CHALMERS

Management of Innovation

A case study of the innovation management process within the industrial automation sector

Master of Science Thesis in the Master's Programme International Project Management

HAMPUS VON SPARR

Department of Civil and Environmental Engineering
Division of Construction Management

CHALMERS UNIVERSITY OF TECHNOLOGY
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ABSTRACT

Innovation is often considered to be an important element to successful business today, significantly contributing to competitive advantage, high customer value, and gaining financial benefits. Innovation is however difficult to manage, particularly with rapidly changing customer expectations and technology, as well as competitive pressure.

This research is therefore intended to investigate the current process of managing innovation at an organisation through a qualitative single case study. Towards the achievement of high customer value through customer-focused innovation, the research examines what barriers and enablers exist, the improvement opportunities for the future, and what tools and techniques are suitable. Data has been collected through interviews with support from observations, supportive documents, and informal discussions. Combined with an extensive literature review it was identified that organisations tend to innovate in silos, lacking both interdepartmental co-operation and customer input, leading to mainly core innovations.

The findings indicate that in order to achieve successful innovation, organisations should increase interdepartmental and customer collaboration, apply visual aids in knowledge sharing, and target cost. Furthermore, organisations should consider innovation on portfolio level, recognizing the innovation pyramid, and encourage creativity through flexible control.

Keywords: Innovation, innovation management, lean innovation, interdepartmental collaboration, enables and barriers in innovation

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List of Abbreviations

QFD	Quality Function Deployment
R&D	Research and Development
ROI	Return on Investment
SBU	Strategic Business Unit
VOC	Voice of the Customer

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1. Introduction

1.1 Background

Today, the environment for companies is highly dynamic, particularly within engineering and high technology industries where the development is rapid and unpredictable. People, market, customers, and even organisations are changing, which has led to innovation being an important element of the success, and even survival of organisations today (Nagji and Tuff, 2012; Kumar and Krob, 2007). Including both competitive pressure and changing expectations that have to be managed.

Innovation is often described as a novel creation that produces value, perhaps most commonly within product and/or service development. In its fundamental, innovation requires an understanding of customers' current and future demands, which implies a lot of risk and uncertainty. Innovation therefore tends to be a complex and difficult task to manage, as successful innovation preferably should provide both value to customers and financial benefits to organisation (Moss-Kanter, 2009).

Traditional innovation processes has lately been identified as too strict and linear to function well in current dynamic environment. This has led to an increasing need to make innovation processes both more customer-focused and efficient, decreasing the time-to-market and increasing customer value. Subsequently leading to a development of methods, techniques, and tools within the management of innovation in order for organisations to be able to incorporate novel methodologies and processes (Du, Leten and Vanhaverbeke, 2014). Lean innovation, open innovation and agile development are examples of well-recognized practices that in several cases proven successful within innovation (Aho and Uden, 2013; Ballé and Ballé, 2005).

This research is therefore intended to investigate the improvement potential of innovation processes within customer-focused development. Examining the case of an innovative organisation in order to obtain a deep and comprehensive insight in the organisation and how innovation is actually conducted in practice.

1.2 Purpose and Aim

The main purpose of this research is to investigate the current process of innovation, particularly the pre-study phase, at a product focused industrial automation firm that continuously work with innovation. The research is supposed to investigate the current state of the organisation, how the organisation utilizes customers and their demands, and how they can improve their processes to become more customer-focused and achieve even more successful innovation. This study should provide current research with insight of how innovation tend to actually function in practice and the implementation possibilities that exist, additionally supporting the organisation of the case with new insight and perspective of how their innovation process and projects function. The main objectives are:

- Conduct a current state analysis of the innovation project management process at the organisation of the case, focusing primarily on the pre-study phase.
- Examine literature and theory regarding customer-focused innovation in order to identify novel and effective management methods and practices.
- Collect comprehensive data of the organisation, through interviews, observations and internal documents.
- Presenting current state analysis and identifying possibilities to implement new methods and techniques within innovation management.

1.3 Research Questions

The goal of this research is to investigate the opportunities and possibilities to improve the process of innovation and product development projects. The research has a specific focus on how to improve the customer focus throughout the projects, particularly within the pre-study phase, which sets the foundation for the complete project. The research is conducted at a industrial automation firm called FlexLink, and is intended to suggest potential improvements to the current innovation process at the organisation. This has lead to the development of following research questions:

1. What are the barriers and enablers within the process of innovation?
2. How to improve the process of customer focused management within innovation?
3. What tools and techniques are most applicable when collecting customer needs and transforming them into specific requirements?

1.4 Research Outline

The structure of this research is organized into seven main chapters in the following order: introduction, literature review, research methodology, case study, result, discussion, and conclusion, as illustrated in Figure 1.1.

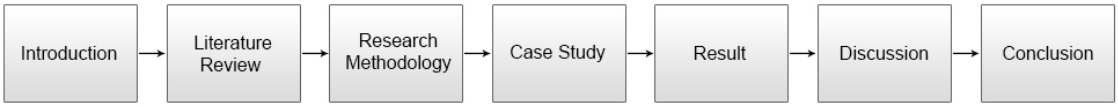

Figure 1.1 – Research Outline

The introduction part provides a brief background to the research, its purpose and aim, as well as the research question, which is the foundation for the research. The literature review sets the theoretical basis for the research, providing past and current research within the field. The research methodology chapter presents the selected research methods and approaches applied to this research. The case study section presents the organisation of the case, and the result section presents the findings that were revealed from the data collection. The discussion chapter entails discussions of the result, combined with parallels to the theory from the literature review. Lastly, the conclusion chapter discusses the most significant findings, answers the research questions, and suggestions for further research.

1.5 Limitations

This research is limited in terms of time and participation availability, as well as the focus of the research (only the pre-study phase of the innovation process at one specific firm). The limited amount of time restricted the researcher to gain a complete understanding of details surrounding the organisation and the innovation process. However a comprehensive holistic understanding was attained, much thanks to interviews with rich data, observations and supportive data in the form of internal documents, describing both organisation and processes.

The availability of interview participants was very good, much thanks to strong support and interest from the organisation of the case study. However, due to both time limitations and availability, the participation was slightly limited.

The focus of a single-case study limits the possibilities to generalize the findings, but provides the opportunity to gain a comprehensive understanding of the case.

2. Literature Review

The literature review is the theoretical foundation of the research. It is intended to provide previous research within the field and an understanding of the topic of the research. The literature review also function as support in the development of research questions and interview questions.

2.1 Innovation

Today, the market situation for companies within engineering and product development is dynamic and complex. Changing expectations and competitive pressure in a global arena has put innovation as one of the corner stones of achieving successful business and competitive advantage (Nagji and Tuff, 2012). However, innovation consequently implies risk of failure and lost investment. (Volberda, Van Den Bosch and Heij, 2013; Selden and MacMillan, 2009; Cole, 2002)

Generally innovation is a broad term, often defined as a novel creation that produces value. The characteristics of innovations can differentiate a lot, and within organisations innovations are often divided into classifications depending on its proximity to the core business and degree of uncertainty (Nagji and Tuff, 2012).

As the importance of innovation is increasing and organisations tend to invest more resources into research, development and innovation a need to streamline its processes is central for the survival of businesses today (Srinivasan, 2010). Developing effective processes may both decrease costs and time-to-market for new products and services, which are vital in markets with high competitive pressure. On the other hand, standardized processes have been identified as somewhat of a creativity strangler (Aggeri and Segrestin, 2007; Kumar and Krob, 2007).

2.1.1 Benefits and Issues of Innovation

As mentioned above, innovation is important for the success of businesses. However, innovation does also entail risk, risk of lost investment and unachieved customer needs. From the business point of view, in the long-term perspective innovation is commonly investments that are supposed to provide financial benefits, in other words return on investment (ROI) (Nagji and Tuff, 2012).

In order to be successful within innovation, it is necessary to understand customer needs and demands. However, the situation in which organisations and companies, particularly within engineering currently stand, the market expectations and situation is constantly changing and developing. This is a difficult and complex task to manage, involving a lot of uncertainty and risk (Cole, 2002; Von Hippel, 2001). It requires companies and organisations to manage their innovation portfolio with care, prioritising and selecting what and how they should invest in innovation (Nagji and Tuff, 2012; Selden and MacMillan, 2009).

2.1.2 The Innovation Portfolio

Innovations can be of various characteristics, Nagji and Tuff (2012) identified three different types of innovation based on their proximity to the core business: core innovation, adjacent innovation, and transformational innovation, as illustrated in Figure 2.1.

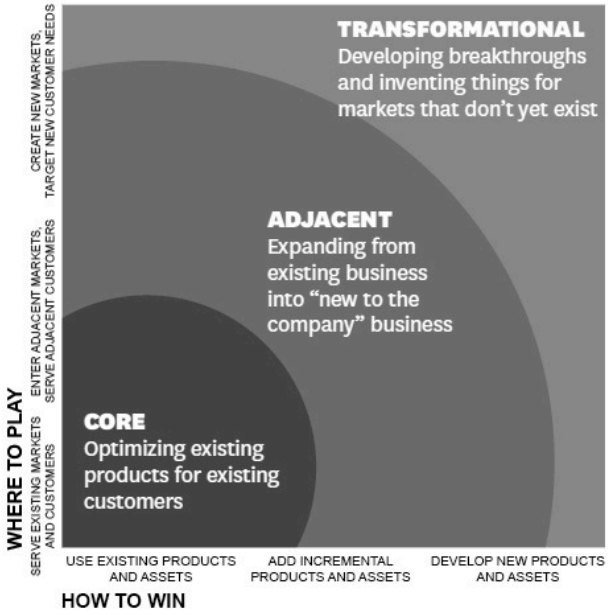

Figure 2.1 – The Innovation Ambition Matrix (Nagji and Tuff, 2012, p. 69)

Noteworthy of these different types of innovation is that they contribute different amount of risk and uncertainty. Core innovation is well known to the organisation, which implies reduced risk and uncertainty, while transformational (or breakthrough) innovation often implies high risk and uncertainty. Lastly, adjacent innovation is positioned in the middle of these in terms of risk, uncertainty, and proximity to the core business, further described in Table 2.1 (Nagji and Tuff, 2012; Selden and MacMillan, 2009).

Table 2.1 – Type of Innovation Explanation (Nagji and Tuff, 2012)

Type of Innovation	Products and Assets	Markets and Customers
Core Innovation	Use existing products and assets	Serve existing market and customers
Adjacent Innovation	Add incremental products and assets	Enter adjacent markets, serve adjacent customers
Transformational Innovation	Develop new products and assets	Create new markets, target new customer needs

By considering innovation in this perspective, managers have the opportunity to develop an understanding of the overall innovation portfolio. How an organisation should divide its innovation portfolio depends on each organisation, its strategy, vision and situation. However, through a cross-industry analysis, Nagji and Tuff (2012) identified that a ratio of 70-20-10 (Core-Adjacent-Transformational innovation) of the total innovation portfolio was associated with an enhanced financial performance and risk distribution than other ratios. Furthermore it was found that the long-term total return on investment was opposite to the above ratio, i.e. 10-20-70 (Core-Adjacent-Transformational innovation). Which implies that transformational innovations tend to provide a high return on investment, but also high risks, and the other way around with core innovation (Nagji and Tuff, 2012; Selden and MacMillan, 2009). In other words, you got to bet to win.

The ratio by Nagji and Tuff (2012) is a good starting point, and using the innovation pyramid (Figure 2.2) provides a clear picture of a commonly recognised healthy innovation portfolio strategy, in line with the 70-20-10 ratio (Moss-Kanter, 2009).

