectives. Thompson (1992) argues that set objectives are attained by the transformation of a strategic plan into actions i.e. strategy implementation. Agreed within strategy implementation theories, is that this field is of necessity in order for strategic decisions to be realized. However in reality far more is demanded as to bridge the differences between wished and actual strategy (Roos & Von Krogh, 1994).

Mintzberg and Waters (1985) researched the relationship between leadership plans and intentions and what the organizations actually did by investigating strategy as patterns of actions and not decision. They argue that the formation of strategy has two sides, one

deliberate and one emergent, illustrate in a model presented below in figure 2. For a strategy to be considered entirely deliberate, that is to be realized exactly as intended, three conditions needs to be fulfilled. First of all the strategy must involve concrete and exact intentions that are communicated at a detailed level to all actors, to eliminate doubtfulness of what was desired before any changes were made. Secondly to exclude any doubt concerning if the intentions were a collective action within the organization, as the intentions likely were a response to some sort of controls, they must have been common amongst nearly all actors either shared as their own or accepted from managers. Thirdly it's essential that these collective intentions were realized exactly according to the initial plan. Meaning that the environment must have been completely predictable and possible for the organization to control as well as no external factors such as the market, technology or politics affected the strategy in any way. Regarding entirely emergent strategy it implies that there were no intention behind the strategy, no consistency or at least that the unrealized strategy intentions had not met. Mintzberg and Waters (1985) means that the emergent strategy originates from the interaction between the organization and its environment and not from the conviction of a strategist. The thought of an action being entirely absent from intention is highly unlikely as would be the expectation of the perfectly emergent strategy as well as the perfectly deliberated one. However, Mintzberg and Waters (1985) argue that its research purposes that certain patterns come quite close.

Types of Strategies

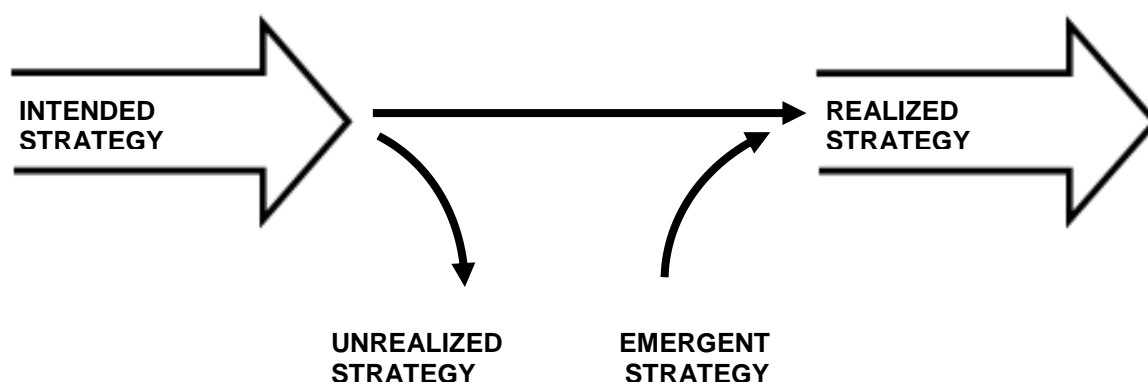


Figure 2, *Types of Strategies*, Mintzberg and Waters (1985) p.258

CHAPTER 4 - EMPIRICAL FINDINGS

This chapter comprises of our empirical findings obtained from the conducted interview with the Product Manager at Division X, thus the presented findings are the perception of the one respondent. We initiate this section by presenting the view of complexity at Division X. Thereafter, we elaborately explain the process within Division X when taking a product from idea to commercialization, referred to as the New Market Offer Process. Further we present the Product Development Process which is integrated and runs parallel with the previously mentioned process.

