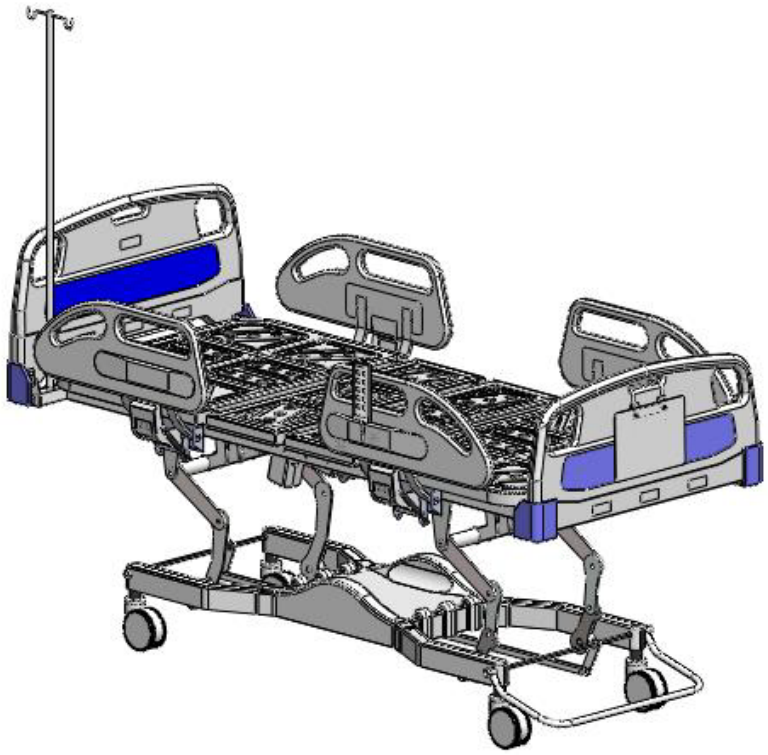
Improving product innovation at PT. Sarandi Karya Nugraha



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Bachelor Thesis

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PT. SARANDI KARYA NUGRAHA

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Management Summary

This report is the result of a three month research at PT. Sarandi Karya Nugraha. Sarandi is an Indonesian SME which produces medical equipment.

This research aimed to explore how Sarandi can improve their product innovation. This was realized by formulating a best practice model from the literature and comparing this to the situation at Sarandi. Pilot projects were then used to find out how the organization handles changes and if certain aspects of the general theories in the literature worked in this environment. Based on both the comparison between the literature and reality, and the pilot projects, conclusions and recommendations were formulated.

The first step was to review the literature on critical success factors for innovation. Subsequently the implications of being an SME and originating from an emerging economy were studied. This led to five elements. The heart of the approach is the **innovation process**. This has to be supported by an **innovation strategy** and conducted in an **innovative organization**. In order to overcome the disadvantages from being an SME and originating from an emerging economy, **external inputs** are needed to upgrade the innovation process. These external inputs can be used effective and efficient when the firm possesses sufficient **absorptive capacity**.

By interviewing different people in the organization and by performing objective observations it was determined to what extent the success factors were used at Sarandi. This resulted in a detailed description for all elements.

Two pilot projects were then started. During these projects, elements from the literature were introduced to the innovation process, in order to test how changes were adopted and if any benefits could be observed from these changes. Towards the end of the pilot projects, evaluation interviews were scheduled with the team members to capture their opinion on the changes.

Based on the results from the research and the pilot projects conclusions were drawn. Table A shows on a scale from one to seven the extent to which the situation at Sarandi is in line with the literature. This shows that the way innovation is organized at Sarandi is not in line with the literature. However, based on the results of the pilot projects it can be stated that the organization is willing and capable of changing. The final conclusion was therefore that in order to improve the product innovation, Sarandi has to change their innovation process in line with the best practice model. In order to make the right changes, recommendations were formulated.

Innovative Organization	
Innovation Strategy	
NPD Process	
External Inputs	
Absorptive Capacity	

Table A

The most important recommendations are to work in cross functional teams, limit the role of the managing director to organizational sponsor, develop an innovation strategy and increase the involvement among the employees. Besides that, Sarandi should try to seek foreign partners in order to create external inputs.

Some remarks can be made regarding the validity of the research. The data that were gathered from interviews were based on people's perceptions and even though they all matched, it is not sure whether it is objective. Furthermore, in order to draw firmer conclusions on the usefulness of the model a longitudinal approach needs to be taken. This study should also include multiple companies.

Preface

This document is my bachelor thesis. It serves as the final examination in order to finalize my bachelor education at the University of Twente. For my bachelor thesis I performed a research towards improving new product development in small and medium enterprises in emerging economies. I performed the research at PT. Sarandi Karya Nugraha in Sukabumi, Indonesia.

During my three months at Sarandi, I have experienced more than I could have ever hoped for. I have improved some critical skills in communication, leadership and analytical thinking. Moreover, I got the opportunity to experience a new culture. I have made many new friends, have seen many unforgettable things and gained a different perspective.

It is therefore that I want to thank Mr. Arief in particular. He supported me at work and showed me around Indonesia in my free time. Furthermore, I would like to thank my colleagues and friends, Mr. Isep, Mr. Budi, Mr. Ferdisar, Mrs. Yeni, Mr. Razali, Agung, Agustian, Bolu and Wudi. Besides these people with whom I have worked very closely I would like to thank all my other friends from Indonesia, who made my stay there so great.

Finally I would like to thank Martin Stienstra and Tiago Ratinho who supported me with their useful feedback and helped me to get this thesis to its current state.

Hopefully, this research can contribute to the success of Sarandi in the future, so that they can stay an example for other companies from Indonesia and other emerging economies.

Enschede, January 2012,

Luuk van Stek

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1 Introduction

In this report the efforts on the research towards improving product innovation at PT. Sarandi Karya Nugraha are formulated. PT. Sarandi Karya Nugraha, from now on referred to as Sarandi, is an Indonesian small and medium enterprise (SME) which produces hospital equipment. This chapter will introduce the reader to the research. It will do so by first introducing the country, Indonesia. Subsequently the company, Sarandi, will be addressed. Then an introduction to the problem is presented where the research question will be stated. Paragraph 1.4 provides the reader with background information on important concepts in this research. The final part of this chapter will explain the structure of the rest of the report.

1.1 Indonesia

Indonesia is a country situated in the South East of Asia. The country consists of many islands of which the biggest is Java. The majority of the Indonesian population lives on Java. Jakarta, being the capital of Indonesia is the center of the economy and culture. Jakarta has almost 10 million inhabitants. (CIA Factbook) In total Indonesia has 245.613.043 inhabitants as estimated in July 2011. Therefore Indonesia is the 4th biggest country in size of the population. (CIA Factbook) The population is spread over more than 17.000 islands of which about two thirds is inhabited. (Lonely planet)

Just like many other countries in South East Asia, Indonesia can be considered an emerging economy with an average growth in gross domestic product (GDP) of 6 percent in 2010 and 6,5 and 4 percent in 2008 and 2009 respectively. This brings the total GDP at purchasing power parity (PPP) at 1,033 trillion US Dollar which is $4.300 per person. Compared to the Netherlands, the total GDP is one and a half times bigger, but per person the Dutch GDP is almost 10 times as large as that of Indonesia. (CIA Factbook)

The most common religion is Muslim (86,1%). Religion has a big impact on both private and working life in Indonesia. For instance, employees are allowed a special break in order to pray and every Friday all men go to the mosque together. With 8,7 percent, Christianity is the second largest religion followed by Hindu with 1,8 percent. (CIA Factbook)

1.2 Sarandi

Company

Sarandi is a medical equipment manufacturer that started as a company in 1997. It is founded by the current managing director Isep Gojali, in the city Sukabumi. Besides the factory in Sukabumi there is an office in Jakarta for sales and marketing. Since Sarandi was founded, it grew from 7 employees until the current 267 employees.

Sarandi's main products are hospital and ICU beds, stretchers, gynecology beds/chairs, dentist chairs and bedside cabinets. From these products there exist some standard products and based on those, the portfolio shows many other varieties with small adaptations from the standards. This causes the total amount of products to be very large.

In the factory there is one production line where all products follow the same process. First the raw material is cut. Then there are more machining handlings, drilling and bending. Different components are then welded together to subassemblies which are going to grinding, chemical treatment and polishing. Finally the parts are powder coated, assembled and packaged. Some parts are bought from suppliers and subcontractors and processed in the assembly stage. This process is shown graphically

in appendix 1.
Mr. Gojali is the managing director and head of the company. There are two commissioners, Mr. Kustomi and Mr. Prasetio, who take care of the strategic management. Mrs. Marlina is the personal assistant of Mr. Gojali and she arranges everything he needs. The management team consists of Mr. Rachman (general manager), Mr. Adrian (marketing & sales), Mr. Razali (production) and Mr. Somantri (finance).These people take care of the day to day management of the company. Below the management team there are the different heads of department, who are in direct contact with, and lead, the operators and administrative employees. The organization chart is shown in appendix 2.

Certification
Sarandi is ISO 9001 and ISO 13485 certified, which means that they fulfill quality management systems requirements and that they live up to specified medical standards. Besides the ISO certification, the Indonesian government will obligate the ICE standards for all medical equipment manufacturers. However the demands to the products are different, since medical equipment is divided in different categories.

I. Medical equipment without electrical functions
IIa. Medical equipment with electrical functions
IIb. Medical equipment with electrical functions and micro chips
III. Very complicated medical equipment (MRI scanners, Implants, etc.)

Sarandi has some products belonging to class 1 and some belonging to class 2. Besides those, Sarandi has some non-medical products like the bedside cabinets, which do not categorize under the new legislation.

Corporate social responsibility
Sarandi tries to be a front runner in the area of social responsibility. A good example is that Sarandi offers an opportunity to less fortunate people. Therefore, Sarandi currently employs five people with a disability; deaf and mute.
Although it is not their core business, Sarandi works on improving agricultural techniques in order to help out local farmers, as well as the environment. Sarandi is currently developing new methods to grow rice, which can double the productivity. Besides that the company also helps farmers using compost to re-fertilize the soil. This is not only good for the productivity of the land, it also reduces the emission of methane.
Another project of Sarandi is to capture rainwater around the factory and use this for flushing toilets.

Market
Sarandi operates mainly in the Indonesian health care market and sells their products all over the country. At times they also receive orders from foreign customers. There are for instance orders from Singapore, the UN and some countries in Africa.

The domestic market for Sarandi is large with over 1320 hospitals. Within this market they mainly sell their products to the middle to low end, by making economical products. Furthermore most of their customers are government owned hospitals. This limits the market for them since a little over half of the hospitals are private enterprises. The reason for selling to government owned hospitals, is that they work with budgets and do not bargain about prices as long as it fits the budget. Doing business with private hospitals is more difficult since they have very specific and strict demands about quality and price.

One characteristic of the Indonesian market is the importance of the brand name. Hospitals believe that products from foreign brands always have higher quality than Indonesian brands. Big hospitals in Jakarta even prefer to pay triple the price for an American product compared to a similar product from an Indonesian brand.

No.	Owner	2003	2004	2005	2006	2007	2008
1	Ministry of Health	31	31	31	31	31	31
2	Provincial/District/Municipality Government	396	404	421	433	446	446
3	Armed Forces/Police	112	112	112	112	112	112
4	State-Owned Corporation	78	78	78	78	78	78
5	Private	617	621	626	638	652	653
	Total	1234	1246	1268	1292	1319	1320

Table 1 (Indonesian Ministry of Health)

The Indonesian healthcare market can be expected to grow very fast in the near future. This expectation is based on two facts. On the one hand the government is working on reforming the health insurance market, which will lead to a universal coverage. Therefore, many poor people who could not afford to go to a hospital before will get that opportunity. On the other hand, the ratio of inhabitants to hospital beds in Indonesia is now 1-1360. The standard that is used by the World Health Organization (WHO) is 1-500. This also implies that the amount of hospital beds in Indonesia has to increase by more than 100 percent in order to comply with this rule.

