Project Communication for Successful Product Development

- Developing a Project Overview at ITT W&WW

EMMA LUNDBERG

CHRISTIAN SEGLERT

KTH Industrial Engineering
and Management

Master of Science Thesis

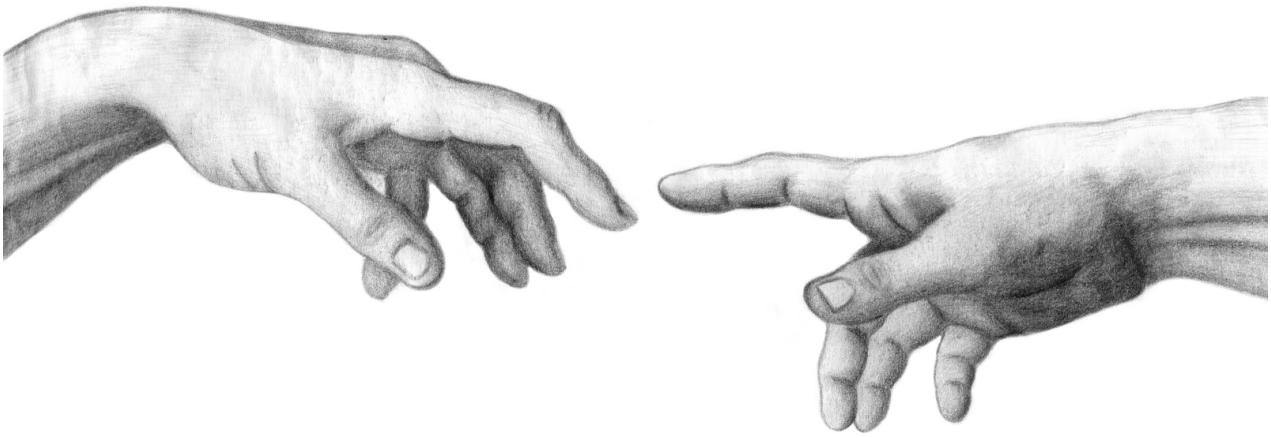
Stockholm, Sweden 2011

Project Communication for Successful Product Development

- Developing a Project Overview at ITT W&WW

by

Emma Lundberg
Christian Seglert



Master of Science Thesis INDEK 2011:56/MMK 2011:47
KTH Industrial Engineering and Management
Industrial Management/Machine Design
SE-100 44 STOCKHOLM

KTH Industrial Engineering and Management

Master of Science Thesis
INDEK 2011:56
MMK 2011:47 MCE 259

Project Communication for Successful Product Development

- Developing a Project Overview at ITT W&WW

Emma Lundberg
Christian Seglert

Approved	Examiner	Supervisor
2011-06-09	Johann Packendorff	Johann Packendorff
	Commissioner	Contact person
	ITT W&WW	Christian Wiklund

Abstract

The majority of companies working with new product development today are using a product development process. Although very helpful, a process will not guarantee successful product development. One of the most important aspects to consider in projects and product development is communication - how project members exchange information with one another. Successful product development is hard to achieve without efficient project communication.

This master thesis is based on the previously mentioned background. The questions to be answered are: What problems exist within product development projects? How are these related to communication? How can communication be improved to solve them? To answer these questions, a case study at the product development company ITT Water and Waste Water was carried out. By conducting 37 interviews, data regarding the company's communication and development process has been collected. In addition, theories regarding project development and communication are researched. Together, theses constitute the basis for the thesis analysis.

The empirical research showed that there indeed exist problems in the case company's development process: a lack of project evaluation, too development times, a lack of market orientation, and decisions being made without sufficient information. The later two where found closely dependent on communication.

Further research showed that introducing a project overview would solve these problems. As a final conclusion, a layout of the proposed project overview was introduced. Even though insufficient communication is not believed to be the only cause for the identified problems, the authors believe that the project overview would in part solve them. Since there are large similarities in how product development is carried out at different companies, the findings are most likely transferable to other organizations.

Key-words: Communication, Product development projects, Project Overview.

KTH Industriell teknik och management

Examensarbete
INDEK 2011:56
MMK 2011:47 MCE 259

Projektkommunikation för Framgångsrik Produktutveckling

- Utveckling av en Projektöversikt på ITT W&WW

Emma Lundberg
Christian Seglert

Godkänt	Examinator	Handledare
2011-06-09	Johann Packendorff	Johann Packendorff
	Uppdragsgivare	Kontaktperson
	ITT W&WW	Christian Wiklund

Sammanfattning

De flesta företag som arbetar med produktutveckling idag använder sig av någon form av produktutvecklings-process. Även om en process är mycket användbar, så garanterar inte den en framgångsrik produktutveckling. En av de viktigaste aspekterna i projektarbete och produktutveckling är kommunikation – hur projektmedlemmar utbyter information med varandra. En framgångsrik produktutveckling är svår att uppnå utan effektiv projektkommunikation.