4.1 View of Complexity

Division X considers its operations to be highly affected by complexity surrounding its business field. To illustrate it experiences complexity from an external perspective, this is influenced by customers changing demands and competitors changing offerings. These influences results to additional complexity arising within Division X, from an internal perspective. Furthermore the efforts conducted as a response to meet customer demands or to differentiate from competitors offers, i.e. introducing new products variants, inevitably subjects the organizational operations to internal complexity. Moreover, as part of an industrial organization Division X sees it as an immense complexity to remove product characteristics, as it is not entirely aware of whom the end customers are at the distributors. Thus, it cannot be sure for which reasons or characteristics the customers purchase its items, which further indicate that product complexity is a prevailing part of Division X products offerings. Additional experienced complexity is attached to when determining how many attributes a product variant should and can attain as it might be regarded as unnecessary for the customers rather than adding value. Furthermore an important aspect to have in consideration is that when adding on a characteristic to a product it is necessary that the product is still compatible i.e. does not set barriers for other products. Perhaps the most difficult, though necessary, aspect regarding product complexity for Division X is to predict upcoming customer needs.

Furthermore, Division X approach to address complexity is by obtaining a standard product stock that can meet most requirements by providing, in the main product directory, different product sizes with different variants. Preferably there is no need for additional variants however if required the aim is that the new aspect of a variant should be applied as late as possible in the manufacturing process. This strategy is enabled as Division X utilizes modular at assembly, as Division X wants to stay as cost efficient as possible. Additionally, when introducing new variants there is the prevailing risk of diminishing sales of other own

products. However, that is a preferred scenario rather than that a competitor is the underlying reason for loss in sales of a product. Finally, it is essential that the Product Manager has a holistic view and understands the entire process from generating ideas to commercialization of a product offering. Hence, in order to obtain a holistic view the Product Manager needs to, in some way or another, be involved in the entire process taking a new product offer to commercialization. This process is specific and predetermined within Division X organization and entitled The New Market Offer, described elaborately in the following section.

4.2 New Market Offer

When Division X addresses a new business case, i.e. adding a new characteristic or product to the existing offerings it has as stated in the paragraph above a certain order of procedure, referred to as New Market Offer (NMO). This procedure generally has a time span of eight years. Importantly, in order for a product idea to even be considered it needs to be built upon a business case of relevance; here the innovation costs should be taken into consideration along with the market needs. When Division X develops its product portfolio it aims to define the very reason why there is a need for development, hence identifying the core problem. To exemplify with a scenario; if a customer expresses the desire for a product to be cheaper, Division X will rather enhance the utility of the product than offering it for a lower price. By doing so the product life cycle of approximately 15 years is prolonged and the product ends up being cheaper for the customer. This also allows Division X to stay in line with the organization identity by this approach to try to fulfil customer satisfaction with expertise rather than low price strategy.

4.2.1 New Market Offer Process

The New Market Offer Process is initiated when ideas are generated which occurs on a regular basis, coming either from the Business Unit (BU), Product Line or from the different segments. Reflections of how to bring the product to the market and a cost analysis should be done before presenting and motivate the idea to the local Portfolio Board. A pre study is then initiated where questions regarding how to for example solve the problem behind the idea, what characteristics it should attain, how it affects the manufacturing and if it is worth to proceed with the idea. This step is then followed by a phase of *predictions* and *forecasts*, where the Product Manager runs activities that try to predict the next generations need this by illustrating a matrix chart to attempt to see connections and make certain conclusions. Thereafter the product manager turns to the concerned segment to see if it regards the idea to be realized. Furthermore, importantly, the product managers' products must comply with the other product managers' products this so that new variants do not put up barriers for

other product divisions. In order to try to avoid this scenario Division X has a Central Management where all product managers within the organization meet and give input regarding how they wish that the future should turn out, thus mutually agree upon a plausible future market need. The next step, *development*, is where the Product Manager evaluated the situation to see if and how the new product should be introduced to the market. Commonly conducted at this step is pilot testing of customers, where the Product Manager attempts to reach out to the leaders within the industry. The final step before the *close out* is the *launch preparation* where a meeting is held with participants such as board of directors, managers within manufacturing, sales, segments and product development. From here the business case reaches its final evaluation stage to see if it should be launched to the market or not. However, for a new offering to be approved it must also have made it through the Product Development Process which is integrated and runs parallel with the NMO process. If approved, the new offering will be launched at one of the two existing release dates of each year.

4.2.2. Product Development Process

When an idea has been established within Division X it will be brought into the product development process to examine if the idea is suitable for the NMO process and hopefully eventually reach the stage of commercialization. The Product Manager explained Division X product development process, here next illustrated by a frequently occurring scenario when an idea is derived from a customer problem.