In Indonesia, Sarandi faces competition from MAK, Paramount and Tesena. Besides these companies there are some smaller competitors.

As mentioned before Sarandi buys mainly raw materials, but some components are bought from subcontractors and suppliers. Purchased components are for instance mattresses, actuators, lifting columns, plastic head and foot panels and wheels.

1.3 Problem definition

Previous research at Sarandi shows that there is room for improvements in many fields, like production, planning, human resource management (HRM), sales and marketing. (Westrik, 2010) From first observations and interviews these conclusions seemed accurate. Therefore it was important to set a scope for the research and focus on one topic. In that way the complexity and workload was manageable in the available time.

From the first interviews that were conducted with the management of Sarandi it immediately became clear that they wanted this research to focus on product innovation. They believed that the products of Sarandi were not competitive enough in the market and when the process of developing a new product would be improved this would lead to a competitive edge. Before product innovation was accepted as the topic of this research, it had to be confirmed that performance in this area was poor in order for the research to be of sufficient added value.

Whether the products were competitive in the market was difficult to justify. Sarandi had no focus on market research and therefore the knowledge about customer demand and competitor activities was very limited. This made it hard to determine the current position of Sarandi's products.
A possible indication that the products were not good enough was the decrease in turnover from 2009 to 2010. This could of course have had other causes like the financial crisis, or other problems that caused an overall decrease in demand.

However, even if the products were up to standards, they have to be upgraded at some point. An example of this necessity is that Sarandi has to upgrade their products due to the changed legislation in Indonesia. Another reason to improve their products is to sell their products to private hospitals where demands for quality and price are higher. Therefore it is essential to possess a well functioning product innovation process. At first glance, the current process of innovation is not yet optimal. Among others, there is a lack of long term plans for innovation and a lack of interdepartmental communication. Since improving product innovation is the preferred topic of the directors and since it will, most likely, improve Sarandi's competitiveness; improving product innovation will be the focus of this research. Therefore the research question is

"How can Sarandi's product innovation be improved?"

In order to answer this question, it can be divided into two sub-questions that together lead towards a solution for the research question.

- What are the critical success factors for product innovation mentioned in the literature? (focusing on emerging economies and SMEs)
- How does Sarandi currently conduct product innovation?

1.4 Important concepts

In this paragraph the concepts product innovation and emerging economy are discussed. These concepts will be used throughout the rest of the text. The short introduction to these concepts serves as background information for the rest of the thesis.

1.4.1 Product Innovation

Product innovation is part of the broader concept; innovation. Tidd and Bessant see innovation as change. They define four broad categories: (Tidd and Bessant, 2009)

- Product Innovation – changes in things (products/services) that an organization offers
- Process Innovation – changes in the way in which they are created and delivered
- Position Innovation – changes in the context in which the products/services are introduced
- Paradigm Innovation – changes in the underlying mental models which frame what the organization does

From this division the relation between product innovation and innovation becomes clear. New product development (NPD) is often used as a synonym for product innovation. Even though it is not exactly a synonym, this report will treat them as such in order to avoid complexity from the incompatibility of NPD and product innovation.
Since the research focuses on product innovation, the term innovation will from now on refer to product innovation.

1.4.2 Emerging Economy

Emerging economies can be defined as "developing countries that have started an economic reform process aimed at alleviating problems such as poverty, poor infrastructure, overpopulation, and achieved a steady growth in gross national product (GNP) per capita". (Cavusgil et al., 2002) The International Finance Corporation identifies Indonesia as one of the 51 emerging economies in the world. (Hoskisson et al., 2000)

In recent years an increasing amount of established Multi National Corporations (MNC) attempted to enter the markets in emerging economies. However, they experience problems in doing so, since these countries differ significantly from Western, developed, countries.

Therefore there is a growing amount of research being done towards the success factors of doing business in emerging economies. This is needed to create a better understanding of how to benefit from these markets. As can be concluded from this, the fact that Indonesia is an emerging economy also has its implications on this research.

The main difference between established and emerging economies can be explained using institutional theory. Institutions are metaphorically described by North as “the rules of the game”. (North, 1990) More formally they are defined by Scott as “regulative, normative, and cognitive structures and activities that provide stability and meaning to social behavior”. (Scott, 1995) Institutions can be divided between formal and informal institutions. The former “are guaranteed by state agencies and their disapproval is sanctioned by that state” meaning that they consist of official laws and clauses. (Lauth, 2000) Informal institutions are not official. Therefore the biggest difference with formal institutions is that they are not written down. “The power of sanction involved with them is linked largely to social mechanisms of exclusion”. (Lauth, 2000)

Institutions are the rules in a country or region, which shape the way people behave. They consist of formal rules mainly in the form of laws and informal rules which are mainly the social guidelines. In emerging economies, there are less formal institutions. Causing difficulties for established MNCs, because they cannot rely on for instance patents and other legal issues. In emerging economies the informal institutions are leading, which forms an important barrier for Western people and companies to do business in those countries.

Besides these political and social barriers Khanna et al. identify some other differences. They mention the underdeveloped product, labor and capital markets that make it more difficult for MNCs to operate in emerging economies. (Khanna et al., 2005)

1.5 Structure of the report

The rest of the report is structured as follows. Chapter two serves as an overview of the literature on success factors for innovation. After the general success factors, the implications from being an SME and originating from an emerging economy will be discussed. This leads to two factors that help to overcome the disadvantages. Together with the general success factors they form the model that will be used as best practice, against which the situation at Sarandi will be compared.
Chapter three subsequently discusses the methodology that is used to research how innovation is currently conducted at Sarandi. It will also describe the methodology used to test the applicability of the best practice model at Sarandi.
In chapter four the findings of the research are presented. For every element of the model a detailed description is given on the extent to which this element is used at Sarandi.
Chapter five describes a pilot project that was conducted to find out how the organization handles changes and if certain aspects of the literature will work in this environment. An evaluation of the project will complete the chapter.
Chapter six wraps up the report with conclusions on how much the situation at Sarandi is in line with the literature and how Sarandi can improve their product innovation. In the recommendations the conclusions are put into advices how Sarandi can accomplish to improve their innovation and finally there will be a short discussion.

2 Literature framework

In this chapter an overview is given on which critical success factors are mentioned in the literature, concerning innovation. In the first place, in paragraph 2.1, the focus is on success factors for innovation in general. At this point, location and firm size are not taken into account. Subsequently the implications of being an SME and originating from an emerging economy will be discussed in 2.2. Afterwards, in 2.2.1 and 2.2.2 solutions on how to overcome these disadvantages will be examined. This leads to an overview of critical elements for innovation in an SME from an emerging economy.

2.1 Critical Success Factors for innovation

In this paragraph success factors for innovation are sought from literature. In this field a lot of research has been done. This does not always supplement each other. Ernst argues that a universal framework for successful product development does not exist. (Ernst, 2002) However, different studies broadly cover the same topics. In table 2 the overlap between the elements of three studies is displayed.

In the first column the main success factors from Ernst's 2002 literature review are shown. In this paper he summarizes the most important findings from empirical research that has been done towards success factors in NPD up to 2002.

The second column shows the elements of Cooper's innovation Diamond. (Cooper, 2006) This is a practical model that summarizes the empirical research of Cooper and Kleinschmidt from 1996. Cooper and Kleinschmidt are seen by Ernst as the two leading researchers on NPD success factors. (Ernst, 2002)

The third column is based on the book, Managing Innovation, by Tidd and Bessant. (Tidd and Bessant, 2009) This book takes a different approach compared to the two other authors. First of all it covers the broader concept of innovation instead of focusing on new product development, like Cooper and Ernst did. Secondly, it is more practical by also including management practices and detailed descriptions on how to tackle possible problems that can be faced.

Despite the different approach, the three elements used by Tidd and Bessant cover the same topics as the four elements from Cooper and the five categories from Ernst. Within the elements there are some differences between the authors. Therefore the success factors of all authors will be combined and displayed in the framework of Tidd and Bessant. The reason for using their topics for displaying all success factors is that the other success factors can be easily placed in the elements of Tidd and Bessant's framework. This is due to the thoroughness of their work, which takes everything into account and therefore their framework can cover all success factors. It is also the preferred model because of the clear definition of the elements. They allow the success factors of the other authors to be easily placed in one of the elements.

Ernst	Cooper	Tidd & Bessant
R&D Process	Idea to launch system	Process
Organization	Climate, Culture, Teams & Leadership	Organization
Culture		
Role and Commitment of SM	Resources	
Strategy	Strategy	Strategy

Table 2

Together these authors form a complete picture of product innovation success factors. Ernst provides a summary of previous empirical research, Tidd and Bessant have a more practical approach

towards successfully managing innovation and the Innovation Diamond provides the experience and conclusions of two of the leading researchers in the field.

2.1.1 Building an Innovative Organization

Tidd and Bessant see an innovative organization as a prerequisite of being successful in innovation. For them the innovativeness of an organization is determined by the concepts leadership, organizational structure, key individuals, involvement, effective teamwork, innovative climate and external focus. Two concepts will not be separately discussed here. These are leadership, since leadership is a quality a person possesses and therefore it will be part of key individuals, and external focus. The reason to exclude external focus is that it will play a more important role in this approach. This will become clearer later in this chapter. The other concepts will now be explained; in addition it will be mentioned which success factors also come forth in the work of the other authors.

Tidd and Bessant stress the importance of a suitable organizational structure and processes to enable innovation. For the different organizational structures they draw upon the work of Mintzberg who specified different organizational archetypes. In appendix 3 an overview of these archetypes is given, along with the implications they have on innovation. (Tidd and Bessant, 2009) The most important aspect of choosing a structure is that it has to fit the operating contingencies of the organization. These contingencies are the size, age and strategy of the company, as well as whether they use small batch or mass production.

Innovative organizations need key individuals. These are distinct roles that have to be fulfilled. Tidd and Bessant mention the project champion, the person who believes in the project and who motivates other team members in order to get the work done; the organizational sponsor, a person high in the organization who can pull some strings to make the project happen; the business promoter, someone to represent the user perspective; and the gatekeeper, a person who connects different information sources in the organization. (Tidd and Bessant, 2009) In addition to these roles the project leader is added. Leadership is described by Tidd and Bessant as a separate success factor, but here it is seen as a key individual.
Cooper and Ernst also mention the product champion, the team leader and the organizational sponsor, or in Ernst's terminology a power promoter. This last role is very important according to both Ernst and Cooper, they say that senior management should support the projects in order to overcome internal resistance. (Cooper, 2006; Ernst, 2002) Cooper says that innovation should be part of management's performance indicators as an extra incentive for them to support innovation. (Cooper, 2006)

High Involvement Innovation is a concept in which all people in the organization contribute in one way or another to innovation. Bessant defined five stages in High Involvement Innovation. These stages go from random problem solving, short term benefits and no formal efforts of structure, to; involvement as a dominant way of life and everyone being actively involved in the innovation process. (Bessant, 2003) In appendix 4 the characteristics of each stage are described.