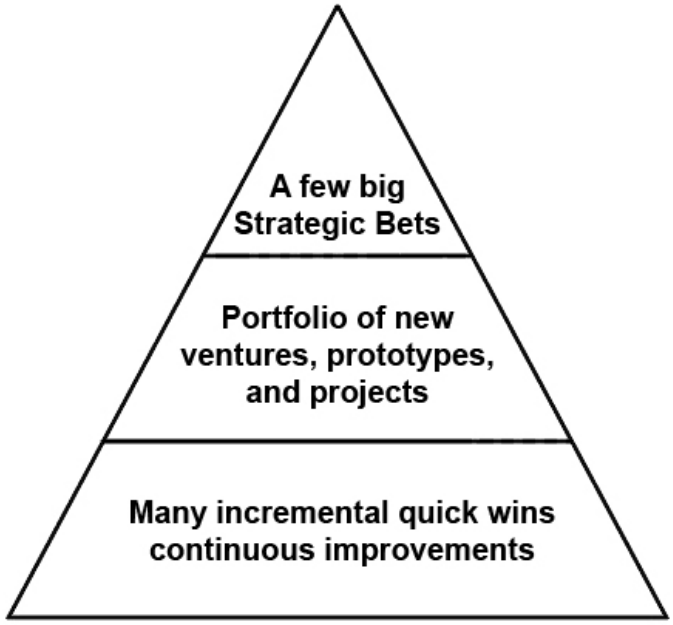

Figure 2.2 – The Innovation Pyramid (Adapted from: Moss-Kanter, 2009)

The innovation balance is however problematic to manage, as core innovation, just as transformational innovation may lead to large profits. Too much focus on core innovation may on the other hand in the long-term perspective lead to business stagnation, as the innovation development may not keep up with market changes and/or competitive development (Nagji and Tuff, 2012). Furthermore, the importance of a continuous information flow, shared ideas and co-operation throughout the different levels and departments within the organisation is vital for the development of successful innovations, which will be further described in section 2.2.1 (Moss-Kanter, 2009; Selden and MacMillan, 2009).

The management of innovation projects should be customized depending upon type of innovation, as an example transformational innovation should be detached from the core business of an organisation, both financially and physically. In terms of customer-centric innovation the innovation strategy of a company should include both offensive and defensive approaches. An offensive approach entails the establishment of deep relationship with customers, both within core customers, beyond core customers, and finally within new customer segments. While defensive strategy is mainly focused on continuously keeping track of changes of customer needs and the competitive pressure (Selden and MacMillan, 2009).

2.2 Innovation Within Organisations

Innovation is one of many tools within organisations in order to realise the vision and strategy, and most often gain financial benefits, either short-term or long-term revenues (Selden and MacMillan, 2009). However, innovation is very much affected by external influences, such as political change, financial environment, changing market and customer expectations (Moss-Kanter, 2009).

A tension that is common in most organisations is the differences between long-term and short-term priority. While short-term is focused on maintaining a fruitful business in the present and protecting current revenue streams, long-term is focused on the future success of the business, setting emphasize on new concepts and future innovation, which could be fundamental to the future survival of the business and organisation (Moss-Kanter, 2009; Selden and MacMillan, 2009).

2.2.1 Innovation Across Borders

The Research and Development (R&D) department is perhaps the most common unit for innovation within organisations. This is where you often find the most technically skilled individuals, more or less working in silos and innovating for the future, also known as closed innovation (Du, Leten and Vanhaverbeke, 2014; Lindegaard, 2010). This is a common situation at numerous of organisations today, especially where a high product centricity is substantial. Often with a lack of knowledge and information of customer needs, value, market and surrounding environment (Moss-Kanter, 2009; Kärkkäinen, Piippo and Tuominen, 2001).

Managing innovation in silos is problematic as successful innovation often originates from external sources, through information flow and co-operation between different departments and units, where opportunities to combine different markets, customers and technology is generated (Nagji and Tuff, 2012). One example of this is the case of Gillette in the late 1990s, which had a toothbrush unit (Oral B), an appliance unit (Braun), and a battery unit (Duracell), but still delayed in introducing the battery-powered toothbrush (Moss-Kanter, 2009, p.77).

Innovation, particularly of the transformational type requires support, both within and outside the organisation. Investors need to be able to understand the innovation and its potential, customers need to understand the value of the innovation and internal departments such as sales units need to understand its value in order to be able to promote and sell it (Selden and

MacMillan, 2009). This is realised by understanding the human side of innovation as well as the customer perspective of it. This is not stating that the technical side of innovation is not important, but rather that it is one path to realise customer value, and particularly leaders need to understand the human perspective of innovation (Moss-Kanter, 2009).

The value of combining the right people and enable an innovative friendly culture and environment with clear goals is therefore crucial in order to achieve successful innovation (Moss-Kanter, 2009). Encouraging information flow both within and outside the borders of the organisation enables more sources of ideas to be discovered. As technical skilled individuals are yet highly important to realise innovation and functions, there is a tendency to get trapped in old patterns and thereby strangle the innovation creativity (Du, Leten and Vanhaverbeke, 2014; Öberg, 2010).

Instead, the human side and personal interactions should be tighter, both internally and externally (Moss-Kanter, 2009). As the example of Gillette earlier indicated, innovation often arises from a combination of different technologies, markets, customers or departments. Subsequently, individuals that have the personal skills and possibilities to network and connect with the right persons and organisations are imperative to innovation projects (Du, Leten and Vanhaverbeke, 2014; Sorli and Stokic, 2009).

2.2.2 Future or Current Success

Innovation, especially transformational, does often encounter obstacles from both organisations and individuals that are resistant to change, and tend to have difficulties in changing old patterns. Most organisations also struggle between prioritizing the current or future success of the business, between existing business and revenue streams and future success and innovation. As most organisations are product focused and hurrying for immediate revenue, innovations with high potential for future may be mistreated and ignored (Moss-Kanter, 2009)

Organisations are required to allocate resources and investments in innovation projects, and particularly large and complex innovations often require a lot of resources during a long period of time without any immediate return on investment (Selden and MacMillan, 2009). Nevertheless, these investments are important for future success and sufficient funds are required to be allocated. However, innovations can be difficult to predict and might be

encountered when least expected, when neither plans or resources to invest are available. This is another obstacle that might prevent innovations and great opportunities to be undertaken. One solution advocated in literature, is to allocate special funds for unexpected innovation opportunities, which enables resources in order for ideas to grow and develop (Moss-Kanter, 2009).

2.2.3 Budget and Control of Innovation

Fixed budgets and control mechanisms are important in organisations and companies to ensure profitability, control processes and keep the business on track with its vision and strategy. However, too tight control has proven to be negative for innovation, strangling creativity and possibilities to think outside the box (Selden and MacMillan, 2009). Innovation requires new thinking and work patterns separated from the existing business in order to avoid falling into old patterns and reducing the chances to identify innovation opportunities that are separated from the core business. Hence, control and budget of innovation projects should not play by the same rules as residual organisation, preferably given more flexibility (Moss-Kanter, 2009).

2.2.4 Managing Innovation Systematically

A systematic methodology refers to a defined process of tasks and methods to follow as a pathway or roadmap that supports project members in the process of achieving project goals (Maylor, 2010). Within innovation, customer requirements have been identified as the perhaps most important focus that should saturate the whole process and be the foundation for each decision (Almefelt, 2005).

Toyotas product development methodology, often referred to as lean innovation, has been recognized as successful. One of the main aspects of this is that the decision-making process includes representatives from each department involved (such as manufacturing, development, assembly etc.). This ensures that early decision holds water throughout the whole process, reducing the risk for expensive late changes and unnecessary iterations. Another aspect is the constant focus on customer value and reduced waste (non-value adding processes and parts) (Ballé and Ballé, 2005).

The early stage of the innovation process, where customer needs and demands are established, and requirements are initiated have been identified as one of the most important

stages, laying the foundation for the complete remaining process (Moss-Kanter, 2009; Sorli and Stokic, 2009). This has lead to an increasing focus and role of requirement management within innovation projects (Almefelt, 2005).

Requirement Management is the practice of analysing and setting requirements, which includes interaction with stakeholders, control changes and ensuring that project outcome reflects customer requirements (Almefelt, 2005). Significant characteristic of requirements is that they should be verifiable, as well as flexible to change, as customer demands may change; requirements must also be able to change. However, many organisations tend to have difficulties to reflect the requirement priority in their work process, instead the work process often reflects the availability at the organisation, meaning what current skills, technology and resources that already exist (Almefelt, 2005; Kärkkäinen, Piippo and Tuominen, 2001).

Too fixed methods, control and budget has been recognized as innovation stranglers. However, a systematic methodology within innovation may increase the general quality of the outcome, especially when incorporating different departments and potentially external partners (Du, Leten and Vanhaverbeke, 2014; Kärkkäinen, Piippo and Tuominen, 2001). The importance of a systematic methodology within innovation is that it should function as support and roadmap, provide flexibility within budget, control and scalability of project complexity. The methodology should as mentioned earlier have a main focus on requirements and customer value (Sorli and Stokic, 2009; Almefelt, 2005).

2.3 Process of Innovation

Within innovation, and particularly product innovation (or new product development), Sorli and Stokic (2009, p.11) identified eight stages that in general are performed. These are:

1. Start-up decision.
2. Specification definition – Should be done in close relationship to customer.
3. Conceptualization – Overall characteristics defined.
4. Detailed design – Concept defined by drawings, materials etc.
5. Trials – Developing physical products to investigate appearance, feasibility, problem-solving etc.
6. Pre-production – Short series produced in order for final refinement and changes.
7. Product launch – Delivering product to customers, mass production.

8. Market – Closing the loop, provide feedback from market and evaluate.

Implementing standardized processes and methods to manage innovation is common within organisations today. These processes and methods are often intended to provide guidance to the individuals working within innovation and development, as well as a control mechanism for project steering, controlling progress, cost, quality etc., but does not always function as intended (Moss-Kanter, 2009; Hines, Francis and Found, 2006).

Innovation projects should include the encouragement of creative thinking and avoid too fixed processes and administrative undertakings. Not only may standardized processes limit creative thinking, but also cause innovators to fall into old patterns, reducing the chances to enhance transformational and novel innovations (Moss-Kanter, 2009). Furthermore, in organisations standardized processes are often required as a control mechanism. As mentioned earlier in section 2.1.2, different types of innovation projects also require different type of management due to its proximity to the core business and complexity (Volberda, Van Den Bosch, 2013; Selden and MacMillan, 2009).

Enabling successful development of transformational innovations demands processes and financial restrictions to be detached from the day-to-day business. Transformational innovation is often associated with higher risk and uncertainty as it often includes entirely new markets, customers and demands. This has led to a development of innovation processes becoming more customer-focused and accessible to an environment in constant development (Moss-Kanter, 2009). These methods often include the investment of more resources earlier in the innovation process, ensuring that customer- and market demands are comprehensively investigated. Investing these resources in the early phases of the innovation process has every so often shown to be successful in the end, providing value to the customer and profit to the company (Selden and MacMillan, 2009). By investing resources early to understand customer demands, examine solutions etc. the risk for late changes in the project is significantly reduced, subsequently reducing the chance for expensive changes as the traditional cost of change curve in Figure 2.3 illustrates. Lean innovation, agile development and open innovation are examples of acknowledged practices within the field - often involving leading customers, suppliers, and external partners etc. to enable innovation to be novel and successful (Du, Leten and Vanhaverbeke, 2014; Stober and Hansmann, 2010). These practices will be further described in section 2.4.