Firstly the *idea* is clarified and delimitations of the idea have to be appointed thereafter the *requirement specifications* are to be determined. The next step is to within the prior established frame conduct *concept generation* and *selection*. Information about the idea is gathered and studied then if *per se* it regards a problem it should be defined and attain an understanding of the problem and the needs. There is a search externally which could involve interviews with lead users, consult experts, benchmark related products then there is an internal search involving individual and or group brainstorming, scenarios and observations. Thus, in order to attain an understanding of the problem and the needs, information about the idea is gathered and studied. Hereafter, comes the *embodiment design* process where the abstract conceptual path, chosen in the previous conceptual design phase, is meld into a system that can actually be produced. Areas that covered include a definitive layout, preliminary form design, preliminary production information, materials and process selection and process selection and industrial design. This phase outlines a bridge between the conceptual stage of the design process and the detail design stage. In the following stage of *detailed design* previously acknowledged concept alternatives, preliminary physical architectures, design specifications and technical requirements are transformed into

final cross-disciplinary design definitions. The two final steps before the *handover* are *verification* and *validation* and require security testing's and pilot trials. After its final pre testing's and pilot trials the product reaches its final stage called *handover* meaning that the product moves from the Product Development Process back to the development phase in the NMO process to awaiting the approval decision of being launched. Noteworthy is that after each stage the product goes through a technical gate to ensure it corresponds to the expected requirements of each phase within the New Product Development Process. The Product Manager upholds a holistic view of the procedure and is somewhat involved and informed in every stage of the NMO process, including the PD process. Thus he states that he is highly dependent on his college's professional capabilities within the different departments to reach the outcome of a new product offering. To specify with an example, the segments need to be deeply involved within their industries in order to recognize and capture future and existing needs before the industry itself but most important before its competitors. Furthermore employees within the development and design sections need to attain a real good technical expertise and know how in order to optimize and construct the best quality design and characteristics of the product that will be cost and time efficient in the manufacturing process. To be noticed is also that managers are playing a significant role in to guide and motivate staff and further control the time frame and make sure that the each of the different process steps runs in line with the expectations.

CHAPTER 5 - ANALYSIS

In the sequent section a carefully conducted analysis is presented of how Division X manage complexity of product offerings. The analysis is deduced from the empirical findings obtained from our conducted case study and the discussion is aided by the previously outlined theoretical framework. Firstly, we highlight that it is evident that complexity exists and that it is three-dimensional. Thereafter, we outline that there is an acceptance of complexity, which then leads us to discuss how complexity is managed. The structured manner of our analysis gives us a scientifically legitimate foundation, which lays the ground for our derived conclusions presented in the following chapter.

5.1 Existence of Complexity

Division X acknowledges that complexity has a great impact on its operations regarding product offerings. In the first section of the analysis we utilize Wilson and Perumal (2010) three different dimensions of complexity: *Product, Process and Organizational Complexity*, this as to aid the discussion of the existence of complexity.

5.1.1 Existence of Product Complexity

The main and evident demonstration that product complexity is present in Division X operations is the experienced unawareness of for which reasons or characteristics the customers purchase its items. Bohnes (1998) states that all variety adds costs to a business, but not all of it is sufficiently valued by customers or as Bliss (2000) addresses it, that negative complexity is that of which occurs when the level of complexity for a product surpasses the level of complexity demanded by the market. However as the main part of Division X product sales goes through distributors the order placed by the distributors to Division X, can reveal which products that are demanded but not the underlying reason for which characteristics the product is desired. Thus this existence of product complexity is considered within Division X to hamper its ability determine how many attributes a product variant optimally should and can attain, as stated added characteristics might be regarded as unnecessary for the customers rather than adding value. Additionally acknowledged by Division X there is another dilemma, the prevailing risk of diminishing sales of other own products when introducing a new product offer. Though Division X sees it as an aspect of control, and prefers that it is one of its own products that are the reason for loss in sales of another product, rather than due to competitor efforts. Furthermore explained by Sum et al. (1993) is that less product complexity results in lower inventory levels, less complex material flows and lower production costs. Within Division X the opinion is that the less product complexity created the better it is for the Division X's operations; the Product Manager

explains that Division X obtains a standard product stock that can meet most requirements by providing, in the main product directory, different product sizes with different variants. This as Division X understands that product complexity exist with the understanding that it also believes that when adding on additional product offer to the product portfolio it opens up for further complexity.