Effective teamwork is mentioned by all authors as a critical success factor. They all mention that innovation projects should be conducted by cross-functional teams. (Tidd and Bessant, 2009; Cooper, 2006; Ernst, 2002) Ernst argues that in this team there should be at least people from marketing, R&D and production. (Ernst, 2002) Tidd and Bessant stress that the behavior styles of the team members should match. (Tidd and Bessant, 2009) Moreover they say that there should be clearly defined tasks and an effective conflict resolution mechanism within the group. (Tidd and Bessant,

2009) All of the authors state that the team needs a competent leader who will stay on the project during the whole runtime. (Tidd and Bessant, 2009; Cooper, 2006; Ernst, 2002) Cooper also argues that innovation teams benefit from software tools that can support them throughout the process. (Cooper, 2006)

An innovative climate is also mentioned by all authors, but only Tidd and Bessant clearly specify how such a climate can come about. They mention: (Tidd and Bessant, 2009)

- Trust and openness
- Challenge and involvement
- Support and space for ideas
- Conflict and debate
- Risk taking
- Freedom

2.1.2 Developing an Innovation Strategy

Besides having an innovative organization, Tidd and Bessant stress the importance of an innovation strategy to determine the direction of the firm. An innovation strategy is also mentioned by both Cooper and Ernst as a critical success factor for innovative success. (Cooper, 2006; Ernst, 2002)
Tidd and Bessant distinguish between rationalist and incrementalist strategies. A rationalist strategy starts with a thorough evaluation of the environment based on which the strategy is determined and carried out. An incrementalist strategy assumes that the firm possesses incomplete information. Therefore a firm must be ready to change its strategy when new information becomes available. The latter is advocated by Tidd and Bessant, since they argue that it is more realistic.

Tidd and Bessant distinguish between three elements of corporate innovation strategy, based on the framework of Teece and Pisano (1994).

- Managerial processes; the way things are done in the firm, its 'routines', or patterns of current practice and learning.
- Position; current endowment of technology and intellectual property, as well as its customer base and upstream relations with suppliers.
- Paths; the strategic alternatives available to the firm, and the attractiveness of the opportunities which lie ahead.

Important in determining the above mentioned elements is the technological trajectory. Since different companies from different industries use different technologies, they need different innovation strategies, adapted to the technological trajectory of the firm. (Tidd and Bessant, 2009)
Five major technological trajectories are distinguished by Pavitt based on a research among 2000 significant innovations in the UK. (Pavitt, 1990) For each trajectory Tidd and Bessant identified its typical core sectors, its major source of technological accumulation and its main strategic management tasks. These are shown in appendix 5.

"The ability of firms to track and exploit the technological trajectories described above depends on their specific technological and organizational competences". (Tidd and Bessant, 2009) Therefore it is important for management to identify and develop the firm's core competences. This should be done in two steps; "first, to identify and develop the range of disciplines, or fields that must be combined in a functioning technology; second (and perhaps more important) to identify and explore new competencies that must be added if the functional capability is not to become obsolete." (Tidd and Bessant, 2009)

It can be concluded that the innovation strategy, according to Tidd and Bessant, is determined by the technological trajectory. The strategic elements processes, position and paths, follow from the technological trajectory. Furthermore, the firm should identify and develop their core competences and look for emerging competences that can support their technology trajectory. (Tidd and Bessant, 2009)
All four authors claim that there should be a long term focus within the R&D efforts. This creates a direction in which research is done. Useful tools for this are technology and product roadmaps, including a resource allocation. (Cooper, 2006; Ernst, 2002; Tidd and Bessant, 2009)

Cooper and Ernst add another element to the innovation strategy. They say that the goal of the innovative efforts has to be clearly stated. (Cooper, 2006; Ernst, 2002) This can be done in a certain percentage of sales from new products or the total number of new products released. Besides formulating them, they should be well articulated and communicated. (Cooper, 2006) This will ultimately lead to a better understanding in the organization on the position of innovation.

2.1.3 The Innovation Process Model

The innovation process is the center of the approach of Tidd and Bessant. An innovative organization and an innovation strategy are facilitating conditions, while the process produces innovations.
They split up the process in four steps; Search, select, implement and capture. Below the four steps will be addressed, but first some general success factors on the innovation process will be discussed.

Cooper and Ernst both stress the importance of implementing stage-gates. These are predefined times where a project is evaluated and can be approved to continue or it is killed at that moment. (Cooper, 2006; Ernst, 2002)
Cooper also mentions the use of automation. When the process is implemented in a company's software it is easier to manage and the information will be afterwards easier to retrieve if necessary. (Cooper, 2006)

Search

The first step in the process is the "search" phase. This "involves detecting signals in the environment about potential for change." (Tidd and Bessant, 2009) The main question here is; "Where do innovations come from?" Tidd and Bessant conclude that there are many different sources. Innovation can, for instance, be based on R&D and therefore come from a "knowledge push". The other way around innovation can originate from a "need pull", where based on a need from customers an innovation is developed. These are merely two broad categories of where innovations come from. In reality "innovation is triggered in all sorts of ways". Tidd and Bessant therefore emphasize on "open innovation". (Tidd and Bessant, 2009) Open innovation originates from the famous work of Chesbrough. He argues that organizations are open and can communicate and link to other organizations when necessary. (Chesbrough, 2003)

Select

The second step of the process is the "select" phase. Here all the possible triggers for innovations have to be narrowed down to a realistic portfolio of projects that should be carried out. (Tidd and Bessant, 2009) Knowledge is critical in this process. It helps to make a decision whether or not to continue with a project. In order to help making the decision of which projects to proceed, business plans should be written for the different projects. The sections that will typically be included in a business plan, according to Tidd and Bessant, can be found in table 3. (Tidd and Bessant, 2009)
Cooper and Ernst endorse making a business plan. The main elements they mention are the product

concept, together with a technical assessment, the target market and the market assessment and the relative utility gain for the customer. (Cooper, 2006; Ernst, 2002)

Details of the product or service
Assesment of the market opportunity
Identification of the target customers
Barriers to entry and competitor analysis
Experience, expertise and commitment of the management team
Strategy for pricing, distributon and sales
Identification and planning for key risks
Cash-flow calculation, including breakeven points and sensitivity
Financial and other resource requirements of the business

Table 3

It is important to take into account the amount of resources that can be employed for NPD. Since a firm does not have unlimited resources, they have to be divided between the different projects. Therefore a portfolio should be created to ensure the balance between high and low risk; short and long term and incremental and radical projects. (Tidd and Bessant, 2009; Cooper, 2006; Ernst, 2002)

Implement

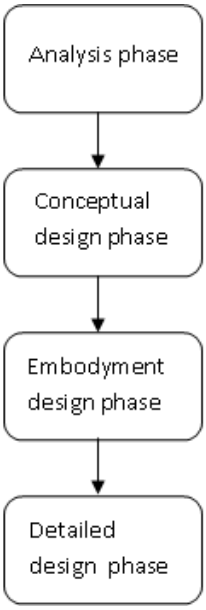

Figure 1

The third step in the process is the "implement" phase. This step evolves around developing new products. Therefore a process is needed. Mulder developed a development process specially for Sarandi. This process is shown in figure 1. A summary of this process is given in appendix 6. (Mulder, 2009)

In order to make the product that is being developed a success, the project team should think about how this product will stand out. Tidd and Bessant argue that a new product should differentiate itself from the competing products. They mention three market strategies for a new product.

- *High relative quality* is associated with a high return on sales
- *Good value* is associated with increased market share
- *Product differentiation* is associated with profitability

Tidd and Bessant also mention the use of customer segmentation, in order to offer your customers what they want. (Tidd and Bessant, 2009)

Capture

The fourth and final step in Tidd and Bessant's innovation process is the "capture" phase. The purpose of this step is to capture the value from the innovation efforts. Innovation can lead to financial, economic and social benefits. (Tidd and Bessant, 2009) For companies mainly the financial benefits are important. The most common view on how to capture financial benefits from innovation is through intellectual property rights, setting the standards for the rest of the market and first-mover advantages.

Besides the financial value innovation has an even more profound influence on fundamental social and economic development. (Tidd and Bessant, 2009) Economic development in emerging economies is for instance greatly boosted by innovation. Innovation can also create social change and value by for instance relieving poverty, develop the community and enhance health and welfare.

Finally, innovation can incease the sustainability of the organization by for instance developing cleaner products, or more efficient processes.

2.2 Impact of being an SME from an emerging economy

In paragraph 2.1 the most common success factors for innovation are displayed along the classification of Tidd and Bessant. However, these success factors are not taking into account disadvantages that are caused by being an SME and originating from an emerging economy. The main disadvantage is the lack of resources. SME's lack mainly the financial resources and available time, due to their limited size. For a firm from an emerging economy it is the lack of knowledge, which causes difficulties in innovating. For both disadvantages a brief review of the literature is given concerning the influence it has on innovation and how to overcome these disadvantages. From this review it becomes clear that the approach to overcome the disadvantages is similar and consists of external inputs and absorptive capacity. Subsequently ways of connecting to other firms in order to create these external inputs are described in 2.2.1 and in 2.2.2 the notion of absorptive capacity will be further explained.

The disadvantage of being an SME

Opinions differ on whether SMEs innovative capacity is limited by their size. The Schumpeterian hypothesis says for instance "that innovative activity is promoted by large firms' and by imperfect competition". (Acs and Audretsch, 1987) In many studies this is interpreted as large firms having an advantage over small firms when it comes to innovation. However Acs and Audretsch state that this is a misinterpretation and that large firms merely have an advantage in markets that are characterized by imperfect competition. By means of an empirical research among US firms they show that large firms have an advantage in the capital- and advertising intensive, concentrated industries and small firms in the opposite industries. (Acs and Audretsch, 1987) Therefore they claim that a limited firm size is not necessarily a disadvantage when it comes to innovation.

The use of inter-firm relations is most often mentioned to overcome the disadvantages of a limited size. According to Hoffman these relations are a possible source for competitive advantage for high tech SMEs. (Hoffman et al., 1998) Also other authors mention the possible benefits from inter-firm linkages. (Grotz and Brown, 1993; Keizer et al., 2002; Freel, 2000) However, not all studies see networking as a *direct* link to successful NPD. Keizer et al. conclude for instance that "Links with knowledge centres are only fruitful if a company has some idea what it is looking for". (Keizer et al., 2002) Hall mentions the argumentation of Cohen and Levinthal about absorptive capacity. (Hall et al., 2009) He states that in order to be able to use knowledge from other sources, it is necessary to have basic knowledge in that field and that this should be gained through internal R&D activities. (Hall et al.,2002)

The disadvantage of operating in an Emerging Economy

Hobday describes the disadvantage in innovation for firms from Emerging Economies as a twofold problem. On the one hand companies from emerging economies are disconnected from "the world centers of science and innovation and is behind in engineering, technical skills and R&D." On the other hand, the "underdeveloped, small local markets and unsophisticated users" make it more difficult for innovation, since user-producer linkages are important to innovation and industrial development. (Hobday, 1995)

In the literature the most common approach to overcome this disadvantage rests on two pillars. One pillar is the access to external knowledge and the other is the company's absorptive capacity which improves the way the company can implement the gained knowledge in their products, services and processes. (e.g. Li et al., 2010; Matthews, 2002; Hitt et al., 2005; Hobday, 1995) Matthews and Li et al. claim that mainly the foreign inputs are important. (Li et al., 2010; Matthews, 2002)

More specifically this is described by Hobday as the process as going from OEM (original equipment manufacturer), to ODM (original design manufacturer) to OBM (original brand manufacturer). This means that the firm starts with producing fully specified products for an external company (OEM). While they learn from their customer, they start to take over parts of the design (ODM) and finally they bring their own brand products to the market (OBM) and perform their own R&D in order to surpass their previous customer in innovativeness. (Hobday, 1995)

2.2.1 Increasing external knowledge input

In order to overcome the disadvantages from being an SME and originating from an emerging economy, external inputs are critical. (Grotz and Brown, 1993; Keizer et al., 2002; Freel, 2000; Li et al., 2010; Matthews, 2002; Hitt et al., 2005; Hobday, 1995) This is similar to the famous work of Chesbrough on Open Innovation. He argues that organizations are open and can communicate and link to other organizations when necessary. (Chesbrough, 2003) Chesbrough, but also the previously cited authors Cooper, Ernst, and Tidd and Bessant, write that these external linkages are important for innovation in any organization. (Tidd and Bessant, 2009; Cooper, 2006; Chesbrough 2003; Ernst, 2002) However, since it is especially mentioned for SMEs and firms from emerging economies, external input is separately discussed here, in order to stress its importance.