Temat för den här uppsatsen är baserad på denna bakgrund. De frågor som ska besvaras är: Vilka problem finns i produktutvecklings-projekten idag? Hur är de relaterade till kommunikation? Hur kan kommunikationen förbättras för att lösa dessa problem? För att svara på dessa frågor har en fallstudie på produktutvecklings-företaget ITT Water and Wastewater genomförts. Genom 37 intervjuer har data rörande företagets kommunikationsmetoder och utvecklingsprocess insamlats. Dessutom har teorier på samma studerats. Tillsammans bildar de basen till examensarbetets analys.

Den empiriska datainsamlingen visade på problem i utvecklingsprocessen: brister i utvärderingar av projekt, långa utvecklingstider, projekt med för svag marknadsorientering och beslut tagna baserade på otillräcklig information. De två sistnämnda har identifierats att vara beroende av kommunikationen i processen.

Vidare visade studien att en projektöversikt skulle lösa dessa problem. Som resultat har författarna skapat en utformning av denna projektöversikt. Fastän brister i kommunikation inte är den enda anledningen till de identifierade problemen, tror författarna att den framtagna projektöversikten kommer att avstyra dem. Då det finns stora likheter i hur produktutveckling utförs på olika företag idag, anses resultatet vara överförbart även till andra organisationer.

Nyckelord: Kommunikation, produktutvecklings-projekt, projektöversikt.

Table of Content

Table of figures

1. Introduction

This chapter contains an introduction of the thesis topic. The original problem description is defined, and the thesis delimitations are introduced.

1.1. Background

To be successful in product development in today's global society is to be successful in product innovation. Successful product innovation means to have a current and competitive product range that appeals to the needs of the market (Tidd and Bessant, 2009). If a company can't offer this, their competitors will surpass them and before they know it they will perish to "corporation-heaven" populated with other like them who also failed to innovate. Globalization is eliminating distances between different geographical markets. This means that any day, a competitor from a previously distant part of the world, could be standing on a company's markets doorstep offering their customers a product more attractive than their own. Competition is tougher than ever, and consequently; having a working product development strategy is very important in order to survive. (Cooper, 2008)

Fortunately, most large companies have been aware of the importance of product innovation for some time now and consequently they have developed a rigorous product development process for decades (Cooper, 2008). Most of these processes are of a "stage gate" nature, meaning that a product development project is divided into a number of stages with decision milestones and tollgates after each stage (Tonnquist, 2008). The benefit of the Stage-Gate process is that it allows easy monitoring of large project portfolios while at the same time ensuring a market demand and an opportunity for profit for the product taking form (Cooper, 2008).

However, having a rigid product development process does not assure successful product innovation (Cooper, 2008). A number of factors affect the outcome of a product development project, and subsequently the market success of the developed product. For example, lack of resources will probably prolong the time to market, which can result in the product completely missing the "gap" in the market that was identified in the first place (Iansiti & MacCormack, 1997). Other obstacles could be a product which demands a technology that is completely new for the company in question, resulting in a lack of available knowledge that could result in the finishing product being inferior in quality. Either way, very few product development projects are completely without problems (Cooper, 2008).

A factor of great importance in product innovation is the communication between the stakeholders in the product development project (Griffin, 1992). The more people involved, the greater the risk of misconception or information loss is. This can lead to failure to meet deadlines, failure to meet market demands or inability to co-operate efficiently with fellow project members. In a successful project, the people or functions in the project know what information needs to be shared, who it needs to be shared with, and when (Griffin, 1992). The reality is however that communication in product development projects is hard. Having a defined

product development processes helps, but it's not uncommon that projects step outside this process resulting in a lot of "special cases" that put even higher requirements on a working communication structure. The fact that many companies run a large number of projects at the same time, adds to the confusion (Cooper, 2008).

1.2. Problem description

In this thesis the communication between stakeholders in product development projects is studied. Previous discussion supports the aim to answer following questions:

- *What common problems exist in a product development process today?*
- *Which of these problems can be solved by improving the communication between project stakeholders?*
- *What tools or methods should be used to improve communication between the project stakeholders?*

1.3. Aim of Thesis

The problem description above shows this thesis has a very wide area of interest. The aim of this thesis is therefore divided into two steps.

In the first step, the authors aim to identify common problems in product development projects at the case company studied for this thesis. Furthermore the identified problems are examined and analyzed to terminate which can be resolved by improving project communication.