5.1.2 Existence of Process Complexity

The existence of complexity becomes obvious within Division X processes when altering a product offering as it subsequently affects the product process itself. Boarts (2009) states that process complexity has expanded from a general linear process to more steps and channels. Division X has when a new idea is to be translated into a product, two intertwined processes which runs parallel and are set up to be dependent on communication and control at different stages throughout the process, in order be able to proceed further. Here it experiences process complexity as illustrated by an example it would be easier for an engineer in the development process to independently proceed with the product idea throughout the entire process than as it is now has to communicate and obtain information and directions from staff involved within the parallel NMO process. Wilson and Perumal (2010) explain that process complexity is affected by the amount of processes, process steps and handoffs that it takes to execute and deliver the outcome of a product. As Division X experiences unpredictable process complexity as it emerges within the different process stages as well as from external and internal factors. Where external factors could be the input from new developed technology and the internal could be insight from segments or board members. However, the internal complexity can be reduced by having the product and process performance being optimized (Müller, 1998).

5.1.3 Existence of Organizational Complexity

The organizational decision to run two interdependent processes parallel with the requirement of communication and providing status reports when taking a product from idea to commercialization creates complexity within the organization of Division X. Further, as Wilson and Perumal (2010) states that organizational complexity increases by the number of facilities, assets, functional entities, organizational units, systems that are involved in the executing process of the organization. In fact complexity is imbued within Division X as the process to develop a product is setup as such that the idea is required to pass through several stages and requires the participation of several stakeholders. With the decision of having two parallel processes, organizational complexity naturally prevails as employees within different departments needs to communicate and cooperate in order to take the

product idea to the next step within the process. Though, Division X experiences the dilemma of that there is a need for special expertise from staff from different departments to make a successful outcome of a product offer at the same time it is complex to handle participation of several parties. To illustrate with an example, the segments need to have high expertise to be able to identify core problems and future needs. To be able to identify core problems they need to possess the ability to identify core problems that the industries do not find and it's essential to predict future needs long before the competitors. Moreover Division X is in need of technical expertise and knowhow in order to select and construct the design of the product, different managerial positions are also required in order to guide staff, control the time frame and ensure that the process runs in accordance to expectations. Moreover addressed by Marti (2007) it is of essence for management to have a holistic approach, which is regarded as true at Division X. Though this also reflects as creating organizational complexity within Division X as the product manager has obtained a holistic view as a result of being involved in somewhat every step of the entire procedure of developing and introducing a product offering.

5.1.4 Three Dimensional Complexity

Above we have clarified that complexity exist within product, process and organizational dimensions, though not only does it exist it correlates. Thus, complexity is three-dimensional. Due to the fact that the very issue with complexity is that it's not graspable we cannot visualize it in a figure. However, as it exists within Division X we can aid the comprehension of our discussion by illustrating, in a figure below, where complexity can exist when taking a new product offer idea into the organizationally predetermined NMO and PD processes. To accentuate complexity can exist in all stages illustrated in the figure below.

New Product Offering – Process from Idea to Launch



An example follows here as to demonstrate that complexity is in fact three-dimensional that is that product, process and organizational complexity correlates. As Division X already in the

NMO process initial stage, *the prestudy*, meets the complexity of determining how many attributes a product variant optimally should and can obtain. With, the complexity prevailing in the unawareness of which product characteristics are regarded as adding value rather than unnecessary for the customers. Further this existence of product complexity also inflicts process complexity as for example within the parallel run PD process one must now see if the product idea with the determined product characteristics is suitable to proceed within the NMO process. With the process complexity arising with the necessity to involve several stakeholders and obtaining insights from leading customers, segments and/or board members. Insights which additionally might lead to the need to add process stages in order to realize the product offer idea. Additionally the decision to add a process stage is an organizational decision which on the one hand it is a self creating complexity on the other hand it provides a structure of process stages as how to realize a product idea. Thus if complexity exists regarding a product idea not only does it affect the product but also processes and the organization itself, as everything interlinks. Thus implying, as Wilson and Perumal (2010) explains, that if complexity comes across in one dimension it also exist in the context of the other dimensions.