In this paragraph the possibilities for increasing the external knowledge input will be discussed. There are many ways in which a firm can cooperate with other organizations in order to tap into external knowledge. The different options can be categorized by the source of the knowledge. This leaves four categories: Suppliers, Customers, Knowledge Centers and Employees. A fifth category is a general one which includes options that work with all possible firms. Cooperating with these different organizations or people can allow a firm to tap into their resources. The possibilities to engage in such cooperation are described below.

Suppliers

The relationship between buyers and suppliers has been changing. The role of suppliers has become increasingly important. They gained more responsibilities and involvement. (Bidault et al., 1998) In connection to innovation the white, grey and black box theory has been developed. This shows the level of involvement of the supplier in the development process of a new product. It ranges from no supplier involvement to the supplier designing and developing the product. (Petersen et al., 2005) In figure 2 the different levels of involvement are shown.

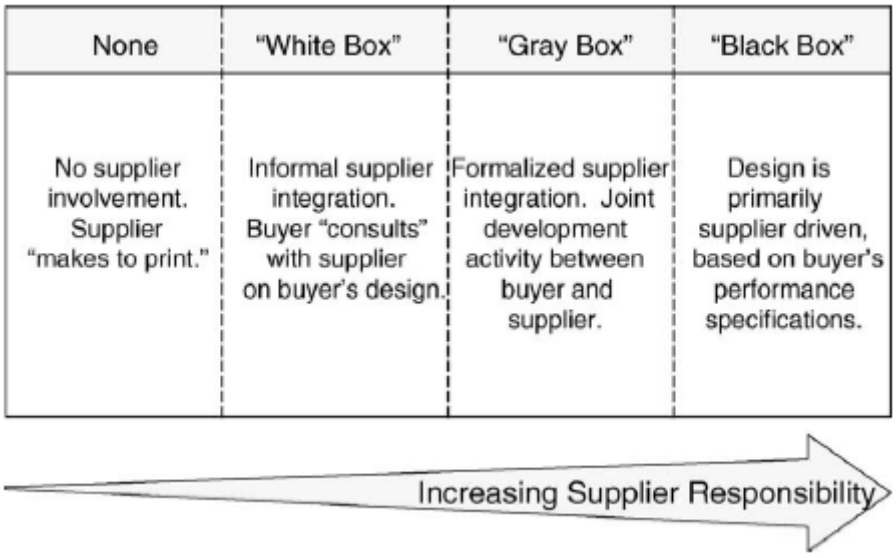

Figure 2 (Petersen et al., 2005)

Early supplier involvement in innovation has proven to give significant benefits to companies. For instance, early supplier involvement is seen as one of the main reasons that Japanese automobile manufacturers outperformed their Western competitors. (Bidault et al., 1998)

Firms from emerging economies can use foreign suppliers. They generally have more advanced technological knowledge compared to local suppliers. The downside is that parts have to be imported which brings along the necessary import taxes and paperwork. A more preferable option would be to cooperate with a domestic supplier which is part of a foreign company and uses foreign technology. (Krishnan and Prahbu, 1999)

Customers

Another option is "learning by exporting". This way, products are sold to foreign customers, who in return help to improve different business aspects. The customer's incentive is that they need high quality products for a low price. Help can be, for instance, sending information of competitor products which they have bought in the past, detailed drawings from their own engineers and in some cases visiting the plant to help with all sorts of issues, ranging from management to educating operators. (Hobday, 1995)

However, there is some discussion on whether learning by exporting does indeed help to improve firm's innovativeness. Clerides et al. argue that learning by exporting does not exist. They claim that the causality is the other way around; Superior companies start exporting, because they have a competitive advantage. (Clerides et al., 1998) This lack of learning seems strange, since anecdotal evidence proofs that there are knowledge transfers between the foreign buyer and the supplier. Therefore Salomon and Shaver focused on innovation as the dependent variable. This study found that learning by exporting does affect a firms' innovativeness by increasing the amount of newly developed products and requested patents. (Salomon and Shaver, 2005) Blalock and Gertler researched the learning by exporting effect among Indonesian manufacturing firms. Here an increase in productivity has been found after the companies started exporting. The authors explain this with the level of development of the Indonesian economy. They argue that because Indonesian firms are far behind in technical knowledge and managerial and production techniques, they can learn more

from overseas customers. (Blalock and Gertler, 2004) The same conclusion is drawn from a similar research among companies in sub-Saharan countries, which can also be seen as significantly less developed. (Van Biesebroeck, 2003)
The conclusion should therefore be that learning by exporting does exist. Especially in countries that fall behind in technological knowledge and managerial and production techniques.

Knowledge Centers
Knowledge centers are mainly used for doing basic research. They develop new technologies, which companies can use directly or use for further applied research to prepare the technologies for the market. Knowledge centers are mainly universities and government research institutes. Besides the basic research, Fu and Li find that the universities in emerging economies have an extra role in their collaboration with the industry. Universities should also help firms decipher new foreign technologies that are transferred to the developing country. This extra role is more important in the context of emerging economies. (Fu and Li, 2011)

The cooperation between universities and industry in innovation is seen as a major contributor in breakthrough innovations. (Fu and Li, 2011) However, Fu and Li point out that most of the literature on the importance of universities in innovation is focused on developed countries. Eom and Lee and Fu and Li conclude that in emerging economies the cooperation with knowledge centers has fewer benefits for firms. Eom and Lee explain this with absorptive capacity, while Fu and Li explain this with the different role of knowledge centers in emerging economies. (Eom and Lee, 2010; Fu and Li, 2011) Therefore cooperation with knowledge centers can contribute to innovativeness, also in emerging economies.

Employees
Employees are mentioned to be a source of knowledge input. Foreign people can be hired to benefit from their knowledge of, for instance, new technologies. Also native people who have experience abroad can be recruited. They might have studied or worked abroad and thereby they have mastered the foreign technologies and new developments, which they can bring into the firm. (Hobday, 1995)

Another option is to provide the current employees with trainings abroad. These trainings can be in universities, R&D centers and companies where knowledge about the newest technologies is available. Through such an engagement the knowledge can also be brought into the firm. (Hobday, 1995)

Foreign Firms
The last category of foreign knowledge contains basically all possible foreign companies. By means of foreign direct investment (FDI), joint ventures, licensing and consultancy, foreign knowledge can enter the firm. For these methods it does not matter if it comes from a customer, supplier, a third party or even a competitor. The different options will be shortly addressed.

FDI can have two directions. Foreign companies can invest in local companies, inward FDI. The other option is that the local firm invests in a foreign company, outward FDI. In the first case the company can benefit directly from foreign knowledge if it is the subject of the investment. If another local firm is bought by a foreign company, knowledge spillovers can be realized through collaboration with this firm. (Li et al., 2010) In the latter case, the outward FDI causes a direct input of foreign knowledge from the foreign company that is been bought by the buyer. (Hobday, 1995)

Another way to cooperate is by means of a joint venture. Together with a foreign company a new firm can be started. In this way the technological and managerial knowledge of the foreign firm can be used and the institutional knowledge and networks of the local company can be deployed. (Hobday, 1995)

Cooperation by means of licensing is a well-established way of acquiring technology. (Trott, 2008) Licensing is the exploitation of "intellectual property of another firm". Intellectual properties can have different forms: ideas, devices, products or processes. (Tidd et al., 2005) The impact of licensing on a firm is not very big, since it does not involve strong collaborative links between firms. The arrangements are mainly on a contractual basis and do not necessarily lead to more obligations. (Trott, 2008)

The last option to work together with another company is by using their consultancy services. In this way you get their expertise for a limited amount of time in which they can help you in any way necessary. (Fu and Li, 2011) Bessant and Rush stress the importance of consultants in the technology transfer. "Their inputs can be direct, offering transfer of specific technological competence, but they are often more involved in a wider and more flexible interaction in the process by providing an amount of information and related services which help to bridge the gap between technological opportunity and (often poorly articulated) user needs." (Bessant and Rush, 1995) They also mention the high failure rate in technology transfer and that this is especially the case in SMEs. (Bessant and Rush, 1995)

2.2.2 Absorptive capacity

Cohen and Levinthal (1990) introduced the term absorptive capacity and defined it as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends". This is seen as crucial in the process of learning. When a firm does not possess enough absorptive capacity it will find itself unable to use the knowledge spillovers and will therefore not experience a learning effect. (Aw et al., 2007)

Absorptive capacity consists of previous knowledge and the ability to communicate and transform knowledge. (Cohen and Levinthal, 1990) The function of previous knowledge is to make it easier to learn something new. For example, when a child possesses an extensive knowledge on algebra it will more easily learn calculus.
When a person or a specific group in the organization has acquired new knowledge, the ability to communicate is important to share it with others. The ability to transform knowledge makes it possible to adapt it and make it fit better to your needs.

There are different ways of increasing absorptive capacity. A certain redundancy in knowledge improves the ability to communicate and transform knowledge. (Cohen and Levinthal, 1990) Increasing the relationships between employees can improve the dissemination of knowledge and therefore the absorptive capacity. (Vinding, 2006) And according to Li, absorptive capacity increases from having in-house R&D and a strong marketing department. (Li et al., 2010)

When a firm possesses sufficient absorptive capacity a firm can better value new developments, because of past experiences and investments. It also becomes easier to assimilate, or understand, the new knowledge, because of an overlap between your current knowledge and the new knowledge. Also, absorptive capacity implies that new knowledge is available due to sufficient spillover effects and that you can protect the innovation. (Cohen and Levinthal, 1990)

2.3 Model for innovation in SMEs from Emerging Economies

In the previous paragraphs the literature on success factors of innovation is discussed, as well as how to overcome the disadvantages caused by limited size (being an SME) and from originating from an emerging economy.

This resulted in three categories of success factors, creating an innovative organization, formulating an innovation strategy and developing a successful innovation process. Since the research focuses on SMEs from emerging economies, two categories were added; External inputs and absorptive capacity. Together these categories form a best practice on NPD in SMEs from Emerging Economies. The way these categories relate to each other is shown in figure 3. In the heart of the model is the NPD process, this has to be supported by an innovation strategy and executed in an innovative organization. Furthermore the arrows represent external inputs that can be used more effectively through the absorptive capacity of the company.

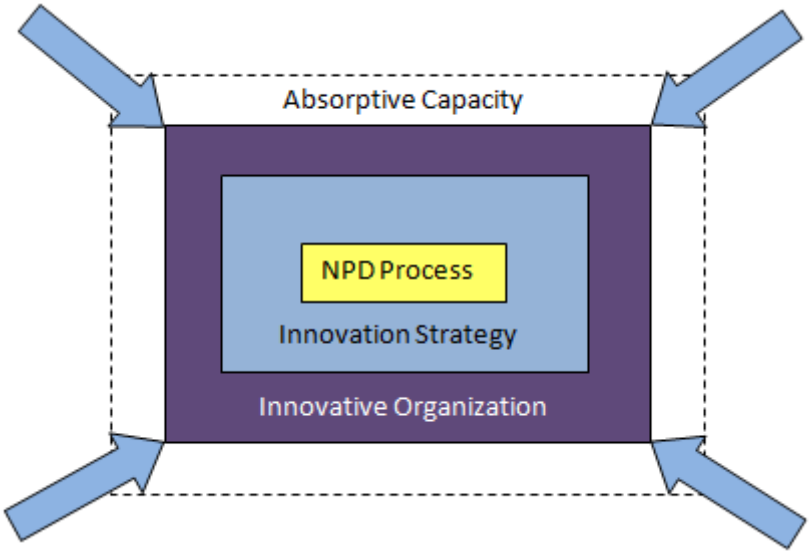

Figure 3

3 Methodology

In this chapter the methodology that is used for the research will be addressed. Since the research is done in two parts, this chapter will address these in turn. The first and main part of this research is descriptive, since it aims to describe the current situation of innovation at Sarandi. The second part of the research is a pilot project to find out how the organization handles changes and if certain aspects of the literature will work in this environment.