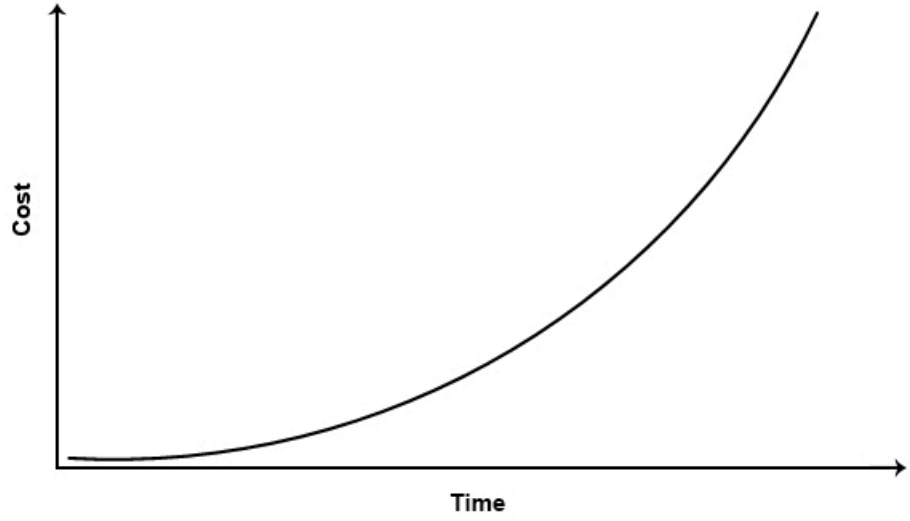

Figure 2.3 – Traditional Cost of Change Curve (Folkestad and Johnson, 2002, p.99)

2.3.1 Traditional Approach of Innovation

The traditional process of innovation, especially within new product development is commonly based on a linear methodology. Currently, this type of innovation process is still used at many organisations. This type of process is commonly composed out of stages (or phases), which are predefined tasks to undertake, and gates with predefined checkpoints and milestones that is required to be completed in order to allow entering the next stage. This method is often referred to as the stage-gate model, visualized in Figure 2.4 (Maylor, 2010; Stober and Hansmann, 2010).

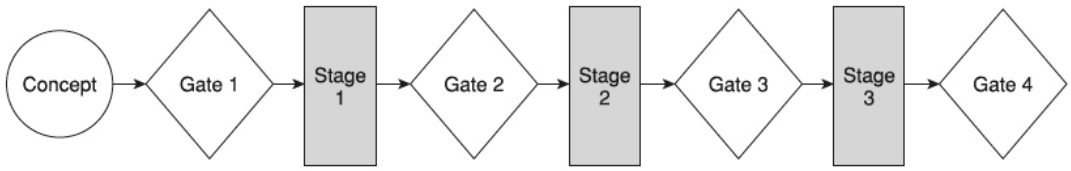

Figure 2.4 – The Stage-Gate Model (Maylor, 2010, p.110)

This methodology provides both a control mechanism and clear guidance, which is straightforward and easy to follow, probably the reason for its popularity (Maylor, 2010). However, a strict linear process does limit the possibilities to make changes and iterate the process smoothly, which in the current changing market environment can be necessary in order to realise high customer value and achieve successful innovation (Stober and Hansmann, 2010).

2.3.2 Customer Focused Approach of Innovation

Setting the customer in focus within innovation has in the last decades been widely recognized as it has shown to result in better performance, both of customer value and return on investment (Du, Leten and Vanhaverbeke, 2014). Organisations have started to realise the importance of understanding customer demands, both current and future demands, and its central part in achieving successful innovation (Srinivasan, 2010).

By initiating customer focused innovation, organisations will not only be able to increase the probability to innovate products and services that meet customer requirements, in addition to this the risk of failure and uncertainty is often significantly reduced (Sorli and Stokic, 2009). In the long-term perspective, most organisations innovate to gain financial benefits, which reducing costs, especially unnecessary costs are part of (Aho and Uden, 2013; Selden and MacMillan, 2009).

2.3.3 Customer Value

Realising customer requirements through products and/or services is possibly one of the most significant aspects of innovation (Almefelt, 2005). Requiring a constant focus on customer value throughout the complete innovation process (Sorli and Stokic, 2009).

Value is defined as benefits divided by costs, meaning that value is dependent on the benefits relative to the cost, and high benefits together with low cost is equal to high value (Association for Project Management, 2012), see equation below. Setting this in relation to customer value has shown that products and services that are developed with focus on customer requirements, often achieve high customer value, which subsequently often leads to higher sales. As such, customer value is highly dependent on used development resources, such as time, production costs, etc. (Sorli and Stokic, 2009; Almefelt, 2005).

$$Value = \frac{Benefits}{Costs}$$

To support organisations in the realisation of high customer value and fulfilled requirements, customer information and demands are important inputs, in technical terms often referred to as the Voice of the Customer (VOC) (Sorli and Stokic, 2009). This process is often incorporated early in the innovation methodology and sets the foundation for the complete

innovation process. Therefore it is essential to ensure that accurate and authentic information of customer needs is collected and utilized accurately (Kärkkäinen, Piippo and Tuominen, 2001).

Depending on what information about customers that is required, possibilities to obtain them, and organisation characteristics, different approaches may be applied in the pursuit of customer information and demands (Hopkins et al., 2011; Öberg, 2010). Examples such as customer satisfaction index, input from departments that work close with customers (sales, marketing etc.), co-operating close with customers in the innovation process through discussions, feedback, observations, interviews etc. (Almefelt, 2005; Kärkkäinen, Piippo and Tuominen, 2001).

2.3.3.1 Lead-Customers in Innovation

Including customers, especially lead-customers within the innovation process have in several cases demonstrated to provide high customer value in the end (Sorli and Stokic, 2009). Depending on what role the customer obtains in the process, different types of information and comprehensiveness may be attained. Öberg (2010, p.1003) identified eight different customer roles within innovation; user, marketer, source of inspiration, informant, generator of ideas, developer, co-developer, and initiator.

Organisations and managers need to understand what type of roles and contribution that is required from customers, as well as the identification of suitable customer, and the value of this (Öberg, 2010). Involving customers in the innovation process is a big step towards achieving a customer-focused process. The degree, to which customers are involved, is highly individual and is dependant on the organisation and the proximity of the certain innovation (Hopkins et al., 2011).

2.4 Practices and Strategies of Innovation

This section will provide practices, methods, tools and techniques of customer focused innovation, which has been recognized and proven to be successful in many cases.

2.4.1 Lean Innovation

Lean innovation (or development) originates from Toyotas' lean manufacturing system. The terminology of lean has lately been a well-appreciated approach of working within

organisations. The basic concept of lean is customer focused value and waste elimination, namely realising that every part of a product or production process provides value to the customer and that the waste (non-value adding parts or processes) are eliminated (Ballé and Ballé, 2005). Lean is a well-recognized method of systematically working within production, however researchers and organisations have lately recognized the use of lean principles within product development and innovation (Blank, 2013; Sehestad and Sonnenberg, 2011; Sobek, Liker and Ward, 1998; Ward et al., 1995).

According to Ballé and Ballé (2005) Toyotas' product development is approximately twice as fast and four times more productive than the U.S. equivalent, and has been referred to as lean development. Its fundamental turn of mind is based on every engineer's main focus on the customer interpretation of the product. This means forming both a vigorous vision for future products and communicate this vision to everyone within the development projects (Sehestad and Sonnenberg, 2011; Sobek, Liker and Ward, 1998).

Secondly, one of the fundamentals within Toyotas' product development is to avoid late changes (as mentioned earlier, late changes are expensive). Ensuring that drawings are more or less perfect early in the process and once released does not allow changes solves this in combination with an industrialization of the production of drawings. The development at Toyota avoids decision based on non-accurate or lack of data, which might postpone important decisions and appear costly. However this also reduces the risk for errors that lead to unnecessary late changes, often reducing costs in the long run (Sehestad and Sonnenberg, 2011). Also, tight communication and understanding between the production and development departments early in projects ensures that early-developed products are possible to produce, both efficiently and profitable (Sobek, Liker and Ward, 1998; Ward et al., 1995)

The Japanese word *"oobeya"* in lean terminology could be described as visual planning and management. In lean development used by engineers to combine their experience and knowledge through the use of visual aids, such as drawings, models, diagrams etc. (Sehestad and Sonnenberg, 2011). This simplifies and streamlines knowledge and information sharing. Within knowledge management often referred to as boundary object, meaning objects and paths to share knowledge across boundaries of expertise and understanding (Huang and Huang, 2013; Sobek, Liker and Ward, 1998; Ward et al., 1995).

Target pricing is another aspect of lean innovation; meaning that costs are based on what the market or customer is willing to pay for the complete product. Breaking down the product into each part and process enables Toyota to set a fixed price for each part and process (Ward et al., 1995). Which provides both internal departments and external supplier a clear and early goal to pursue, enabling planning of costs, quality and profitability (Sehestad and Sonnenberg, 2011).

Finally, implementing lean methods and principles in organisations has been somewhat of a trend lately. Nevertheless the implementation of these does not guarantee good result, and lean thinking should be permeated throughout the whole organisation, where both managers and project members should be open-minded towards knowledge sharing and creation to be successful (Srinivasan, 2010; Ballé and Ballé, 2005).

2.4.2 Agile Development

Agile development is a method that has been widely recognized lately and is a method that constantly includes customer oriented feedback loops. The method has been originated and mainly used within software development (Bosch and Bosch-Sijtsema, 2011). It is an iterative process that incrementally uses feedback from customers and users, and constantly applies changes based on the feedback. Through this type of development process, organisations have the possibility to make necessary changes based on customer needs and user requirements (Blank, 2013; Stober and Hansmann, 2010).

Compared to traditional product development processes, agile development requires more flexible prototypes and development procedures. However, the cost of late changes decreases, while the probability of achieving high customer satisfaction increases (Blank, 2013; Stober and Hansmann, 2010). Typical cost of change curve of agile development projects are visualized in Figure 2.5.

Agile development is a growing and evolving process, meaning that the development process changes over time through the input from practitioners, however the process should not be to complex and difficult to handle, kept as simple as possible. The process should be tailored to fit the specific project, team and its complexity. Instead of having processes defined by so called experts, agile development uses a bottom-up approach, meaning that it is the practitioners that are propagating their ideas in their daily work that should influence the

methodology. This reduces the gap between the defined process and the actual work process (Stober and Hansmann, 2010).

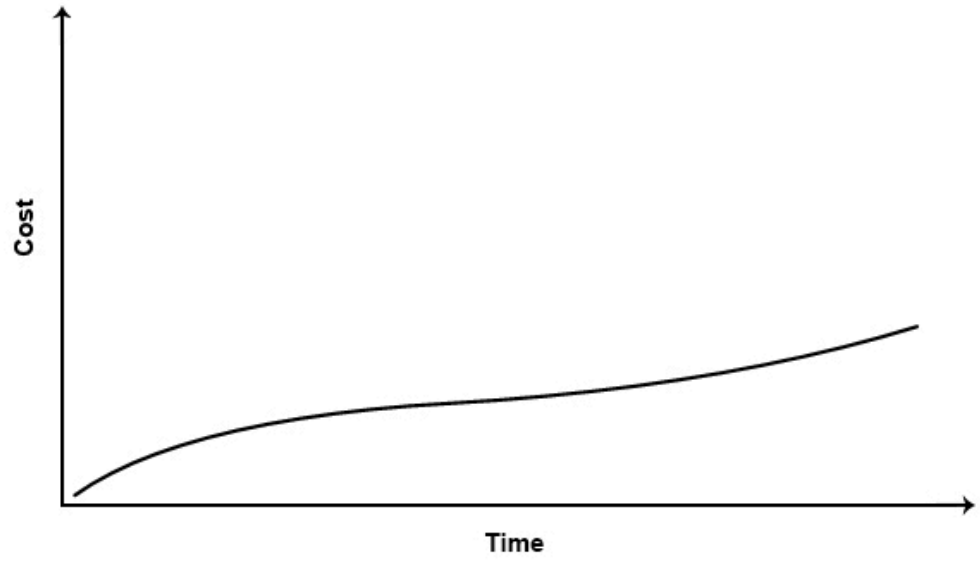

Figure 2.5 – Agile Cost of Change Curve (Adapted from: Stober and Hansmann, 2010, p.152)

2.4.3 Open Innovation

Today, distributing and sharing knowledge within organisations is still a challenge to many companies as departments often are restricted to their own tasks and does not interact adequate interdepartmentally (Lindegaard, 2010). Endeavour to gain and share knowledge outside the boundaries of the organisation is often even more difficult, even if we currently live in an IT environment where information is more accessible than ever. Nevertheless, gaining knowledge both within and outside the organisational borders is more important than ever as markets and customer demands are dynamic and constantly changing (Du, Leten and Vanhaverbeke, 2014; Selden and MacMillan, 2009; Chesbrough, H. W., 2003).