5.2 Acceptance of Complexity

As above concretely portrayed, complexity exists within the product, process and organizational dimensions. Though, whereas the literature emphasizes on defining and explaining what complexity entails for companies the case showed that Division X did not share that focus. It does not focus resources to determine what complexity means for it this as Division X not only expects complexity to arise but also accepts its very existence. This due to its experiences and understanding that with the general time span of eight years that it takes to introduce a new product offer, it makes little to no sense to attempt to define complexity as it not yet knows what the future might hold. Hence, an acceptance of complexity has evolved, subsequently leading to the realization that it is not a question of how complexity is managed in reality as we initially thought. Rather the perspective has gone from managing the complexity to managing under complexity.

5.3 Managing of Complexity

Since Division X are well aware of the existence of complexity affecting its operations and accepts that that is the case it subsequently leads to the, as stated above, understanding that Division X instead of managing the complexity is in reality managing under complexity. Since Division X expects future influencing factors, of both external and internal kind and thus accepts that it is subjected to complexity it therefore makes little sense to plan, as it

does not know what to plan for. Thus, focus of its operations lies upon actions. Further as complexity can be considered as several methods to reach the same result (Dommartin, 1999) and the fact that Division X is a part of a large global organization, there must exist a certain procedure when *per se* developing a product as to not be crippled by the existence of complexity. Cooper (1990) presents a stage gate system as to structure the product development process so that it operates as a quality check, which fundamentally demands specific criteria to be compiled before authorizing the project to be continued. Found were that the parent organization has set as previously mentioned two interdependent processes namely the PD and NMO processes within which there are different stages, thus setting up different target objective over the years that it takes to bring forth a product idea to commercialization. Though within these different stages they expect complexity to arise. However, it enables Division X to operate under those conditions by utilizing the processes as to facilitate the comprehension of which elements, expertise thus also which participants are needed to be involved in the process of realizing an idea. This aids the progress and enables the facts that focus lies upon actions. Moreover, Marti (2007) presents QFD as a tool that can be utilized when managing complexity when going from reflections to action, in regards to customer needs and wants. As Division X experiences a great complexity regarding what characteristics its products should attain this as it is not aware for which reasons and characteristics the general customer purchases its products. The different Product Managers addresses that constantly prevailing complexity by having discussions amongst themselves regarding of how they want the future market to be in terms of its products. Additionally, in order to try to answer the question of what customers needs and wants from its products Division X communicates with segments and large customers. From that aims to derive technical product specifications from what they have decided to be the customers' needs and wants. Further Marti (2007) explains that MFD can be utilized as a tool of managing complexity, as to enhance the development process. Division X employs MFD as it realizes that by utilizing the same basis for products, to the greatest extent possible, it results in the involvement of less stages, processes and participants all where complexity can arise. This with the main underlying reason and belief, that this will be most cost efficient. A perception shared by Thomke and Reinertsen (1998) statement that MFDs main purpose is to reduce cost and facilitate development of product offerings. From Division X perspective MFD is not a tool for managing complexity rather it is viewed as a cost efficient tool used in a product development process that is subjected to complexity.

Further, in research conducted by Mintzberg and Waters already in the year of 1985 they paid particular attention to exploring the relationship between leadership plans and intentions and what the organizations actually did by studying strategy as patterns of actions and not decision. Leading to the reflection that as Division X is not aware of what future

complexity will come to involve, it does not waste resources on planning how to manage complexity. Though needless to say the process to bring a product needs to start somewhere. Thus within Division X it starts with an intended strategy, as how to realize a new product, though as it anticipate and accept influencing factors of both external and internal kind Division X realizes that it will not fall out as initially intended. Hence, Division X is aware that it needs to start at one point but as in the terms of Mintzberg and Waters (1985) it does not see it as being purely deliberate and be realized as initially thought. Neither does Division X think that its strategy will be purely emergent as the thought of an action being entirely absent from intention, is highly unlikely as would be the expectation of the perfectly emergent strategy as well as the perfectly deliberated one. Thus as previously mentioned, Division X accepts the existence of complexity and therefore it does not strive to manage it instead it manages under complexity. Since it obtains the knowledge that by having a set structured procedure as to bring *per se* a new product idea to commercialization it enables that focus can lie upon actions.