3.1 Descriptive research

The descriptive part makes use of the model that was formulated in the previous chapter. Every element from the model was tested for its presence at Sarandi. In order to do so, data had to be collected. For all elements of the model this was done through interviews and objective observations. In addition to the main methods, documentation was sought to confirm information from other sources.

For the interviews it was chosen to use open interviews. The reason for this choice is that it allows the employees to share what they think is important and thereby capturing all information and experiences of the employees. Whereas closed, or semi structured interviews might leave out certain information that was not anticipated in the questionnaire.
The interviews were conducted among five employees. Since only three people used to be directly involved in an innovation project, this sample size was sufficiently large to give a reliable overview of the current innovation practices. All three people who were directly involved in innovation projects have been interviewed for the research. These are the managing director, a 3D modeler from the R&D department and the head of the engineering department. The other two employees that were interviewed were the heads of the production and quality control departments. They were not directly involved in the innovation process, but they knew what was going on through meetings that were held for the heads of departments. Moreover, they were faced with the production and the quality checks of the new products in their jobs and therefore had an informed opinion on the result of the innovation projects and knew where problems arose.
In the course of a view weeks, between the 2nd and the 25th of May, multiple interviews were held with the employees. During the interviews the different elements of the model were discussed. At the same time the employees were free to tell about their own ideas, impressions and opinions, in order to get as much information as possible. During the interviews, difficulties due to the language barrier were overcome by involving the secretary. She masters the English language and could therefore assist in better understanding the interviewees.

Both objective observations and checking documentation is important to confirm the information gathered from the interviews, since the interviews could be subjective. These extra methods could also lead to extra information that was forgotten during the interviews.
The observations were done throughout the whole research from the end of April until the end of July. Since there was no official innovation project running in the way they used to be done, observations were made during regular work. By walking around and speaking with the employees, the work in the factory, as well as in the offices was observed. The conversations with the employees were of very casual form, but serve as a good indication of their opinion on things like the job, the salary, the climate etcetera. More observations were done during the pilot projects. Because the people working on the projects were directly confronted with the process, they were better able to recognize differences with the previous way innovation was pursued.

In the documentation of Sarandi, two types of documents turned out specifically useful for the research; the organogram of the organization and the master files of the different products. The organogram was used to typify the organizational structure of Sarandi. The product master files were used to identify which people worked on the development of the product and they show the outcomes of different steps in the process in chronological order. Thereby the master files helped identifying the teamwork and the innovation process. Also a lack of documentation could be used to back up the information from the interviews. For instance, the lack of a formulated strategy for innovation in itself is not a proof that there is none, but it can help to confirm or question the outcomes of the interviews.

Based on the outcomes of the research, the current situation and the best practice from the literature were compared. Every element of the model was discussed in a detailed description, where for every element the different success factors were discussed. This showed to what extent they were used at Sarandi. In the conclusions a final score was given for all elements. The scores show to what extent the situation at Sarandi was in line with the literature on a scale from one to seven. If a success factor was not used at all, this led to a score of one. If an element was used the way it is described in the literature, the score was a seven. If a success factor was partly used, or used incorrectly, the score was in between one and seven. Figure 4 shows the meaning of the values one to seven.

1	2	3	4	5	6	7
Not	Almost not	Partly	Sufficiently	Approximately	Mostly	Exactly

Figure 4

3.2 Pilot projects

For the second part of the research, pilot projects have been performed. This was done to find out how the organization handles changes and if certain aspects of the literature would work in this environment. During these projects, not all elements of the model could be tested. The reason for this was on the one hand that some parts could not be implemented in such short time, and on the other hand that some measures did not so much influence a single project, but were more focused on organizing the bigger picture. The changes that were made during the pilot projects were; the introduction of cross functional teams, a reduction of the role of the managing director and a market research was performed.

Before the projects started the people involved had to be taught to work in a different way. This could have led to resistance if people would have felt attacked or they would not want to change the way they worked. Therefore the people connected to innovation were involved in the process and the reasons for the changes were explained to them. Furthermore the involved people received training to work in a different way in order to make it easier for them.
After the changes were introduced, the pilot projects could start. During the projects the process was closely guided and observed in order to make sure that the work was performed in line with the literature and that the results were monitored. The results were both the final product, as well as the process to get there. Special attention was paid to people's opinion and the effort it cost them to work in this way.

After finishing the pilot projects an evaluation meeting was held, in order to find the above mentioned results. Interviews were used to capture the opinion of the team members. These interviews had to proof or disproof the correctness of the model for Sarandi. The proof was

therefore limited to the experiences from the pilot projects. Other data, like sales figures or customer satisfaction could not be gathered in such short time.

4 Findings

In this chapter the current situation of innovation at Sarandi is described along the model that was constructed in chapter two. In turn, all categories of the model will be evaluated on the extent to which they are used at Sarandi and how they are used.

4.1 Innovative Organization

Organizational structure

Based on the interviews and observations, Sarandi's structure could be described as a simple structure, in Mintzberg's specification. It is centrally controlled and led by the managing director. However, from the organogram, Sarandi appears not to be centrally led by one person, but there are multiple directors and a management team of heads of departments. During the research it turned out that this was merely the case on paper, but in reality this structure was not used.

Key individuals

There are different roles that need to be fulfilled in an innovative organization. The problem at Sarandi is that most roles are represented by the same person. The managing director is the project champion, the organizational sponsor, the gatekeeper and the team leader. This comes forward in the way projects are conducted. The decision to start a project is taken by Mr. Gojali, from that point on he takes the role of organizational sponsor and makes the project a priority for the people involved. He also functions as the project champion and tries to push the project forward. When a problem arises during the development he is the gatekeeper. He either has a solution himself, from his extensive experience or he knows where to find the information in the organization. Also the role of team leader is fulfilled by the managing director.

Involvement

High Involvement Innovation measures the level of involvement of people in the organization. Bessant defined five levels of involvement, where one is the lowest level of involvement and five the highest. Currently the involvement at Sarandi is between level one and two. It mainly qualifies as level one, because of the lack of strategy and organization. Problem solving happens randomly and often the person facing the problem does not involve other people. However, Sarandi does try to create involvement sporadically. Already for some time they organize a contest for all employees. Everyone can enter their ideas for new products or process improvements. For the winners there are prices, like mobile phones or even a television. In the context of the poverty in Indonesia, the value of these prices is large. Therefore many employees are participating.

Effective teamwork

Innovation projects are currently executed by individuals. The process is controlled by the managing director. He keeps track of the progress and steers the project in the direction he wants it to go. The different steps in the process are performed by different individuals. First, a 3D drawing is usually made by a person from R&D. When this drawing is approved someone from the engineering department takes over and makes a detailed drawing and finally a prototype. In the process there is no input from production and the input from marketing is often too late. It happened multiple times that they saw the product when it was ready and their feedback was not anymore incorporated in the product. Currently there is no software tool to support the innovation process. Also not all information is digitally available. For example the master files of the products exist only in hard copy.

Innovative climate

The innovative climate is made up by six factors.

- Trust and openness – In order to have an innovative climate people should feel emotionally safe in the organization and dare to put their opinions and ideas forward. In Sarandi, the employees are afraid to speak up in front of the directors. They do not want to criticize their ideas or disagree with them. Due to the strong involvement of the managing director in the innovation process, trust issues have a big impact on the innovation projects.
- Challenge and involvement – Employees have a low impact on the direction of the company or even on project level. They follow the direction set out by the directors. Whether this negatively influences the motivation of the employees is difficult to judge. On first sight it does not seem to bother anyone. Moreover, in private conversations no one complains about it.
- Support and space for ideas – In general employees do not get time to spend on their own ideas. They work based on what they are told to do. Some employees from the R&D department have the task to search for new products, new parts, or new techniques on the internet. These people are hereby supported to develop new ideas. Unfortunately people from other departments have no such support.
- Conflict and debate – At Sarandi there are almost no conflicts. The employees have close relations. They frequently have dinner parties together or engage in other activities in their free time. This causes a pleasant atmosphere at the office. Only the relation towards the directors is tensed. Some people are even scared of the directors.
- Risk taking – Although the motto is 'failure is the best way of learning', there is not too much room for risk taking at Sarandi. This is due to the limited resources. The company is not in a financial situation which allows them to take risks. However, on a smaller scale there are possibilities to try something. Risk taking cannot be done on someone's own initiative. Decisions are made by the managing director.
- Freedom – The freedom of the employees is limited in the sense that they cannot decide themselves what to do. Decisions are made centrally. Furthermore, employees have to write down their activities every day, in order for the HRM department to control if everyone is working on the tasks they have to do.

4.2 Innovation Strategy

A strategy or long term planning for innovation is not used at Sarandi. Now it is ad hoc decided which products to develop. Moreover, there is roughly one time per year when new products are developed and that is for the Hospex[1]. This shows that the importance of innovation is not enough articulated in the firm. The reason for innovating is now to show something new at the exposition. Instead, a strategy should make innovation about making new products that can lead to a bigger market share and to be and stay ahead of your competitors.

4.3 Innovation Process

Stage gates are not officially used. However, the managing director is kept up to date regularly and he can take corrective action if the process is not going as planned. In case the project becomes unprofitable he could even terminate it.

Automation is not used in the innovation process. There is no software that can support the people working on a new product throughout the process. The developers do use SolidWorks to create the

[1] An annual hospital exposition held in Jakarta, where medical equipment suppliers show their products.

3D image of the product and other programs like MS Word and Excel to write the product description and calculate the costs.

Search

The “search” phase should be about being open to the environment and from there generate ideas for innovation. Innovation is not actively pursued at Sarandi. The trigger to develop a new product is the Hospex. Occasionally the innovation process is triggered by a need pull. In this case a customer approaches Sarandi with the request for a new product or a change in an existing product. Another possible trigger is a development from the direct competitors. A good example of this is a hospital bed with a digital scale. Sarandi decided to develop this product after they had seen it in a competitor’s brochure.

Select

Since in the search phase there is no active search for signals for change, there are not many ideas for potential projects. The select phase is therefore simply skipped. A business plan is not created for the projects. Instead the managing director decides, rather subjectively, which new products to develop and these projects are subsequently conducted. Product changes that have to be implemented based on customer complaints have to be prioritized by the managing director. This can lead to an unclear allocation of resources, because these requests for changing a product come in very randomly and with different priorities. Together with the ad hoc decisions for innovation, the requests for revising products cause a rather chaotic workload for the staff of the R&D and Engineering department.

Implement

The implement phase is where the new product is actually developed. The way in which this is organized at Sarandi is rather structured. When it is decided to develop the product, R&D creates a 3D drawing in SolidWorks. Based on this drawing a bill of material (BOM) is composed and with that engineering makes the detailed drawing. Subsequently, the detailed drawing serves as a manual on how to construct the new product and is used by the engineering department to build the prototype. If the prototype is approved by the managing director, the product is ready. When orders come in, it will be taken in production. By that time, tools will be designed if it turns out to be necessary. Although this is rather structured, they do not go through the whole process as it is defined by Mulder. They skip the first two steps in which the functions and the working concepts are determined. Instead the managing director decides the functions and working concepts based on his experience and opinion.

During the development, market segmentation is not done. Therefore the products are not specifically developed according to the wishes of a specific customer type. Also the market strategies that Tidd and Bessant mention are not used. Sarandi strives often for high quality products, while their customers are from the middle class segment and lower. Therefore the products might be good, but they cannot be sold. This happened to the three new products that were developed in 2010. Until this moment none of the products has been sold, but at the Hospex the visitors liked the products.

Capture

The last step in the process model is the capture phase. Sarandi has problems with capturing the value of their innovation. They are not first-movers and therefore cannot benefit from the advantages of being in front of the competition.