Currently, a lot of organisations tend to some extent conduct what is called closed innovation. This could briefly be explained as innovation that lacks of input from external sources in the process and that the innovation is carried out completely internal at a Research and Development (R&D) department (Lindegaard, 2010). This is commonly where the so-called best and the brightest individuals within the organisation are expected to develop innovations that provide both value to customer and organisation (Du, Leten and Vanhaverbeke, 2014; Lindegaard, 2010).

Contradictory to the previous, open innovation is focused on bridging the gap between external and internal sources of information and knowledge within the process of innovation (Du, Leten and Vanhaverbeke, 2014). By gaining knowledge from several sources the chances to achieve successful innovation increases, namely achieve innovation that provides value to customer and organisation as well as profit. Open innovation can be used differently depending on purpose and situation. It is often used within idea generation, testing and execution of innovation (Lindegaard, 2010). Comparative to closed innovation; open innovation provides wider possibilities to identify new and novel innovations, both within product- and service innovation, but also within models and processes. While closed innovation often primarily focus on product- and service innovations close to the core business (Moss-Kanter, 2009; Selden and MacMillan, 2009).

Examples of external sources used within open innovation are customers, suppliers, external partners, and academic sources such as universities (Du, Leten and Vanhaverbeke, 2014). Working mainly with customers within idea generation and as feedback source is often called user-driven innovation, which is close to open innovation. However open innovation is often defined and used as a more comprehensive partnership in the innovation process, sharing knowledge, experience and ideas across borders continuously (Lindegaard, 2010).

2.4.4 Tools and Methods

Innovation, especially within product- and service development requires as mentioned comprehensive knowledge about market, competitors, customer and their demands (Moss-Kanter, 2009). To ensure this and that organisations specify the accurate vision and goal of innovation, different tools and methods can play a significant supporting role (Kärkkäinen, Piippo and Tuominen, 2001; Herrmann, Huber and Braunstein, 2000).

The need to understand customer demands and expectations is often the difference between success and failure. Customer needs should be the baseline throughout the complete innovation project and central in every decision and task performed (Du, Leten and Vanhaverbeke, 2014; Lindegaard, 2010). However, a typical characteristic within organisations today is the fact that the R&D department prioritize technology and product features while the sales department focuses on short-term objectives and customer satisfaction (Kärkkäinen, Piippo and Tuominen, 2001). Nevertheless, the sales department

often have the most interaction with customers, and what is required in innovation is a mixture of both technology and customer knowledge, which requires a way to create a common language and understanding of both the customers and technology perspective (Herrmann, Huber and Braunstein, 2000).

Tools and techniques within product development used for the right purpose in the right project may support innovators to find a common understanding, collect and analyse large amount of data (Herrmann, Huber and Brainstein, 2000). Even if it is only a simple, structured way to collect and present required information in an understandable way (Sorli and Stokic, 2009).

Tools are supposed to support the project team within the development and should preferably be easy to use. The need to use tools may differ from different projects and the type of innovation (Herrmann, Huber and Braunstein, 2000). Core innovation where uncertainty, unknowns and risks are low may not require as much supporting tools as adjacent and transformational innovation. In these cases tools can support in creating a common language and understanding, i.e. function as a boundary object, both internally within organisations and external with suppliers, and customers etc. (Kärkkäinen, Piippo and Tuominen, 2001).

The following sections will present identified useful tools and techniques within customer focused innovation. The tools were selected in terms of their relevance to the purpose and aim of the research, as well as their continuous appearance in literature, such as Sorli and Stokic (2009), Almefelt (2005), Herrmann, Huber and Braunstein (2000), and proven successful within the industry.

2.4.4.1 Quality Function Deployment

Quality Function Deployment (QFD), also known as the house of quality, is a tool within customer-focused development that was developed in the late 1960s by Yoji Akon and Katsuyo Ishikara (Lunau et al., 2009, p.102). The tool have been used by many leading corporations, such as Apple Computers, GE, Hewlett Packard, IBM, NASA, Volvo etc. and have been explained as an important key to their success in product- and service development (Sorli and Stokic, 2009; Herrmann, Huber and Braunstein, 2000). Additionally QFD has been referred to as *"One of the most useful techniques in total quality management"* (Cristiano, Liker and Ward, 2000, p. 288).

QFD is a tool that correlates product features with customer needs. By using customer needs as a foundation for innovation through the use of QFD, firms have increased revenues due to product quality that matches customer needs, as manufacturers can focus and prioritise value-adding product features and thereby reduce cost (Sorli and Stokic, 2009; Cristiano, Liker and White, 2000). The tool is often associated with practices such as lean and Six Sigma (Lunau et al., 2006).

The tool was developed in order to break communication barriers among different expertise and knowledge (Sorli and Stokic, 2009) and can be described as a boundary object. It enables product development to focus on customer needs and their satisfaction, which impose engineers to understand the customer view of the product (Cristiano, Liker and White, 2000). As an old Indo-American saying state: *"you will never know your enemy unless you walk a mile in his moccasins"* (Sorli and Stokic, 2009, p.90). As perspective between customer, user and technical individuals differentiate significantly, QFD may join different perspectives, as illustrated in Figure 2.6 (Huang and Huang, 2013; Sorli and Stokic, 2009).

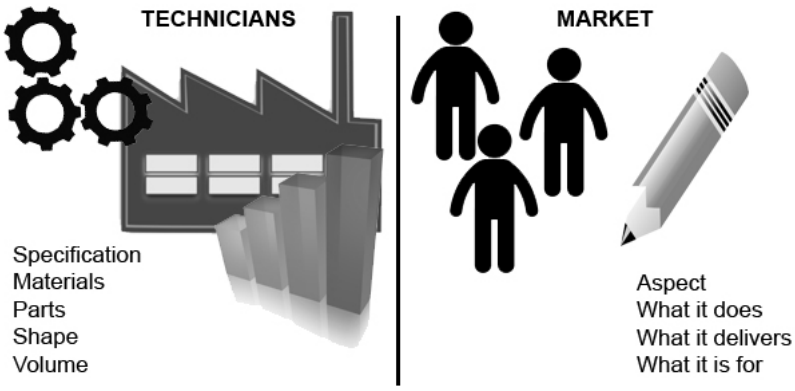

Figure 2.6 – Technician View vs. Market View (Adapted from: Sorli and Stokic, 2009, p.92)

QFD is composed out of correlated matrixes, each matrix has it own input and information, combined the matrixes provide a relation between customer needs, product features and competitive situation (Lunau et al., 2009; Sorli and Stokic, 2009; Cristiano, Liker and White, 2000).

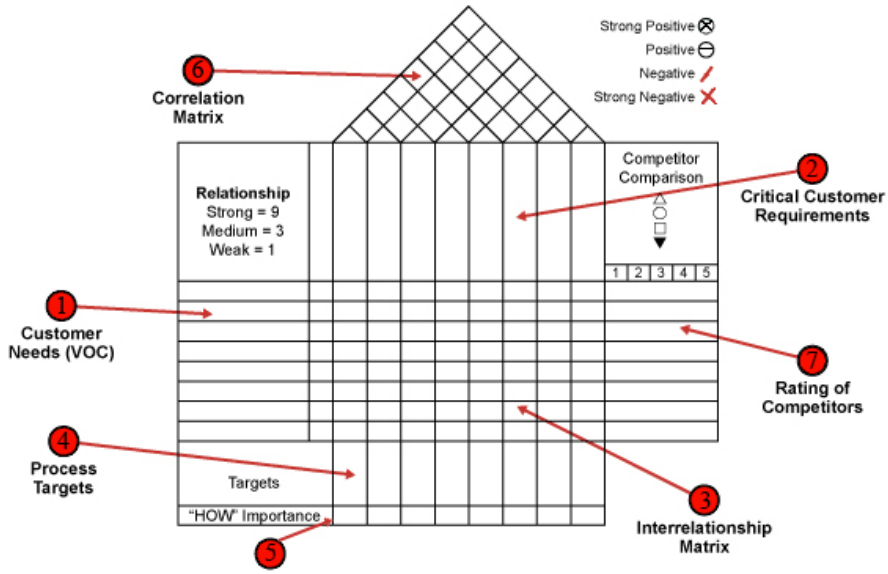

Figure 2.7 – Quality Function Deployment (QFD) Matrix Outline (Adapted from: Sorli and Stokic, 2009, p.91)

The QFD matrix outlined as illustrated in Figure 2.7 has the following matrixes and function (Sorli and Stokic, 2009):

1. The "What" matrix, input of customer needs (VOC) are listed and prioritized in terms of importance/customer satisfaction.
2. The "How" matrix, includes the quality characteristics/product features of the product.
3. The interrelation matrix correlates the relationship between customer needs (What) and product features (How).
4. Target value matrix, each features target value is decided by the project team, based on benchmark values, customer information and requirements.
5. Technical benchmark, each product feature correlated with customer needs and its prioritization provides each features ratio of contribution to customer value and satisfaction.
6. Correlation matrix where the project team identifies positive or negative synergies between different product features, where negative synergies, i.e. a conflict should be avoided.
7. Competitive analysis on competitors and similar products are benchmarked in terms of customer needs.

The QFD therefore enable technical individuals, such as engineers to understand the customer perspective of a product. In a technical environment, setting numerical values on dynamic matters such as customer needs, often simplifies the understanding and development systematically, creating clear requirements (Lunau et al., 2009; Sorli and Stokic, 2009). Therefore, QFD can support to maintain the customer focus throughout the complete product

development project, and increase the innovation value (Cristiano, Liker and White, 2000; Herrmann, Huber and Braunstein, 2000)

2.4.4.2 PUGH Matrix

Within product- and service development engineers and project teams often develop several concepts and solutions to solve a problem. Different solutions have different characteristics, features and strengths. Within core innovations, the problem might be easy to understand and the choice of solution obvious (Kärkkäinen, Piippo and Tuominen, 2001). Even so, both core and transformational innovation does often comprehend several aspects that need to be considered, such as customer need, cost, production process, complexity etc., which could make the choice difficult and complex (Silverstein, Samuel and DeCarlo, 2009).

The PUGH matrix (or concept selection) is a simple tool to determine which concept that would be most suitable. The PUGH matrix supports the project team to consider all necessary aspects, both internally and externally (Kärkkäinen, Piippo and Tuominen, 2001). These aspects are defined in the baseline (criteria) of the matrix, which is developed in terms of the innovation and customer. Each concept is evaluated in terms of its fulfilment of each baseline criteria with a numerical value (Silverstein, Samuel and DeCarlo, 2009; Almefelt, 2005).

Provided from the PUGH matrix is a structured presentation of each concepts strengths and weaknesses, how well they fulfil needs and requirements (Kärkkäinen, Piippo and Tuominen, 2001). Therefore, it provides a fundamental basis to evaluate and select concept (Silverstein, Samuel and DeCarlo, 2009; Almefelt, 2005). An illustration of a PUGH example is showed in Figure 2.8.

Concept / Criteria	 1	 2	 3	 4	 5	 6	 7	 8	 9	 10	 11
A	+	−	+	−	+	−	D	−	+	+	+
B	+	S	+	S	−	−		+	−	+	−
C	−	+	−	−	S	S	A	+	S	−	−
D	−	+	+	−	S	+		S	−	−	S
E	+	−	+	−	S	+	T	S	+	+	+
F	−	−	S	+	+	−		+	−	+	S
Σ+	3	2	4	1	2	2	U	3	2	4	2
Σ−	3	3	1	4	1	3		1	3	2	2
ΣS	0	1	1	1	3	1	M		1	0	2

Figure 2.8 – PUGH Matrix (Pugh, 1990)

3. Research Methodology

3.1 Introduction

The purpose of this research is to investigate the possibilities to implement novel and effective processes and techniques for managing innovation projects, with the focus of an increased customer focus particularly within the pre-study phase. The research is conducted at a Swedish industrial automation firm where innovation is on top of the agenda. This chapter will present the selected research methodology and data collection method of this research, as presented in Figure 3.1.