CHAPTER 6 - CONCLUSIONS

In this following and final chapter we present our conclusions drawn from the conducted research. We set off by answering the research question based upon the understanding obtained from the discussion in the previous chapter. Thereafter we outline the thesis contribution as well as reflecting upon criticism to the research. Then we provide advice regarding managerial implications, where after we enclose the chapter and the research itself by presenting suggestions of further research.

6.1 Research Conclusion

The thesis research began as we found that within current literature of managing complexity the emphasis lays on describing what complexity is and what it entails for organizations, rather than how to manage it. Thus, we were intrigued to investigate how organizations actually manage the complexity. As to find out this, we conducted a case study where we found that in contrast to current scientific literature it's not about descriptions and assessments it is in reality about actions. To clarify, as our case study revealed Division X is highly aware of that complexity exists and affects its operations and as it cannot know what the future will hold it does not attempt to handle complexity before it emerges instead Division X accepts its existence. Thus as we have obtained an in depth understanding of the specific field of area, we when answering our research question "*how do industrial organizations manage the complexity of product offerings*" bluntly answer it do not manage the complexity it manages under complexity through actions. As Mintzberg and Waters concluded already in the year of 1985, it's about the actions not the decisions. In reality we found that there are intended patterns of actions though they are not purely deliberate nor are the actions entirely absent from intention thus not entirely emergent. To accentuate, our real-life example illustrates that regarding product offerings industrial organizations operates under complexity within a set structured procedure enabling focus to lie upon actions.

6.2 Criticism to Research

By conducting a case study on solely one product division within an organization and utilizing the obtained empirical findings from one out of two conducted interviews, our research could possibly be biased. This as if we had conducted interviews with additional employees at the case company who were involved in Division X's product offerings, we might have ended up with different result and drawn conclusions. Though, as we have from the beginning of our case study have had this knowledge, that the study might be considered biased, we have kept it in mind throughout the research. Furthermore regarding the decision to base the empirical section on the one respondent answers, was from our standpoint a manner of

quality assurance as it was one of the respondents that directly contributed to the research problem. Hence, we have aspired to fortify the validity of our research. Additionally, as the purpose of our thesis was to see how an industrial organization manages the complexity of product offerings we argue that a case study approach enabled us to conduct an in-depth interview resulting in us obtaining access to confidential information of great significance for the analysis and conclusions of this thesis. Finally, as to strengthen the validity of our research we have throughout the thesis process reflected upon our way of procedure from a critical point of view.

6.3 Thesis Contribution

Firstly, the thesis contributes as it identifies and highlights the research gap between scientific comprehension and real-life practice regarding managing complexity. Though, the main and highly significant contribution of our thesis is the provided insight that the existence of complexity is *accepted* within the industry. Subsequently we also contribute with the understanding that the industries do not manage the complexity it manages under complexity.

6.4 Managerial Implications

In addition to the theoretical contributions described in the previous section, this study has provided new insights for applied business management. The research gives a practical contribution which ought to be of interest to managers within industrial organizations. That it is of essence to obtain an awareness of the existence of complexity and also accept that that is the case. If not acknowledging the very existence of complexity it is likely that resources are wasted upon planning for an unknown future.

6.5 Further Research

We set out to find how complexity is managed in reality, though as stated we found that it does not. Instead management is subjected to complexity. Further as the global market is not showing tendencies to become less complex it is our sincere belief that increased comprehension of how organizations manage under complexity is a subject of essence for companies to stay competitive. Thus, the obvious recommendation we have for further research is to investigate how organizations manages under complexity. We looked into the manufacturing industry though it would be interesting to scrutinize the phenomenon in other industries as well.

Additionally this study was restricted in both time and scope, thus it would be interesting and beneficial to the field of management to conduct more in depth study. Furthermore to follow a certain product procedure over a longer period of time, in an organization that accepts the existence of complexity

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