Currently Sarandi even has problems with piracy. They do have a registered trademark, but there are increasingly more cheap copies of products with their trademark. This is damaging their brand value, since the illegal copies are of very low quality. Unfortunately there is not much they can do about it. They learned from experience that lawsuits will not work in their favor and only cost them time and money. The reason for this is that intellectual property rights are not very valuable in Indonesia.
The social value of Sarandi's innovations is significant. By developing new products and making them available on a large scale they indirectly save lives and create jobs. Sarandi is one of the larger employers in Sukabumi. In this poor area this alleviates poverty for all the employees and their families.

4.4 External knowledge input

In this paragraph the external inputs in Sarandi's innovation process are described.

Customer involvement

In Sarandi's current innovation process, there is some involvement of their customers. Based on customer wishes products are changed. However, this is only for the orders of this specific customer. In a few cases standard products are adapted based on feedback of a customer. In the literature, customer involvement moves beyond this. It means receiving technical drawings of competitor products or getting specialist's help in developing a new product. This does not happen at Sarandi.

Supplier involvement

There is some form of supplier involvement. Some parts are specially developed for Sarandi's products. This is exclusively with local suppliers. A good example is the padding of the examination chairs and operation tables. Sarandi makes the drawings, where is determined how it should look completed with specified sizes. Within these specifications, the supplier has the freedom to use different techniques and materials in order to make the product the way he thinks it is best. With other suppliers, like the head and foot panels from China, there is no cooperation at all. Parts are simply ordered from a catalog, even though it does not always complement the product well.

Knowledge centers

Knowledge centers are used to a certain extend. The way knowledge centers are used, is by internships from university students. This research is an example of using a foreign knowledge center. At the time of the research there were two more interns at Sarandi. The others were from a local university, but none of them were involved in innovation. Besides hiring interns there is no further cooperation with universities, like letting universities decipher new technologies.
Government research centers are not available in Indonesia. These knowledge centers have helped greatly in the technological upraise in countries like Taiwan, South-Korea and Singapore. Unfortunately Indonesia does not provide such support for their industries.

Employees

Using employees as source of external knowledge is not frequently used at Sarandi. The exception is the production manager. He is Malaysian and used to work in Malaysia for Sony. His function there was to implement the production of new products in the factory. Therefore he is a source of foreign knowledge. Unfortunately his experience has not been used yet for innovation.

FDI

Sarandi is not involved with either inward or outward FDI. Their financial position does not give them the opportunity to buy a stake in a foreign company. Moreover they did never seriously consider the possibility to do so. The other way around, selling shares, is not an option for the owners. They want

to keep Sarandi an Indonesian company. This is also one of their marketing strategies; “100% Indonesian products”.

Joint venture, Licensing & Consultancy
Joint ventures, licensing and consultancy are not used, or even considered by Sarandi.

4.5 Absorptive capacity

From the definition of Cohen and Levinthal two main aspects of absorptive capacity can be identified. These are the available knowledge base and the internal communication.

At Sarandi, some critical knowledge is present. For instance there is experience in, Solid Works, the software to design a new product. Also experience in prototyping is present. These skills would make it easier to pick up new techniques or improvements on the existing ones. However, there are some places where there is a lack of expertise. Some are soft skills, like project management or leadership, other are more technical like electronics or more in depth mechanics.

Communication is not optimal at Sarandi. Between departments not many experiences are shared. A good example of this is when the head of the engineering department was told to use certain standards; He could not find the documents where they were explained. However, the marketing department already possessed these documents for years.
On the topic of communication there is an issue that was not mentioned in the literature, but which raised some concerns during the research. This issue was the language; at Sarandi the level of English of most employees is rather poor. This can cause difficulties in communicating with a foreign party and therefore reduces the possibility of learning from them.

5 Pilot projects

This chapter describes a pilot project that has been conducted between the end of May and the end of July. In the first place this project had to result in a successful product. For the research this project served as a test, to find out how the organization handled changes and if certain aspects of the literature would work in this environment. The changes that were made compared to past innovation projects were that during the project cross functional teams were introduced, the role of the managing director was reduced and a market research was performed. Two projects were started; one for a new intensive care unit (ICU) bed and one for improving the ergonomics of a gynecology chair. Since the processes of the two were very similar, only the first project is described below.

5.1 The Pilot Project

The main project that was started aimed to create an ICU bed complemented with a scaling system and a quick release function. The benefit of a build in scale was to save the nurses time and effort to move an ill person out of the bed on a separate scale. When patients are very ill, they need to be weighted regularly, since this is the only way to determine the fluid balance in their body. In case of a fever or other illness a patient might lose a lot of fluids and this can only be controlled by using a scaling system.
The quick release function also had a clear benefit. Patients in the ICU are in a critical condition and therefore it is likely that now and then a patient needs cardiopulmonary resuscitation (CPR). When the bed is not in a flat position, this is hard, if not impossible, to do. Electrical beds usually move slowly and in case of emergency it might take valuable seconds to get the bed back in a straight position. Quick release takes care of this and puts the bed back in the basic position in a very short amount of time.

Both these functions have never before been included in a product from Sarandi. Therefore this product was seen as a big challenge. For this job a team was put together consisting of people from Marketing & Sales, Engineering, R&D, Purchasing, Quality Control and Production. This resulted in a large group since some departments were even represented by two people. With this group a kick-off meeting was held, in which the new way of working and the goal of the project was explained. The kick-off meeting was rather chaotic. Because of the large group, people were either not paying attention or speaking at the same time. Therefore the decision was made to reduce the size of the team. This resulted in a small core group consisting of one person from respectively Engineering, R&D and Production. Besides the core group close contact was kept with purchasing and marketing. In the group the team leader was appointed, who also served as the project champion. Moreover the team operated autonomous and only occasionally presented the progress to the managing director. Hereby his influence was reduced and the team members were more engaged and came up with solutions by themselves.

The search and select phase from the innovation process were not performed by the team. The directors decided upfront that the ICU bed with digital scale and quick release had to be developed. They based their decision on developments from Sarandi's direct competitors. These competitors already developed a similar ICU bed with a build in digital scale. In order to surpass them the directors wanted to add the quick release function to the bed. This idea originated from the supplier of the electrical beds' motors. They pitched the idea of the quick release as an addition to the

standard electrical motors. The combination of the two new functions has to display Sarandi's advanced technologic skills at the Hospex.

Even though the product serves as a showpiece and therefore the commercial success is subordinate, the team decided to perform a market research. This way some experience could be gained and it was tested how customers respond to the surveys and visits. Two meetings were planned with hospitals in the surrounding of Sukabumi. The team conducted in depth interviews with both the nursing and the purchasing staff of both hospitals. These interviews gave a better insight on the demands of the customers. This was clearly biased, since the nursing staff said they needed all functions we discussed and the purchasing staff indicated they would only buy the most standard models and that there was no money available for a more advanced product. These outcomes needed to be verified with other hospitals before they could be generalized. This was attempted by means of an online questionnaire. However, the response rate on the questionnaire was zero. Even after two reminder emails, none of the selected hospitals gave a reply. Therefore it could be concluded that this has to be done differently in the future.
Due to the subordinate commercial success the team decided to take the lessons learned from the failed market research, but continued the process for the time being.

In the next weeks the design was created and problems that arose were discussed with the core team and in this way dealt with effectively and efficiently. A significant factor in the process was that all team members were given sufficient time to work on the project. Moreover, the managing director made the project first priority, which speeded up the process. Also the team meetings helped to speed up this part of the work. Any doubts were taken away and due to the support of each other, the team members felt more confident in their work.

The next serious problem arose due to miscommunication from the supplier. The team was told that all items that were necessary for the digital scale were ordered and that it would work the way one can expect. Some weeks later, round the time the parts should arrive, the team was informed that before the scale would work properly the different parts needed to be calibrated at the headquarters of the supplier in Denmark. This was a huge setback and delayed the process significantly.
Fortunately the parts arrived just in time to be put together before the exposition.

5.2 Evaluation

Based on observations the pilot project was a success. The team work went well. The team members were engaged and problems were solved efficiently. Moreover, due to the team members from different departments, the development process was done based on different perspectives. There were for instance sessions to reduce the product's production costs and increase the customer orientation.
Without the pressure of the managing director being involved, the team seemed to feel freer. Therefore communication improved and the atmosphere was more productive. Also the presence of a team leader who championed the project and created involvement among the other team members seemed to pay off. Unfortunately the market research failed. This deserves extra attention in order to benefit from it during other projects.
Another positive outcome from the pilot projects was that the directors were open to change. They supported the changes that were made and the managing director did not interfere with the project and granted the team freedom to work autonomously.

In order to confirm the observations that were made during the pilot project an evaluation session was planned with the team members and three other people that were involved during the project. The evaluation was done individually with the three members of the team. With other involved people a more informal approach was used to speak about the changes that have been made during the course of this research.

Team member 1:
From the interview with this person, it became clear that the new way of working had a benefit. He said that the work went well and that it went faster than normally. In his task for the project he did not see much changes compared to before. He acknowledges the importance of meetings with different departments and would like to see this scheduled twice a week. Finally he would like to receive more training to perform his job even better.

Team member 2:
The second team member was very enthusiastic about the new way of working. He said that it is better organized and that it is nice to have a person to keep the focus on the project. The visits to the hospitals gave him new insights to the customer's needs.
Some possible points of improvement would be to make a more detailed planning at the outset of the project. He also believes that the goals can be better formulated, so there will not be endless discussions on whether to optimize performance or reducing costs.

Team member 3:
The third team member liked the cooperation with each other. He thinks that this helps to set the priorities right. With that he means that instead of only making a product with functions that are specified by the director, there will be now also a focus on how to make a product for a lower price and to get it in line with the customers' wishes. He also shared that he would like to develop more technology in house, since he believes that in order to compete in the long term it is necessary to have technological knowledge. Furthermore he suggested to have fixed team meetings, so it would be easier to plan the meetings in his other activities.

Others
Feedback from other people highlighted some other important aspects. One person pointed out that in order to take a product into production, jigs are needed. These are tools that keep a part stable during different production steps and show where the operator needs to welt, drill, bent etc. The jig for a new product is not always made on time. Therefore the production process has to be done without, causing many mistakes in the process and thereby higher costs.
Besides the jig being made in the first place, this person pointed out the benefit of making them Poka Joke, which is Japanese for "idiot prove". By making the jigs in such a way, that the parts only fit in one direction, the jigs will therefore be used correctly and production errors will be reduced.
People from HR were afraid that it would get more complicated to check whether the team members were doing their jobs well. Therefore the NPD IT tool was coupled to the HRM software and the people working for the NPD team were registered.
Several people mentioned the lack of communication between the factory and the Jakarta office. In order to make a step in solving this, it was decided to let the marketing responsible work two days per week from the factory in Sukabumi. That way he can be more involved in innovation projects and also improve communication between Sukabumi and Jakarta.

6 Conclusions and Recommendations

In this chapter the conclusions of the research will be drawn, recommendations are formulated and some limitations and options for future research are mentioned. First, conclusions will be drawn on the extent to which the situation at Sarandi used to be in line with the literature. Then the conclusions of the pilot projects are given and finally the research question is answered. Based on these conclusions, recommendations towards Sarandi will be formulated on how they can achieve improvements in their product innovation. Finally some limitations of the research will be discussed.

6.1 Conclusions

This research aimed to answer the question; *"How can Sarandi's product innovation be improved?"*. In order to do so, critical success factors for product innovation were searched from the literature, whereby the focus was on emerging economies and SMEs. Also the way Sarandi used to conduct product innovation was researched. From comparing this situation with the literature the following conclusions can be drawn. In table 3 an overview is created of how well the situation at Sarandi was in line with the literature.

Innovative organization

Most of the problems in this element originate from the managing director. In his drive to improve the company and bring Sarandi forward, he harms the innovativeness. He is controlling everything that is happening at Sarandi. Therefore the organization can be typified as having a simple structure. This does not suit Sarandi, since the organization is too large for this structure.
During the innovation process he takes on the roles of project leader, organizational sponsor, project champion and gatekeeper. Thereby he fulfills the roles of all key individuals. This slows down the process, makes his influence too big and the process too dependent on him. His large influence and thereby the low autonomy of the employees cause that the climate at Sarandi is not suitable for innovation. However, the relations between the employees are good, which creates a pleasant working atmosphere.