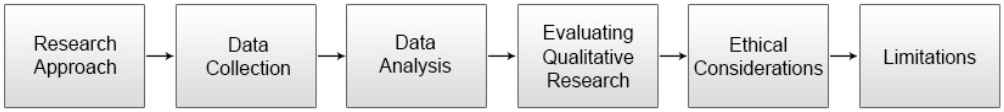

Figure 3.1 – Research Methodology

3.2 Research Approach

This research is intended to investigate a particular process within innovation projects and the potential improvement of this process at a specific firm. For this type of research, the approach of a single case study is applied, where the term "case" entails that it is associated with a location, in this case the firm. The nature of this type of research approach is often, but not necessary connected with qualitative methods. It often includes methods such as observations and interviews as these methods often provide the required detailed input for an intensive and comprehensive investigation of the case in question (Bryman, 2012; Yin, 2009; Stake, 1995).

3.2.1 Qualitative Research

Within the collection and analysis of data, qualitative research is often focused on words compared to quantitative research where primarily numbers is the main focus. Qualitative research is often of inductive characteristics, meaning that theory is generated out of research. The advantage with conducting a qualitative research is that it provides the opportunity to collect rich and deep data of the specific case. However, there is scepticism over its reliability and validity. Reliability refers to the possibilities to repeat the study, and validity refers to the integrity of the findings and results, terms often used within quantitative research (Bryman, 2012). This research applies a qualitative approach in order to be able to investigate the case thoroughly and in detail, focusing on examining how and why, rather than what and where.

The main steps of qualitative research, which will be applied in this research is presented in Figure 3.2.

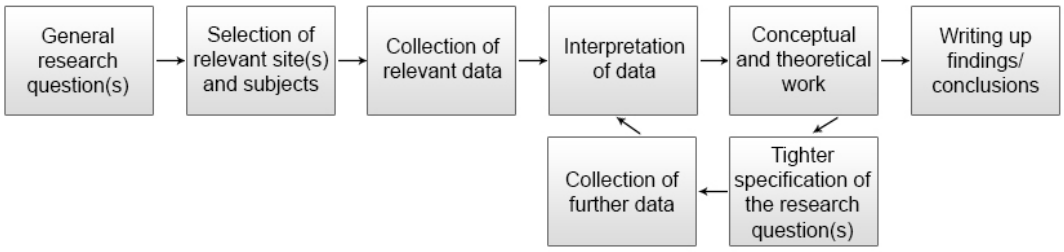

Figure 3.2 – Main Steps of Qualitative Research (Adapted from: Bryman, 2012, p.384)

An alternative criterion for the evaluation of qualitative research is through Trustworthiness, which is based on four criteria: Credibility, Transferability, Dependability, and Conformability, which are equivalent with internal validity, external validity, reliability and objectivity respectively (Bryman, 2012; Denzin and Lincoln, 2011). These will be further described in section 3.5.

3.2.2 Case Study

This research is conducted through the approach of a single-case study at one specific organisation and its process of innovation projects. Accordingly to Bryman (2012) a case study provides the opportunity to investigate a case in detail. As commonly within case studies, a qualitative approach is applied. In which interviews or observations are the perhaps most common data collection methods (Yin, 2009; Stake, 1995). For this research, semi-structured interviews will be the main source for data with support and verification from supportive data, observations and informal discussions.

This research encounters a relatively common situation at manufacturing firms today. The current process at the organisation is by its features of common characteristic, and numerous of literature within the field can be found, by researchers such as Blank (2013), Sleden and MacMillan (2009), Ballé and Ballé (2005), Von Hippel (2001) to mention a few.

Therefore, this single case study can be described as what Bryman (2012) refers to as representative or typical case, or an exemplifying case as he prefers to call it. This type of case is common when the researcher seeks access to an organisation in order to be able to investigate a certain situation of phenomena when implementing new technology or similar. Often the researcher has been influenced by considerable literature within the subject and pursues to investigate this. The exemplifying case does therefore often fit in a certain

category, meaning that to a certain extent, it is possible to apply the findings in a different context (Bryman, 2012; Yin, 2009; Stake, 1995). This research will apply an iterative approach, in other words both inductive and deductive. This entails that there is an iterative relationship between theory and research (Bryman, 2012), as presented in Figure 3.3.

Figure 3.3 – Iterative Relationship Between Theory and Research (Adapted from Bryman, 2012, p.26)

3.2.3 Sampling method

The sampling method of this qualitative research is strategically chosen to be able to collect as rich information as possible. Therefore purposive sampling is applied, this sampling method is conducted with reference to the purpose of the research where units of analysis are selected in terms of criterion that will allow the research questions to be answered and can support in reducing bias in the sample selection. In other words, it is a non-probability sample, which does not enable a generalization of the population (Bryman, 2012), however in this case this is neither a requirement or necessary as the participants are sampled in a strategic way to be relevant to the research questions.

Within purposive sampling, there are different approaches to how the specific sample is collected and selected. The unique and specific focus of this research, i.e. investigating the firms innovation process, imposes that participants are relevant in terms of experience, role and knowledge of the innovation process. Therefore, criterion sampling is selected, to strategically select the participants that are able to support the research with valuable information concerning the process, and subsequently supporting in answering the research questions (Bryman, 2012).

The criterion for participants in this research are based on the pursue to find a sample of variety of perspectives with the following criteria:

- Experience of innovation process and projects
- Role within organisation, close to innovation
- Knowledge of innovation process
- Experience of customer focused innovation

3.3 Data Collection

Within qualitative research the data collection approach tends to become more unstructured than quantitative research. Quantitative research demands a structured approach with very low flexibility in order to maximize the reliability and validity of the result. Qualitative data collection often requires more flexibility in order to be able to collect as comprehensive and detailed data as possible. The method is often characterized by interviews or observations, where unstructured and/or semi-structured interviews are common to apply (Bryman, 2012; Yin, 2009). The main data collection for this research has strategically been selected as semi-structured interviews, as it provides the opportunity to collect rich data and still maintain a common thread throughout the interviews.

Additionally, data is further collected from supportive data, such as internal documents that the researcher has been entailed full access. Also observations and informal discussions with individuals at the organisation are applied. This multiple collection method and sources of data is often referred to as triangulation, which will be further described in section 3.5.1.1.

3.3.1 Semi-Structured Interviews

The foundation of the interviews, based on the literature review and customized in order to fit the specific case was divided into eight subthemes:

1. Current process
2. Customer input within innovation
3. Process requirements
4. Transforming customer needs into technical requirements
5. Organisational involvement
6. Current state analysis (Closed questions)
7. Successful project experience
8. Future process (Desired state)

The subthemes function was to enable adaption to each participant's specific experience, relevance and role within the firm. The interview method was primary of qualitative nature. The subtheme called *Current state analysis* was however designed of closed questions, which was based on the study by Kärkkäinen, Piippo and Tuominen (2001). Their study examined the relationship between issues within companies and the tools that would enable support in the solution to the problems, which was reflected in the specific interview questions. An outline copy of the interview questions can be found in Appendix A.

All participants were required to complete a research participant consent form (RPCF), which will be further discussed in section 3.6 Ethical Considerations. Formal interviews were held with a total of six individuals at the organisation, including positions such as product managers, innovation manager, application engineers and human resources. Each interview was conducted in face-to-face meetings and tape recorded in order for the researcher to be able to comprehensively analyse the data from the interviews. Another aspect of data collection is derived from meetings with manager and supervisor at organisation, providing support and comprehensive insight in the organisation and their way of working, particularly within innovation.

3.3.2 Supportive data

Within purposive sampling described earlier in section 3.2.3 items such as internal documents may be applied. Organisations produce a lot of documents, official, internal and confidential that might be difficult to obtain. Documents of this nature are likely to be authentic and meaningful, however it is important to be aware of the risk for the lack of credibility and representativeness in them and therefore analyse them critically (Bryman, 2012).

In order to evaluate the quality of documents Bryman (2012) presents a criterion framework called Scott's four criterions for assessing documents. Within this criterion authenticity, credibility, representativeness and meaning should carefully be analysed.

3.3.3 Observations

Observation, particularly participant observation is a difficult method to collect data. However, it provides the researcher the opportunity to investigate behaviours and individuals thoroughly and comprehensively. A method that often includes taking notes and recording the observed phenomena. Observation may produce comprehensive insight and significant contextual understanding, and often includes three key elements (Guest, Namey and Mitchell, 2013):

1. Identifying and entering correct location, in this case the organisation.
2. Establishing trust among the participants
3. Allocate enough time to assure that observations are accurate, including both observation and developing report. Dependent on scope of research project.

Within observations, organizing the data accurately is highly important for the data analysis even if there is risk for research bias (Guest, Namey and Mitchell, 2013).

3.4 Data Analysis

Qualitative research is often associated with large amount of data and information. The coding of qualitative data is often criticized of being problematic and unreliable. Problems such as losing the context of what is actually said, coding only portions of the complete data collected is a few of the critics (Bryman, 2012).

3.4.1 Thematical Analysis

Thematical analysis is a common approach to qualitative data analysis. The most general strategy within this method is the framework approach, which could be described as a matrix where data is systematically organised. The data is divided into main themes and subthemes, and presented in a matrix as in Figure 3.4. Not completely dissimilar to an SPSS matrix, often used in quantitative data analysis (Bryman, 2012).

	Main theme 1		Main theme 2	
	Subtheme 1.1	Subtheme 1.2	Subtheme 2.1	Subtheme 2.2
Interviewee 1				
Interviewee 2				
Interviewee 3				
Interviewee 4				
Interviewee 5				

Figure 3.4 – Thematical Analysis Framework (Adapted from: Bryman, 2012, p. 579)

It is important that the data in the matrix is accurate and therefore requires the researcher to read and listen to data and information comprehensively, preferably several times. Even if thematical analysis does not require specific procedures or tools, the approach is common to use within qualitative research. Supporting the researcher in coding qualitative data in a systematic and organised way (Bryman, 2012).

Thematical analysis is therefore applied in this research, to support the researcher in the coding of a large amount of data from comprehensive interviews. The main themes of the thematical analysis are designed in relation to the research questions.

3.5 Criterion for Evaluating Qualitative Research

Some researchers have claimed that qualitative research requires a different evaluation than quantitative research. One criteria is called Trustworthiness, which is divided into four different categories; Credibility, Transferability, Dependability, and Confirmability (Bryman, 2012; Denzin and Lincoln, 2011).

3.5.1 Credibility

Credibility, similar to internal validity, is concerned with whether or not the researcher has carried out the research accurately and has correctly understood the findings and result of the research. One recommended technique for this is triangulation (Bryman, 2012; Denzin and Lincoln, 2011).

3.5.1.1 Triangulation

Triangulation involves the usage of several methods or data sources in the collection of data. Utilizing more than one method or source of data provides a better confidence of the findings and results, meaning higher credibility. Triangulation has often been related to quantitative research, but may support qualitative research as well. An example could be to conduct interviews in order to verify observations (Bryman, 2012). Triangulation is applied in this research to broaden the source and methods of data collection in order to verify the credibility of the findings with the use of interviews, observations, supportive data, and informal discussions.

3.5.2 Transferability

Transferability, similar to external validity, is concerned with whether or not the findings are applicable to other contexts. As qualitative research often tend to be highly contextual and unique of the specific case, qualitative research is often difficult to generalize (Bryman, 2012; Denzin and Lincoln, 2011). In terms of transferability, this qualitative research is highly contextual and has limitations in its appliance to other contexts. However, due toe the similarities of the organisation of this case and other organisations, there is a possibility that the findings might be applicable in similar contexts to some extent.

3.5.3 Dependability

Dependability, similar to reliability, is concerned whether or not the findings are repeatable. This has a lot of emphasis on the collected data of the research, and particularly how the data was collected, this to ensure that procedures have been followed accurately. However, due to

the large amount of data that usually develops in qualitative research, the investigation of its dependability is often very demanding (Bryman, 2012; Denzin and Lincoln, 2011). In order to assure dependability, the process of this research has been comprehensively described in chapter 3, enabling researchers in the future to repeat the study.

3.5.4 Confirmability

Confirmability, similar to objectivity, is concerned with whether or not the researcher has been objective during the research. Within social research, complete objectively is according to Bryman (2012) impossible. However, the researcher can demonstrate a research executed in good faith, meaning that personal values and preferences did not purposively affect the findings (Bryman, 2012; Denzin and Lincoln, 2011). The confirmability of this study, as mentioned earlier cannot be entirely objective. However, the researchers position as an external academic within the organisation provides the opportunity to be as objectively as possible and see the case in a new perspective. Furthermore, triangulation as described earlier as the usage of several methods and sources of data collection, reduces the influence of researcher bias in this study (Shenton, 2004).

3.6 Ethical Considerations

The research encounters mainly two ethical dilemmas that need to be considered. Firstly, the researcher has been approved access to highly confidential material and documents within the organisation of the case, this material need to be handled carefully, ensuring that the information is not spread or lost. This is secured by the access limited through an internal computer within the network of the organisation. Furthermore a non-disclosure agreement (NDA) has been signed between the researcher and the organisation.

Secondly, human participants are involved this research, the participants are chosen on a criterion based on their relevance to the innovation process, experience and role within the organisation. Participating in the research was completely voluntarily and each participant was fully informed of their involvement and the purpose of the research, so that an informed decision could be made regarding participation. Furthermore each participant must complete a standard research participant consent form (RPCF), where they are required to confirm that they have been completely informed of the purpose of the research, their agreement to participate, anonymity as well as whether or not allowing audio recording of the interview.

4. Case Study

This chapter is intended to provide a description of the organisation of the single case study of this research and present the result that was discovered mainly from the interviews, but also from observations, internal documents and informal discussions with selected employees at the organisation.

4.1 Company Introduction

The company that was investigated during this research is a Swedish industrial automation firm called FlexLink, specialized within complete automated production flow solutions. The company was essentially started within a production efficiency project at SKF in 1980 and has since the early 1980s been a well-recognized provider of conveyor solutions, with clients in a wide range of industries, worldwide. The company has established sales units all over the world as well as strategic business units (SBU's) that are focusing on specific industry segments. Headquarter is located in Gothenburg, Sweden, which is also the location where this research has been conducted. The innovative conveyor solutions provided by FlexLink are customized to fit each customer and industry requirements. FlexLink provides customized production flow solutions to industries such as automotive, bearings, electronics, tissue, medical, pharmaceutical, personal care, food, and dairy.

FlexLink has approximately 800 employees all over the world and are since 2012 part of the Coesia Group, a group that consists of 14 companies specialized in automated machinery and industrial process solutions. Coesia is headquartered in Bologna, Italy, and both FlexLink and Coesia Group have a high priority and passion for innovation and product development (Coesia, 2014).

The vision of FlexLink is stated as: *"Set the standard for production flow solutions"* (FlexLink, 2013), and the organisation is constantly working towards improvement.

4.2 Organisation

The organisational structure of FlexLink is illustrated in Figure 4.1. The main focus of this research is within the section of create offer, specifically within innovation management. However, as will be presented in the result section, additional parts of the organisation, their current and potential future involvement in the process of innovation will be examined,

organisational units such as product management, product development, strategic business units (SBU's), and sales.

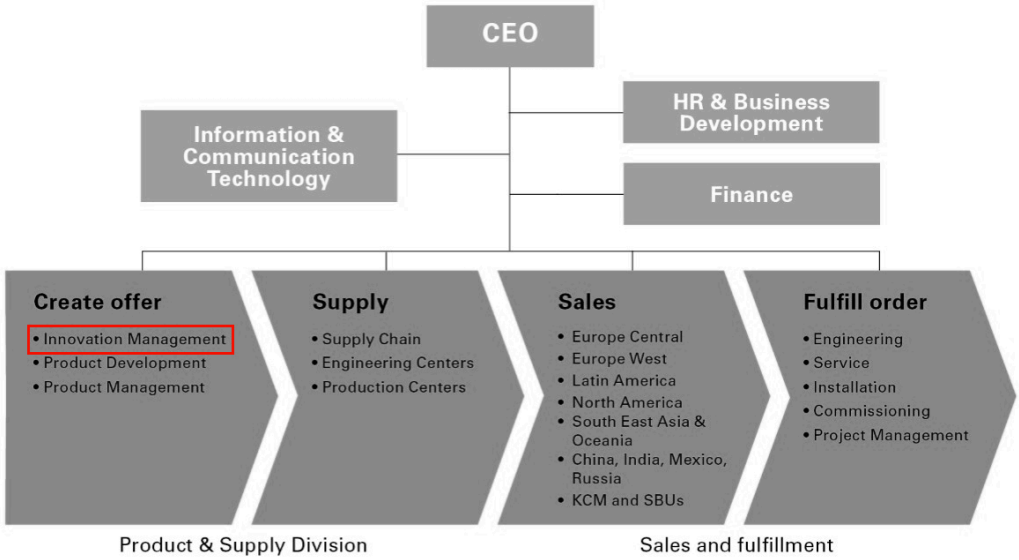

Figure 4.1 – FlexLink Organisational Structure (FlexLink, 2014)

4.3 Innovation at FlexLink

Innovation is one of the corner stones at FlexLink in order to achieve continuous improvement and as stated in the vision *"Set the standard for production flow solutions"* (FlexLink, 2013). Achieving high quality products, services and satisfied customers, require a constant focus on innovation, particularly in a competitive environment. This is achieved by providing complete solutions of top quality products and services with high efficiency, developing new technologies in order to satisfy customers demands and outperform competitor's offers.

Focusing primarily on innovation in terms of product innovation, the product portfolio at FlexLink displays a strong consistency, originated from the early 1980s. The products are within production flow solutions, primarily conveyors made out of flexible plastic links, which is also the idea from which the company name originates.

4.3.1 FlexLinks' Innovation Process

The formal innovation process at FlexLink could be described as a linear process that has it origins in the traditional stage-gate model, with stages consisting of tasks to perform, and gates with predefined targets and milestones to achieve. Due to confidentiality agreement between the researcher and FlexLink, a more comprehensive description of the formal innovation process is not possible in this report. However, the researcher has been approved

access of these documents, and has therefore been able to analyse the innovation process and other documents thoroughly. Subsequently, the researcher has been able to discuss documents and their validity in the interviews of the study, providing valuable information to the findings.

4.4 Interview Participants

The interviewees of this research were selected in order to collect comprehensive amount of data, i.e. experience, but also to receive a high variety of perspectives. Therefore, the following roles within the organisation were selected for interview, but will remain anonymous in the presentation of results:

- Research Engineer
- Product Manager / Innovation Manager
- Product Manager
- Application Engineer (SBU)
- Software Manager
- Human Resources Business Partner

5. Result

This chapter will present the result that was discovered from mainly the interviews and thematical analysis, but also supported by observations, meetings with supervisor, and internal documents.

5.1 Organisational Innovation

From the interviews, it was clear that the organisational structures of the organisation were heavy. Further explained by one interviewee as the complete demand chain being based on one single concept, meaning that large changes and transformational innovations would require big changes, both within the organisation and externally at suppliers. Leading to difficulties in the process of conducting changes.

5.1.1 Innovation in Silos

It was revealed from the interviews, but also from observations, meetings with supervisor and internal documents that one department (referred to as the R&D department) primarily conducted all long-term innovation. Additionally, the interaction with other departments within innovation projects was exiguous, and basically no formal interaction was conducted. However two interviewees stated that ideas were reflected between different engineers on informal basis within the organisation. One of these interviewees stated: *"Informal discussions over coffee is enough to share ideas and solutions",* but did also express concern over the fact that the R&D department was acting blindly: *"R&D works isolated in a conference room and develops innovation, but does not really know if there is any customer demand or market for it"*. Furthermore, a total of four interviewees stated that ideas, inspiration and solutions should be discussed more interdepartmentally, and were all unified in the opinion that it should not be forced, but encouraged.

5.1.2 Interdepartmental Co-Operation

As mentioned earlier, the interdepartmental exchanges and co-operation at the organisation was found to be exiguous, even if it showed improvements. It appeared clear from the interviews that input from departments such as sales and SBU's was not considered important to the R&D department, or utilized. It was stated that some input from certain innovative persons of these departments would be of interest, but there was still an unequivocal opinion that these departments would mainly contribute ideas for short-term innovation. Additionally,

a request to find a system to streamline the information from sales was expressed by one interviewee.

Nevertheless, one interviewee explained that interdepartmental brainstorming workshops had occurred in the past, which led to successful innovations. Subsequently the participant expressed that this type of workshop would be of interest in the future, to some extend. Another interviewee stated: *"If good ideas exist – they will end up on the table"*.

5.2 Requirement Management

Working with requirements within the innovation projects was identified as both important and difficult during the interviews. The pre-study phase of the innovation projects is where the foundation of the complete project is laid, in other words where the project specification is defined, defining requirements that should be fulfilled in the end. However, several interviewees identified issues with setting clear goals early, leaving a rather floating project specification in the early phases. Also, the need to put more emphasize in the pre-study phase in projects with a high degree of innovation, meaning high risk and uncertainty was discussed, which showed to require more time and resources. One interviewee specified the fact that if the pre-study phase and project specification is done accurately, there would definitively be less late changes, and stated: *"If the pre-study phase is not done accurately, the execution phase has to bear a heavy load, trying to realise perhaps wrong and inaccurate requirements"*. Additionally, it was revealed that decisions were often based on personal bias, subsequently leading to innovations being highly dependent on individuals rather than processes.

5.3 Current State Analysis

As mentioned in the research methodology chapter, one subtheme of the interview was of quantitative nature, analysing the current state at the organisation. This section was developed out of questions that were adapted from the study by Kärkkäinen, Piippo and Tuominen (2001). Analysing the relationship between the situation at an organisation and the tools enabling support in those specific areas. The result presented in Figure 5.1 is the average result from the interviews, where fifteen questions were answered on a scale from 1 (bad) to 5 (good), describing how well that specific statement conforms to the situation at the

organisation, which was presented to the interviewees in the interview framework (Appendix A).

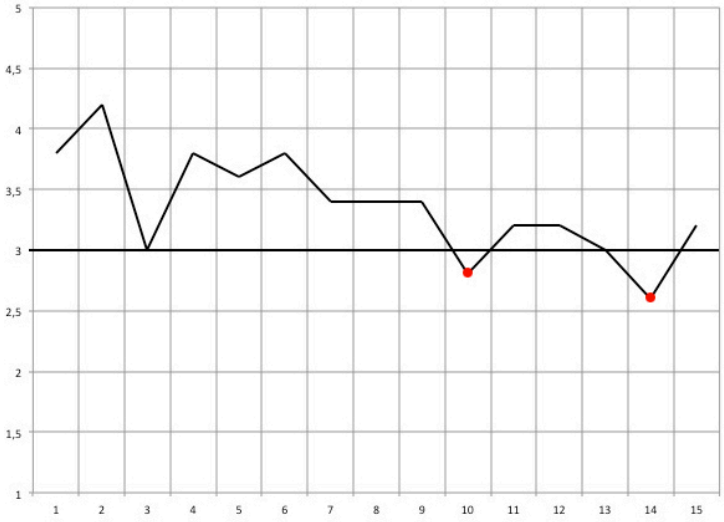

Figure 5.1 – Result From Quantitative Data

Illustrated in Figure 5.1 two definite nadirs (Below 3) can be found in statement 10 and 14. Statement 10: *"Information about customers are well communicated within the organisation"*, and statement 14: *"Customer needs are sufficiently taken into account in the development stage"*. Remaining statements can be found in Appendix A, and the meaning of these results will be further investigated in the discussion chapter.