Another problem was the lack of teamwork. Innovation projects were performed by individuals and coordinated by the managing director. By not including people from involved departments, certain perspectives were not taken into account. For instance incorporating the customer's voice through the marketing department, or designing the product for efficient production.
On the involvement of employees in innovation, Sarandi scored low. There is a need for a formal approach to involvement, where all employees can contribute to innovation.

For these reasons, Sarandi was almost not in line with the literature on an innovative organization.

Element	Score
Innovative Organization	
Innovation Strategy	
Innovation Process	
External Inputs	
Absorptive Capacity	

Table 4

Innovation Strategy

Decisions on which products to develop were made ad hoc. There was no strategy formulated for the innovation efforts at Sarandi. The situation at Sarandi was therefore not in line with the literature concerning the innovation strategy.

Innovation Process
Sarandi did not have official stage-gates and the project team was not supported by automation throughout the process.

Search - Sarandi did not actively search for innovation possibilities in its environment. Responding to triggers from the environment could make them more competitive and could upgrade their portfolio of products.

Select – In this stage of the innovation process Sarandi lacked a portfolio of projects. They did not keep track of ideas or evaluated them. Instead a project was started once per year for the Hospex. The new product was based on the ideas of the directors and not further evaluated. Before a project is started a business plan should be made for it, where at least a market research can back up the project before it is started. Also a resource allocation was missing. This made it unclear for the people involved what the budget was and how much time they could spend on it.

Implement – This part of the process was sufficiently organized at Sarandi. There were two improvements that could be made. First, the products were not oriented on a market segment and the product strategy was not focused on a segment. Second, the team was not involved in determining the functionalities and the working principles behind the functionalities. When these two improvements would be implemented, products fit better to the needs of the customers, with the right specifications and functionalities. It could also improve the functionalities, or make them more cost efficient to produce, by better evaluating the different working principles.

Capture – This stage of the process was a problem for Sarandi. Due to the weak formal institutions in Indonesia patents and trademarks do not offer much protection. Therefore it is important for Sarandi to inform customers on their official sales channels, to prevent that they buy fake products from imposters. Besides that, Sarandi could capture more value from their innovation if they would become a first mover in the Indonesian market.

Overall, the innovation process was partly in line with the literature. Especially the implement phase was well organized. The other phases still need significant improvements.

External inputs
Sarandi used little external inputs. The inputs that were used come partly from suppliers, occasional feedback from customers and from students who did an internship at Sarandi. Sarandi lacked a strong partnership which could help them forward by providing them with the necessary resources. Therefore the situation was almost not in line with the literature.

Absorptive capacity
Sarandi possessed some knowledge and skills that were necessary in the innovation process. This basic knowledge could help them to understand new knowledge better. In some areas they did not posses knowledge. For instance in electronics or mechanics they had limited knowledge. This could be solved by developing these competences or by hiring someone who has them.
The main problem concerning absorptive capacity was communication. There was not much communication between the departments. Therefore it was difficult to spread knowledge in the organization.
Not only internal communication had to be improved. At Sarandi only few people spoke English and the once who did, had limited vocabularies. This limited their absorptive capacity towards foreign

knowledge. Currently there is an initiative where some employees can learn English on Saturday morning. This has to be further developed in order to improve communication with foreign people.

Pilot Projects

Pilot projects were conducted to find out how the organization handled changes and if certain aspects of the literature would work in this environment. Based on these projects the most important conclusion is that the organization is open to change. Throughout the projects there was full support and freedom granted by the directors to make changes in the process and the surrounding conditions.

The changes that were made during the pilot projects, seemed to have had a positive impact. During the pilot project a team of people from several departments was formed. The team members were all happy with the change and liked to work together. Moreover, during the design stage different perspectives were taken into account and thereby the final product was more user friendly and easier to produce. Also the influence from the managing director was reduced. This caused the team to operate more autonomous. Problems could be solved more efficiently within the team and the working atmosphere improved. Moreover the reduction of the involvement of the managing director improved the innovative climate. The team members had more freedom and support, were more involved and open, and dared to put forward their opinions and ideas.

In order to try out a stage gate system, the results of the different phases were pitched to the managing director. Hereby he could intervene in the process or even terminate it, if the project did not show the desired results. This seemed to work well for the managing director, since he was still in charge and up to date, but saved a lot of time by not being that strongly involved in the process.

During the pilot project it turned out that it is difficult to perform a market research. The hospitals did not cooperate with the online questionnaire. Instead a more personal approach might have given better results. Therefore the sales and maintenance teams will hand out a questionnaire when they visit a customer from now on.

How can Sarandi's product innovation be improved

Based on the previous conclusions the research question can now be answered. When comparing the situation at Sarandi to the best practice model it can be concluded that some characteristics of Sarandi's product innovation are counterproductive. This is for instance the structure of the organization and the way work is done by individuals instead of teams. Other important elements are simply missing, like an innovation strategy or external inputs. Therefore, in order to improve the product innovativeness these elements have to be changed in line with the best practice model, to create better conditions for product innovation. In the recommendations it will be described how this can be achieved.

6.2 Recommendations

Based on the comparison of the literature and the current situation at Sarandi, the pilot projects and the conclusions from the previous paragraph, this paragraph will formulate recommendations that should lead to improved product innovation at Sarandi. The recommendations will be given along the elements of the best practice model.

Innovative Organization

In order to make the products that are more customer oriented and easier to produce, the innovation process has to be performed by a cross functional team which consists at least of people from R&D, Engineering, Production and Sales & Marketing. The team should be able to operate autonomous, without too much influence of the managing director. His role should be limited to organizational sponsor, which means that he is informed about the progress that is made and that he can intervene when projects are not according to plan, but that he cannot determine everything in detail anymore. This should improve the innovative climate and let problems be solved faster. Finally, the involvement of other employees should be increased. This way the experience of all employees can be used in order to improve Sarandi's products.

Innovation Strategy

Sarandi needs to formulate an innovation strategy. Following Tidd and Bessant, Sarandi should define their strategy based on their technological trajectory. From the different trajectories given by Pavitt, Sarandi could logically take two directions. They can either continue to produce the products they currently have and go for the scale intensive trajectory. They would then compete on price, which would fit to the Indonesian market, since the hospitals lack financial resources. The other option is to take the specialized supplier trajectory and develop more advanced products. This also fits to the Indonesian market since there is currently no company in Indonesia which produces high-tech medical products. Combined with the protectionist import laws from the Indonesian government this could lead to a strong position in the market. By making a choice for either trajectory, the three strategic elements mentioned by Tidd and Bessant will follow, as can be seen in appendix 5.

When the innovation strategy is defined, it is important that Sarandi works on the identification and development of competences that support this strategy.

Innovation Process

During the pilot project an IT-tool was developed to guide the innovation team. This tool should be used in future projects. This will automatically create the stage gates in the projects, which will allow the directors to stay in charge of the process without too much effort.

The innovation process itself should be extended. Before projects are started, Sarandi needs to search more actively for triggers for innovation. This will lead to more ideas and thereby an increased change on containing successful new products. For these ideas, simple business plans should be created. These business plans should describe the idea and include a market research to see whether it could be successful. Also a technical feasibility study should be included, to insure that Sarandi is capable of developing this idea into a product. Based on these business plans, an innovation portfolio should be created, where projects are prioritized. By adding these steps to the innovation process the uncertainty that is connected to innovation can be reduced by gathering and using information from internal and external opportunities and threats.

During the development process of a new product, the project team should determine the functionalities and working principles. Hereby more knowledge from the work floor and the customers is used in the development, since the team members are closer to this information than the directors. Moreover, the products should be oriented to a certain customer segment. This can increase the economic success of a product by giving the customers what they want.

External Inputs

In order to improve the external inputs Sarandi has a wide range of options. In a short term licensing is a good option. In the Indonesian market brand names are very important and therefore a license contract can increase Sarandi's sales. Another short term external input is hiring someone with experience in innovation to be the project leader and improve Sarandi's product portfolio. This task could also be done by consultants, although this will probably be more expensive. Furthermore they can use the help from suppliers to improve their products.

On a longer term Sarandi could use a joint venture to start a new line of products together with a foreign firm. This way they can learn about new technologies and different products. This knowledge can later be used to upgrade their own products.

Other options are to work closer together with either customers or suppliers.

Absorptive Capacity

The knowledge base at Sarandi can be improved by developing the knowledge of the employees or by hiring people with the preferred knowledge. This knowledge should be in line with the chosen technology trajectory in order to support further development in the direction of the innovation strategy.

Communication between departments can be improved by, for instance, meetings, informal events or job rotation. External communication could be improved by upgrading the level of English of the employees.

6.3 Limitations and future research

The best practice model that was constructed has some limitations. Although all elements are derived from the literature, empirical testing has not been done sufficiently in order to say with any certainty that the model is correct. The explanatory power of the model needs to be determined. This will show to what extent the model can explain successful innovation.

The data that was gathered from the interviews might have been subjective, because it depends on people's perspective. For instance, where one person believes a job has a high level of autonomy, someone else might believe that the level of autonomy is low. Therefore, it can be questioned whether the outcomes of interviews are completely objective. This effect was limited by including a wide variety of employees in the research. Since their answers matched it can be believed to be true.

Another limitation of the data is the short period of observations. This is mainly a concern for the observation during the pilot project, since only two projects were conducted. It might be that negative effects need more time to be observed. It might be that working in teams demands too much time from the employees and therefore the innovation process becomes too costly. Other results can only be observed after a certain amount of time. A good example is the innovation strategy. This needs time in order to judge whether the strategy indeed makes sure that the innovation efforts contribute to the success of the firm.

Future research should be done on the model. In the first place, the best practice model that was developed and used in this research needs to be more thoroughly tested. Therefore, the model should be tested on how well it explains successful innovation. This has to be done in a longitudinal study, since the influences of the model need time before they show results. The model should also be tested in multiple companies, in different countries and different industries in order to test the generalizability of the model.

In addition to this model, a network perspective can be added, by introducing innovation systems or global value chains. In the literature these types of networks were also mentioned for successful innovation. In order to limit the complexity, they were not considered in the model.