In addition to the previous, the interviewees all mentioned that no specific supportive tools were currently used. However, tools of this type were identified as useful to a certain extent, particularly in large and complex projects with a high degree of uncertainty.

5.4 Customer Focus

Several interviewees expressed the technical oriented focus existing at the organisation, and the need to understand each industry in depth in order to enable accurate communication with customers was significant, which was not in general conducted at the time. Another aspect that emerged from the interviews in terms of customer focused innovation, was the need to develop innovation based on not only customer needs, but what customers are willing to pay, in other words target cost. One interviewee stated: *"We should develop products and innovations based on target cost, as a few projects in the past has been either too expensive or not fulfilling customer requirements – subsequently not providing any return on investment due to absent sales"*.

One example, standing out of the crowd, was one major project, where one of the interviewees put a lot of emphasize on developing a trustworthy customer relationship, which according to the interviewee took about two years. Additionally the interviewee gained a comprehensive understanding of the specific industry, which provided the opportunity to collaborate with leading customers at a high corporate level, developing innovation for the future.

5.5 Customer Knowledge

The lack of direct customer input at the R&D department was shown to be the opposite at the SBU's, where individuals in person visit several customer plants, and therefore according to one interviewee often know more than each customer concerning issues, solutions and ideas. Subsequently possessing valuable customer information that could, and should be utilized by the R&D department, of which one interviewee stated: *"Ideas and innovations originated at the SBU's should reach the R&D department more often and faster"*.

The knowledge and understanding of market, customers and their demands, expectations and needs was from all interviewees expressed to be lacking at the R&D department. It was clear that this knowledge had to be improved, and requests to increase the contact and relationship with customers were expressed by all interviewees. Improving relationships with customers was by several interviewees considered the potential approach in order to get out of their comfort zone and gain the accurate knowledge.

However, the identification of the right customer(s) was considered difficult. The right customer was defined as willing to implement new technologies and interested in future visions. Additionally, establishing relationships with customers at corporate level was considered important, as lower level would not provide any innovation or ideas of long-term vision. One interviewee stated: *"Key account managers and product managers should know their customers and establish contact and relationship with them"*. Finally, it was stated by another interviewee, that in order for innovation to be efficient a need and *pull* from the market is crucial, opposite to engineers that *push* innovation through several internal and external barriers.

5.6 Customer Involvement

From the result above, identifying the right customers and collaborate closer with them has emerged as fields which the organisation would like to improve within their process of innovation. Furthermore, one interviewee with long experience of customer-focused innovation expressed concern over how the complete business environment had changed, which was no longer on the same personal level, and stated: *"Now customers are just a number in the database"*.

Nevertheless, most of the interviewees specified that ideally, project teams should have constant interaction with lead-customers, by visiting plants etc. Discussions concerning ideas, solutions, vision for the future, and most significant provide feedback, were stated as desired collaboration with customers. Preferably, the customers should be included both in the pre-study phase and execution phase, providing mainly feedback when required. In other words, including lead-customers in the process of innovation was identified as a task that should be used when needed, and not in all innovation projects, mainly projects of large scale, including higher risks and uncertainty. As stated above, entering customers at corporate level was identified as important in order to work with long-term innovation. One interviewee stated: *"Ideally, discussions should be conducted with all levels at the customer organisation, entering at corporate level will enable this, not the other way around"*.

Additionally, in order to enable a more comprehensive collaboration with lead-customers, there has to be a win-win situation, beneficial to both the organisation and the customer. Due to different expertise and knowledge, several interviewees identified the need to discuss with customers in terms that would be understood easily. Avoid too technical terms and provide customer with functions and a complete solution rather than technical aspects. When collaborating with and/or promoting products to customers, most of the interviewees had identified visual aids, such as models, prototypes, drawings etc. as extremely helpful in the use of sharing knowledge and establishing a common language. It was additionally identified that open innovation had occurred to some extent, with tight collaboration with research institutes in the development of materials.

5.7 Control of Innovation

In terms of control of innovation, the main control function was identified as financial. Several interviewees revealed that there was a very high demand on margins, stiff financial steering, and budget constraints, strangling possibilities to conduct innovation to some extent. In addition there was an expressed request for additional funds when encountering unexpected opportunities and ideas. Within SBU's, an internal resistance to long-term innovation was identified, as each innovation must be able to cover its own costs and a focus on immediate sales, leading to innovations and opportunities missed out. One interviewee stated: *"In terms of control and financial restrictions – there is no innovation culture"*. There was also a clear unequivocal opinion that the process outlined in the internal documents, did not reflect the actual work process.

5.8 Innovation Culture

The culture and climate at the organisation is at one first glance very innovative friendly. Observations and meetings indicated that innovation was on top of the agenda, particularly since the acquisition by the new owners. However, the interviews exposed another version. Even if the interviewees all stated that there was a good environment for innovation at the organisation, a few negative aspects were identified. Firstly, in general a fairly low degree of innovation was performed, mainly including improvements of current products. Several interviewees also mentioned that the organisation still suffered from an internal resistance to change, that innovations often were within the comfort zone and stuck in old patterns. On top of this, one interviewee stated: *"The fear of failing is bigger than the will to succeed"*. Keeping innovation very close to the core business, and products adjacent to the initial product that was developed over thirty years ago.

6. Discussion

This chapter is intended to discuss the findings of this research and identify the parallels with the literature review, subsequently leading to answering the research questions in the conclusion chapter.

6.1 Innovation within Organisation

External factors, such as changing environment, markets and customer expectations influences on innovation were clearly stated in the literature review, as well as the importance to understand customer needs and requirements (Moss-Kanter, 2009). A situation that was identified as problematic in this field, both within the organisation of the case study and the literature review was the innovation development in silos. Where it was expressed concern over the R&D departments' innovation that was performed in isolation and lacked input of customer demands and needs, leading to a high product and technical focus, instead of focusing on customer needs and demands. Subsequently this led to a number of innovation projects failing in the past, confirming the literature in terms of the importance of understanding customer, market and changing environment. In the literature, the practice conducted at the organisation of the case was referred to as closed innovation (Du, Leten and Vanhaverbeke, 2014; Lindegaard, 2010), described as where the best and brightest individuals are expected to develop innovations.

Additionally, co-operation between departments were shown to be exiguous within innovation, even if departments such as sales and SBU's shown to possess a lot of valuable customer information, they were often identified as too short-term focused. Parallel to the theory, where the case of Gillette (Moss-Kanter, 2009, p.77) clearly indicate the importance of both interdepartmental co-operation, and combining different markets, customers and technology in order to achieve successful innovation.

Instead, individuals described that informal discussions over coffee were enough to share ideas and solutions and good ideas will eventually end up on the table. Indicating that ideas and solutions were discussed between certain groups of engineers internally. Providing additional evidence to the rather closed innovation that was currently performed. Literature also identifies the use of encouraging information flow across departments and outside organisation, enabling more sources of ideas to be discovered, and internally providing

support to the innovation, breaking internal barriers (Du, Leten and Vanhaverbeke, 2014). As one interviewee expressed, effective innovation require a *pull* form the market instead of engineers that *push* innovation. However, not incorporating other departments, such as sales within the process of innovation enables boundaries to develop. As Selden and MacMillan (2009) describe, innovation, particularly transformational innovation requires support from both within the organisation and externally, which by incorporating departments and customers in the process could improve, particularly in the pre-study phase.

6.2 Requirement Management

Requirement Management was in literature described as one of the most important stages within innovation projects. The foundation for the complete project in the pre-study phase, leading to an increased focus on its role within the management of innovation (Almefelt, 2005). It was shown that managing the requirements, i.e. the transformation of customer needs into technical requirements was difficult and complex, leading to floating project specifications at the organisation of the case. Additionally, projects entailing high risk and uncertainty were identified as requiring more resources to specify accurate requirements. It was clear that requirements defined inaccurate would be costly later in projects, often requiring late changes.

As the pre-study phase and the specified requirement sets out the foundation for the complete innovation project (Lindegaard, 2010), it is clear that putting more emphasize in this phase to make accurate requirements is important in terms of both profitability and customer value. Setting correct requirements initially will both reduce the risk for late changes, as cost of change increases with time (Folkestad and Johnson, 2002), and support to ensure that high customer value is achieved. However, as it is still identified as a difficult task, tools and methods may support in the process of setting requirements.

6.3 Tools and Methods of Innovation

The quantitative current state analysis, together with the previous statements, indicates that tools would be helpful to the organisation in the pre-study phase, more specifically within the process of setting requirements and selecting concepts. The statements that were identified as not well functioning at the organisation (10: *"Information about customers are well communicated within the organisation"* and 14: *"Customer needs are sufficiently taken into*

account in the development stage") was in the study by Kärkkäinen, Piippo and Tuominen (2001, p.173) correlated to the use of Quality Function Deployment (QFD) and PUGH matrix, to support the organisation and the process of innovation

QFD is a tool that has been used by many leading corporations, and been identified as one of the most useful techniques in total quality management (Cristiano, Liker and Ward, 2000, p.288). The tool enables communication across barriers and helps engineers to focus on value-adding product features and prioritise in terms of their relevance to the customer satisfaction, ensuring that requirements are selected and prioritised in terms of customer value and satisfaction (Sorli and Stokic, 2009). This would support the organisation of the case, particularly in innovation projects with high degree of risk and uncertainty. Enable higher customer value, by focusing on innovation features and requirements providing high customer satisfaction.

PUGH matrix is a simple tool that supports engineers to select concept based on criterion. In a matrix, it presents each concept strengths and weaknesses, enabling engineers to select concept on a well-informed foundation (Silverstein, Samuel and DeCarlo, 2009). From the interviews it was revealed that the heavy organisational structures made changes difficult, leading to concept being deselected based on costly changes in the demand chain. However, PUGH matrix could support the organisation to select concept based on strengths, weaknesses and costs, rather than selected on somewhat of a personal bias.

6.4 Customer Focus

The interviews revealed that the organisation was mainly technical oriented, a common situation when closed innovation is conducted, often focusing on core innovation (Selden and MacMillan, 2009). Additionally, a few projects in the past had been identified as failing due to too expensive price tags, recognizing the use of innovation based on target cost. In line with the literature, applying target costs is one successful aspect of Lean Innovation, providing both internal departments and external organisation the possibility to plan their innovation in terms of costs, quality, and profitability (Ward et al., 1995).

Understanding market, customer and competitors are vital in terms of developing successful innovation (Moss-Kanter, 2009). Defining successful innovation as high customer value,

which is equal to benefits divided by costs (Association for Project Management, 2012). From the interviews, there was evidence of lacking customer knowledge at the R&D department, while the SBU's was identified as well established in terms of customer knowledge, proposing that customer information, ideas and solutions should be able to reach the R&D department faster, once again indicates the importance of interdepartmental co-operation.

Request to improve customer knowledge through increased contact and relationship with customers was also expressed, as this would enable a *pull* from the market in terms of innovation. It was however expressed concern over the difficulties in identifying the right customer(s), enabling long-term innovation vision. It was clear from the interviews that for the long-term perspective, entering customer organisation at corporate level was important; subsequently enabling discussion at all levels within customer organisation. Involving customers in the process of innovation has in several cases proven to be successful (Sorli and Stokic, 2009), and according to Öberg (2010), organisations have to decide what type of involvement that is most suitable. Identified from the interviews, desirable involvement included feedback, discussion of solutions and visiting plants.