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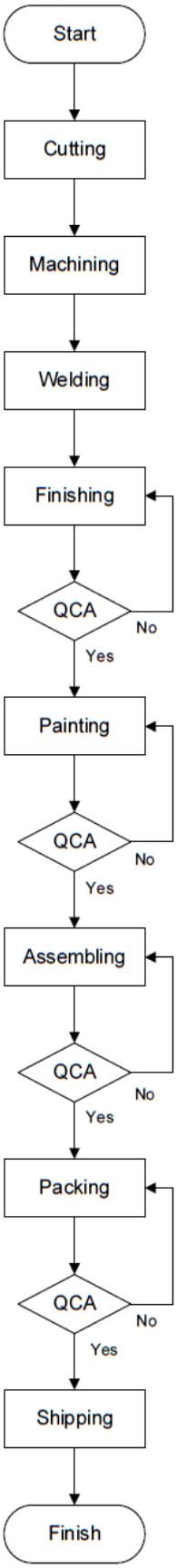
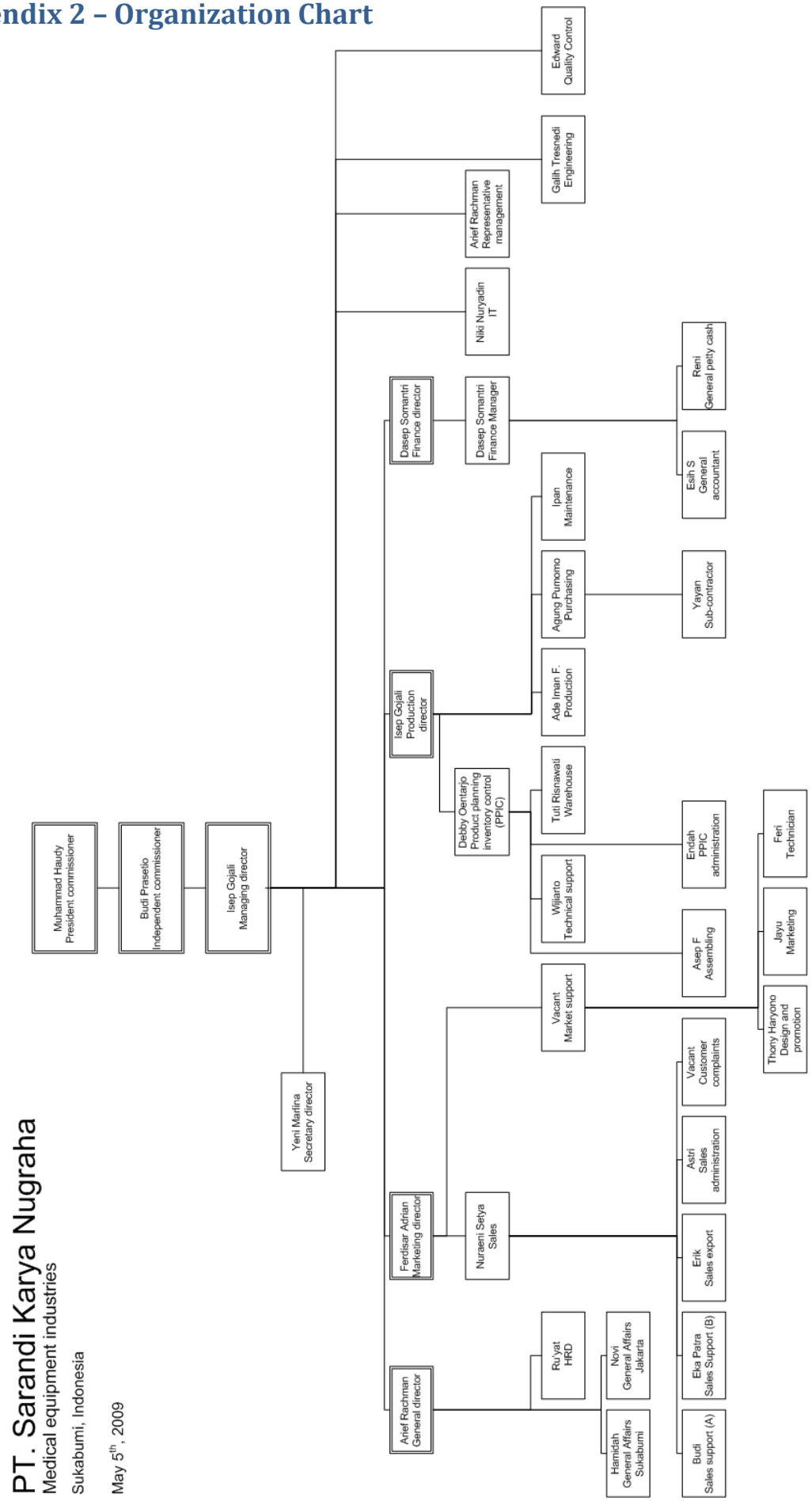
Appendix 1 – Flow Chart Production Process



Appendix 2 – Organization Chart



Appendix 3 – Mintzberg's archetypes

Archetype	Key Features	Innovative implications
Simple Structure	Centralized organic type – centrally controlled but can respond quickly to changes in the environment. Usually small and often directly controlled by one person. Designed and controlled in the mind of the individual with whom decision making authority rests. Strengths are speed of response and clarity of purpose. Weaknesses are the vulnerability to individual misjudgment or prejudice and resource limits on growth	Small start-ups in high technology 'garage businesses' are often simple structures. Strengths are in energy, enthusiasm and entrepreneurial flair – simple structure innovating firms are often highly creative. Weaknesses are in long-term stability and growth, and overdependence on key people who may not always be moving in the right business direction
Machine Bureaucracy	Centralized mechanistic organization, controlled centrally by systems. A structure designed like a complex machine with people seen as cogs in the machine. Design stresses the function of the whole and specialization of the parts to the point where they are easily and quickly interchangeable. Their success comes from developing effective systems which simplify tasks and routinize behavior. Strengths of such systems are the ability to handle complex integrated processes like vehicle assembly. Weaknesses are the potential for alienation of individuals and build up of rigidities in inflexible systems.	Machine bureaucracies depend on specialists for innovation, and this is channeled into the overall design of the system. Examples include fast food (McDonald's), mass production (Ford) and large-scale retailing (Tesco), in each of which there is considerable innovation, but concentrated on specialists and impacting at the system level. Strengths of machine bureaucracies are their stability and their focus of technical skills on designing the systems for complex tasks. Weaknesses are their rigidities and inflexibility in the face of rapid change, and the limits on innovation arising from non-specialists.
Divisionalized Form	Decentralized organic form designed to adapt to local environmental challenges. Typically associated with larger organizations, this model involves specialization into semi-independent units. Examples would be strategic business units or operating divisions. Strengths of such a form are the ability to attack particular niches (regional,	Innovation here often follows a 'core and periphery' model in which R&D of interest to the generic nature is carried out in central facilities whilst more applied and specific work is carried out within the divisions. Strengths of this model include the ability to concentrate on developing competency in specific niches and to mobilize and share knowledge gained

Archetype	Key Features	Innovative implications
	market, product, etc.) whilst drawing on central support. Weaknesses are the internal frictions between divisions and the centre.	across the rest of the organization. Weaknesses include the 'centrifugal pull' away from central R&D towards applied local efforts and the friction and competition between divisions which inhibits sharing of knowledge
Professional Bureaucracy	Decentralized mechanistic form, with power located with individuals but coordinated via standards. This kind of organization is characterized by relatively high levels of professional skills, and is typified by specialist teams in consultancies, hospitals or legal firms. Control is largely achieved through consensus on standards ('professionalism') and individuals posses a high degree of autonomy. Strengths of such an organization include high levels of professional skill and the ability to bring teams together	This kind of structure typifies design and innovation consulting activity within and outside organizations. The formal R&D, IT or engineering groups would be good examples of this, where technical and specialist excellence is valued. Strengths of this model are in technical ability and professional standards. Weaknesses include difficulty of managing individuals with high autonomy and knowledge power
Adhocracy	Project type of organization designed to deal with instability and complexity. Adhocracies are not always long-lived, but offer a high degree of flexibility. Team-based, with high levels of individual skill but also ability to work together. Internal rules and structure are minimal and subordinate to getting the job done. Strengths of the model are its ability to cope with high levels of uncertainty and its creativity. Weaknesses include the inability to work together effectively due to unresolved conflicts, and a lack of control due to a lack of formal structures of standards	This is the form most commonly associated with innovative project teams- for example, in new product development or major process change. The NASA project organization was one of the most effective adhocracies in the programme to land a man on the moon; significantly the organization changed its structure almost once a year during the 10-year programme, to ensure it was able to respond to the changing and uncertain nature of the project. Strengths of adhocracies are the high levels of creativity and flexibility – the 'skunk works' model advocated in the literature. Weaknesses include lack of control and overcommitment to the

Archetype	Key Features	Innovative implications
		project at the expense of the wider organization
Mission Oriented	Emergent model associated with shared common values. This kind of organization is held together by members sharing a common and often altruistic purpose – for example, in voluntary and charity organizations. Strengths are high commitment and the ability of individuals to take initiatives without reference to others because of shared views about the overall goal. Weaknesses include lack of control and formal sanctions	Mission-driven innovation can be highly successful, but requires energy and a clearly articulated sense of purpose. Aspects of total quality management and other value driven organizational principles are associated with such organizations, with a quest of for continuous improvement driven from within rather than in response to external stimulus. Strengths lie in the clear sense of common purpose and the empowerment of individuals to take initiatives in that direction. Weaknesses lie in overdependence on key visionaries to provide clear purpose, and lack of 'buy-in' to the corporate mission

Appendix 4 - Stages in the evolution of HII capability

Stage of development	Typical characteristics
1. 'Natural'/background HII	Problem-solving random No formal efforts or structure Occasional bursts punctuated by inactivity and non-participation Dominant mode of problem solving is by specialists Short-term benefits No strategic impact
2. Structured HII	Formal attempts to create and sustain HII Use of a formal problem-solving process Use of participation Training in basic HII tools Structured idea management system Recognition system Often parallel system to operations
3. Goal-oriented HII	All of the above, plus formal deployment of strategic goals Monitoring and measurement of HII against these goals In-line system
4. Proactive/empowered HII	All of the above, plus responsibility for mechanisms, timing, etc. devolved to problem-solving unit Internally directed instead of externally directed HII High levels of experimentation
5. Full HII capability – the learning organization	HII as the dominant way of life Automatic capture and sharing of learning Everyone actively involved in innovation process Incremental and radical innovation

Appendix 5 - Five major Technological Trajectories

	Supplier Dominated	Scale-intensive	Science-based	Information-intensive	Specialized suppliers
Typical core products	Agriculture Services Traditional manufacture	Bulk materials Consumer durables Automobiles Civil engineering	Electronics Chemicals	Finance Retailing Publishing Travel	Machinery Instruments Software
Main sources of technology	Suppliers Production learning	Production engineering Production learning Suppliers design offices	R&D basic research	Software and system departments Suppliers	Design Advanced users
Main tasks of Innovation strategy					
Positions	Based on non-technological advantages	Cost effective and safe complex products and processes	Develop technically related products	New products and services	Monitor and respond to user needs
Paths	Use of IT in finances and distribution	Incremental integration of new knowledge (e.g. virtual prototypes, new materials, B2B)	Exploit basic science (e.g. molecular biology)	Design and operation of complex information processing systems	Matching changing technologies to user needs
Processes	Flexible response to user	Diffusion of best practice in design production and distribution	Obtain complementary assets. Redefine divisional boundaries	To match IT-based opportunities with user needs	Strong links with users

Appendix 6 - Mulder's NPD process

Below is a summary of the NPD process as it is described by W. Mulder in his research conducted at Sarandi in 2009. The process consists of four phases which in turn consist of some steps.

The first phase is the **analysis** phase. In this phase it should be made clear what has to be developed and when it should be done. Therefore the steps are as follows:

Planning; make a planning of the whole process.
Determine the functions; the functions of the product should be determined.
Determine the specifications; Determine specifications like costs, quality standards, aesthetics etc.

Second is the **conceptual design phase**. Here different concepts are created by combining solutions for the predetermined functions. The steps are:

Search for working principles; Find different ways to achieve the functions that you determined in the previous phase.
Combine them into working structures; make combinations of working principles from all functions.
Develop concepts; work out the working structures into concepts.
Choose the best concept; systematically choose the best of the previously created concepts.

The third phase is the **embodiment design phase**. Here the concept is developed into a more concrete product. The steps are:

Defining the general design; this is done by defining the general arrangement, the shape and the material of all components. Also the production processes that are needed are defined in this step.
Evaluating and improving; After the general design is made it is important to evaluate it and see if it is possible to make improvements.

The fourth and final phase is the **detailed design phase**. In this phase the design and production details are finalized. The steps are:

Designing the individual parts; The exact shapes, dimensions, surface properties of all individual parts are determined.
Evaluating and improving; In this phase the whole design is evaluated and tested by both the developers and production department.
Calculating the production cost; For the production of every part and assembly the costs must be calculated.
Preparing the drawing package; The drawing package functions as the way of communication from the product developers to the production employees. The production employees must be able to understand exactly how the parts are produced and which specifications must be fulfilled.
Prototyping; During this activity it is important that all the problems that are detected are documented and the design is changed if it is necessary. If the production of the prototype is finished, an evaluation of the product takes place.
Defining which tools have to be designed; It can be necessary to developed tools that support the production process.