Within the communication with customers, the interviewees in line with the literature raised the importance of visual aids such as drawings, models, and prototypes in order to be able to communicate and share knowledge accurately. In the literature often referred to as boundary object (Huang and Huang, 2013). Nevertheless, there was also expressed concern over the fact that the personal relations within the business world had change, and the fact that customer merely was a number in the database. A trend that the organisation most likely need to change in order to establish the accurate relationship, involvement and collaboration with customers in order to achieve long-term and successful innovation in the future.

6.5 Innovation Strategy

High demands on margins, stiff financial steering, and budget constraints was from the interviews revealed as strangling innovation. Additionally, a short-term focus on immediate sales within the SBU's, and enabling additional funds for unexpected opportunities was expressed. According to Selden and MacMillan (2009) budget and control tend to strangle innovation and creativity. However, budget and control are important within organisations,

but should be enabled more flexibility and detachment from the day-to-day business of the organisation, particularly transformational innovation (Moss-Kanter, 2009).

The findings indicated that there was no real innovation culture in terms of control and financial restriction, which changed the initial impression of the culture that existed within the organisation. It was clear that the organisation did put a lot of resources and emphasize on innovation, however the interviews revealed a somewhat of restricted environment. In general, a fairly low degree of innovation was conducted at the organisation, meaning that mostly product improvements was performed, which all could be rooted back to the initial product from the early 1980s. It was clear that the organisation tended to be stuck in old patterns and their comfort zone, which was still a successful and comfortable business case. However, as Nagji and Tuff (2012) identified an optimal innovation ratio should include core, adjacent, and transformational innovation (70-20-10), additionally supporter by the innovation pyramid (Moss-Kanter, 2009). This implies that the organisation in the long-term perspective, due to its focus on mainly core and adjacent innovation, may not be able to keep up with competitors and development, leading to risk of business stagnation (Nagji and Tuff, 2012).

Furthermore, the organisational structure was by one interviewee described as heavy, meaning that the complete demand chain was based on one single concept, requiring a lot of work and changes in order to enable larger changes in the product portfolio, limiting the opportunities of developing transformational innovation.

The organisation was according to several interviewees suffering from an internal resistance to change, and one of the perhaps most significant statements indicated that the fear of failing was bigger than the will to succeed, additionally keeping innovation close to the core business. Entailing that particularly within innovation projects, control and budget should be flexible to some extent. As well as the innovation culture should be more encouraging, encouraging individuals to try new paths, interact with individuals across departments, organisations, and customers.

6.6 Managerial Implications

This section is intended to provide the organisation of this case study with future implications in terms of the management of innovation, improvement suggestions to the process of managing and conducting projects of innovation. The findings of this research presented clear similarities between the organisation of the case and the literature, indicating that this case did not stand out of the crowd and could be compared with other similar cases, and the future implications as well. Additionally, the literature review presents well-recognized practices and approaches to innovation, which has been identified as useful to the organisation.

The findings indicated that the R&D department should implement an increased focus on customer value, by enhancing the collaboration both interdepartmental, and with customers and other external organisations. Providing the process of innovation with more sources of ideas and perspectives, increasing the understanding and knowledge of customer demands, needs and value. Additionally, applying more resources in the requirement management, establishing accurate requirements in the pre-study phase is important, and if needed due to high risk and uncertainty, apply supporting tools such as QFD and PUGH.

The interdepartmental collaboration should be encouraged, not forced. The collaboration should include visual aids to a great extent, increasing the knowledge sharing and understanding of other perspectives. Increasing the interdepartmental collaboration would enable the mixture of different customer segments, technologies, and markets, a proven source of successful innovation, as well as decreasing the internal boundaries and resistance to change. The interviewees were unified in the importance of entering customer at corporate level, to enable discussions with all levels at customer organisation, but did not perceive this as important within their own organisation, indicating somewhat of equivocal statements.

Applying useful strategies from lean innovation is also suggested, once again focusing on achieving high customer value and avoid late changes, highly related to decreased cost and putting more emphasize in the pre-study phase, investigating and collaborating with customers. Gain and share knowledge through the use of visual aids, both within the organisation and externally with customers and suppliers. Apply target cost to some extent, not strangling innovation too much, but still ensuring that customers are willing to pay for the outcome of the innovation. Open innovation, was shown to be used to some extend,

collaborating with research institutes within the development of materials, this should be encouraged at more levels within the organisation, avoiding the current closed innovation. Within Agile development, decreasing the gap between the outlined process and actual work process should be applied by incorporating the individuals that actually work with innovation in the definition of the innovation process, as it was shown that the process on paper was not actually followed.

Top management should consider innovation in terms of portfolio level, applying resources and investment in a wider range of innovation, using the innovation pyramid as a starting point. Particularly the current absence of transformational innovation of the case should be considered, for the long-term survival of the business. Through the strategy of applying both core, adjacent, and transformational innovation, and encouraging interdepartmental collaboration, the organisation would enable a change in the innovation culture, changing the fear of failing into *dare to succeed*, get out of old patterns as within innovation you got to bet to win.

7. Conclusion

Through the investigation of a single case study, this research has in a qualitative approach been able to identify the current situation at one organisation within the industrial automation sector. Examining how innovation functions in practice, compared to recent research, enables proposition of future improvements for the case in question. The research entails a high credibility due to the applied triangulation, but may lack in the transferability due to the high contextualisation.

The organisation of the case study showed to correlate to several similarities within literature, in terms of conducting the main innovation in silos with little interdepartmental collaboration and exiguous interaction with customers, leading to a fairly low understanding of customer needs, demands, and value. The organisation can be described as technical oriented, and by working mainly with closed innovation tends to innovate close to the core business.

The importance of achieving support and establishing accurate requirements has been identified as significantly important by both literature and research findings, requiring interdepartmental co-operation and focus on the pre-study phase, as well as enabling a mixture of different markets, customers, and technologies. Using tools such as QFD and PUGH may both support the requirement specification and the achievement of high customer value by reducing personal bias in the decision-making and prioritising requirements that produces value. Also the use of lean methods such as target cost, visual aids to share knowledge, and focusing on customer value have been identified as potential future improvements.

Establishing close relationship with strategically right customers and develop trust is highly important, even if it is demanding, expensive, and time consuming - it often pays off. Top management should consider innovation on portfolio level in terms of the innovation pyramid, in order to achieve both current and future success, and gain competitive advantage. Achieving an innovative friendly culture is significant to successful innovation, which should entail that individuals are not afraid to try new paths, encourage creative thinking outside the box, and instead of fear failing, individuals should dear to succeed, because in order to win, you have to bet.

7.1 Research Questions

This section presents the research questions that was initially set for this research, and tries to answer them from the findings that was revealed from the research.

1. What are the barriers and enablers within the process of innovation?

It was clear from the case study that internal resistance to change existed, and that there were significant differences in the priorities within the organisation, either focusing on short-term success or future success, and a fear of failing. Additionally, there was a clear consistency in being stuck in old patterns and stay within the comfort zone, keeping innovation core in terms of its proximity to the core business.

There was however a clear strive towards an increased collaboration with customers and between departments, which would enable innovation to encounter less internal and external barriers, creating support and unified vision for the innovation that would benefit all departments is therefore important. Otherwise there is a high risk for internal resistance and barriers to overcome.

2. How to improve the process of customer focused management within innovation?

As specified earlier, the following process improvements have been identified:

- Focus on achieving high customer value.
- Increase the collaboration both internally between departments and with customers.
- Apply visual aids in the communication and knowledge sharing, such as drawings, models and prototypes.
- Apply target cost in the process of innovation.
- Prioritize projects in terms of requirements, not available resources at organisation.
- Consider the complete innovation portfolio in terms of the innovation pyramid, enabling both future and current success.
- Do not fear failing, dare to succeed.

3. What tools and techniques are most applicable when collecting customer needs and transforming them into specific requirements?

Within the organisation of this case, particularly the use of QFD was shown to be important, supporting in the requirement management, focusing on customer value, considering competitors, and reducing waste. Particularly enabling an understanding of the customer perspective, which before hand requires a lot of resources in the pre-study phase, investigation, collaborating and discussing with customers and departments.

Secondly, the use of PUGH concept selection tool was shown to enable support in the selection between different concepts. Particularly in projects with a high degree of innovation and uncertainty, entailing a lot of variables to be considered of each concept, reducing bias and enabling informant decisions.

7.3 Future Research

This research has limitations, which would require future research in order to verify the findings and fill gaps in current research. As mentioned, innovation is a complex and difficult process to manage, enabling many interesting perspectives and focuses to be investigated.

Firstly, investigating a more comprehensive study within the decision-making process of transformational innovation projects would be both interesting and valuable, as decisions concerning long-term innovation often are based on complex and perhaps uncertain data.

Secondly, examining the enablers and barriers for customer involvement within innovation projects, which has been identified as important. However the involvement must both consider legal aspects and provide a win-win situation.

Finally, investigating what and how organisations should apply scalability on innovation projects, in terms of management methods and resources, depending on proximity to the core business and uncertainty.

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Appendix A – Interview Framework

Part	Question	Answer
1.0 Current Process	1.1 How does the current process function as a guideline/roadmap?	
	1.2 What problems have been identified in the current process? [VOC/Technical solutions etc.]	
	1.3 What current process/tool/method do you identify as particularly useful?	
2.0 Customer Input	2.1 How do you identify customers and the "right" person within specific firm?	
	2.2 How (and when) do you collect feedback and input from customers?	
	2.3 What input from customers is desirable for FlexLink?	
	2.4 Possibilities/Constraints when involving customers in innovation?	
	2.5 What **practical** possibilities/constraints exist when involving customers in the innovation process? [Workshops/Visit plants/Others]	
3.0 Process Requirements	3.1 What kind of requirements does the manage innovation process have? [Quality/Control/Cost/Time/Other]	
4.0 Transforming Needs Into Technical Requirements	4.1 How do you currently transform customer needs/demands into technical requirements/features?	
	4.2 Is customer feedback collected continuously or at one single time?	
	4.3 What tools/methods are used? [Prototypes/discussions/Other]	

5.0 Organisational Involvement	5.1 Which parts of the organisation are currently involved in the innovation process? (Before B1) [Earlier projects?]	
	5.2 Which parts of the organisation ***should*** be involved in the innovation process? Why? (Before B1)	
	5.3 What type of information may and should be contributed from each part? [Sales/development/Others]	

	Statement	**1-5**
6.0 Current State Analysis	6.1 *We know a lot about our customers and their needs/demands*	
	6.2 *We know from which sources information about customer needs can be found*	
	6.3 *Customers do see the customer orientedness of FlexLink*	
	6.4 *There are a lot of contact between FlexLink and customers*	
	6.5 *Needs of customers are well known at FlexLink*	
	6.6 *Customers are able to express their needs / needs are understood well*	
	6.7 *FlexLink are able to differentiate customer needs*	
	6.8 *The customer downstream demand chain is long / complex*	
	6.9 *FlexLink does distinguish the important needs from the less important*	
	6.10 *Information about customers are well communicated within FlexLink*	
	6.11 *Competitive situation is evaluated systematically*	
	6.12 *Meetings within development are effective and does not address irrelevant issues*	
	6.13 *Distinct goals for product development are easy to be set*	
	6.14 *Customer needs are sufficiently taken into account in the development stage*	
	6.15 *Choosing concepts from many alternatives are often easy*	

7.0 Soap Project Experience	7.1 How did FlexLink collect customer needs/demands in Soap project?	
	7.2 What should be done again, and what should be changed in future projects? Why?	
	7.3 How involved was lead-customers in solutions/technical requirements etc. (in Soap project)?	
	7.4 Other issues/potential within lead-customer involvement that emerged during Soap project? (Time/cost/demands/solutions/etc.)	

8.0 Future Process (Desired State)	8.1 Identified improvement potential for future process?	
	8.2 Required tools/method/input in future process?	
	8.3 What organisational parts should be included in future process?	
	8.4 What type of involvement (how) and input from lead-customers? [Demands/Needs/Solutions/Others]	