In the second step, the authors aim to develop a concept solution improving the communication in the projects, and therefore solve the previously identified problems. The actual product of the thesis is not defined at the start. It may be a model that helps project stakeholders to communicate, or it can be a physical product or system that can be used by project stakeholders. Either way, the product of the thesis should solve the identified problems by improving communication.

1.4. Delimitations

The case study and the study of theory are used to analyze the problems that occur within a product development project. However, the problems in the product development process are only to be solved with improvement of communication, changes in the process itself are not made.

Furthermore the authors focus most work on communication between the market department and the R&D department, and only to some extent the operations department. This limitation is made since the two first departments mentioned are the ones that are located in the same geographical location at the main case company. The production department is included to the extent it is possible but the geographical limitations means some delimitation in this area is inevitable.

2. Methodology

The purpose of this chapter is to provide the reader with an understanding for how the thesis work was conducted, through a practical as well as a scientific perspective.

2.1. Scientific approach

The research of this thesis has two main areas of focus. Firstly the case study at the company ITT Water & Wastewater and secondly the review of theories concerning product development projects and communication. This results in a combined empirical and theoretical approach. The authors aim to develop a conceptual communication model, which can work as guideline for improving communication both at the case company and similar companies. The thesis is thus identified as a deductive research (Collis and Hussey, 2009), because the reasoning works from the more general to the more specific. However the final concept will not be tested and implemented in the frame of the thesis.

The thesis takes it standpoint towards the paradigm interpretivism (Collin & Hussey, 2009). The authors' ontology, how they view the world, is with the belief that the reality is a subjective concrete process that is possible to influence. The epistemology of the thesis lies close to interpretivism since the researchers are close to what is researched and participate in the enquiry in order to construct suitable processes and changes. By studying a wide range of theories the authors also acquire a knowledge base of how project communication in product development projects is best carried out. Following, with logical reasoning and comparison, the results of the empirical studies are analyzed and the areas of improvement are identified. When identified, a concept for solving those obstacles is developed.

For research results to be validated, a repeated study of another case should produce the same result. However, in an interpretivistic approach it is believed that the activities of the researcher influence the research and thus it is difficult to replicate the activities (Collin & Hussey, 2009). In an interpretivistic paradigm, validity is often of less importance or may be interpreted in another way. Interpretations and observations are made by two observers in this study and thus result in two views of the research.

2.2. Knowledge view

This research has a normative research view to most extent, since a case study is combined with an analysis of theories already available on the subject. One of the goals of the thesis is to provide a basis for making improvements. However, to achieve a completely normative result, the number of case studies needs to be extended to validate the findings of this thesis.

2.3. Scientific Ambition

The scientific ambition with this thesis is to create a (to a great extent) normative model for how communication in product development processes is best carried out. The authors believe that the combination of the large case study and the solid theoretical research, results in findings with enough different perspective to be considered normative for at least companies and organizations in similar industries.

2.4. The case company

ITT Water and Wastewater is a high-technology company that develops and produces products for water handling and treatment. The company is a part of ITT Corporation which employs over 45 000 people worldwide and has a yearly turnover of 50 billion Swedish crowns. ITT Water and Wastewater (ITT from here on) itself employs about 12 000 people with research, development and production on four continents. ITTs corporate head quarters are situated in Sundbyberg in Sweden, outside Stockholm. It is at this office that the case study has been carried out (ITT, 2011)

ITT is a very good candidate for this case study for a number of reasons. The company runs about 70 parallel product development projects in 7 project pipelines that represent the company's different business areas. Some resources are specific for each pipeline and some are shared between them. Thus there is a need for great coordination between the different resources and projects in order to succeed with its product development. This also means there is a lot of information needed to be shared between many people. Consequently, ITT is a company with a great need for a successful project communication strategy.

Furthermore, the nature of ITT makes the organization very suitable for analysis. At the headquarters in Sundbyberg, the Research and Development (R&D) department, market department and (to some extent) the operations department are present. This makes collection of primary data from representatives for all project stakeholders considerably easier than if these functions where located in multiple geographical areas. Lastly, the corporate culture at ITT is perceived as very non-hierarchical which also eases the author's work of collection data.

2.5. Data collection

The thesis findings are based upon data which where collected from a number of different sources. The authors are granted permission to use data and material from ITT´s internal database, which is analyzed partly to understand the process in the organization. Furthermore, interview and workshop-results from project stakeholders constitute the primary data for the analysis. Lastly, acknowledged theories within the field is the second main source of information for the analysis.

The interviews for collecting primary data are conducted in three different stages. In the first stage the author's goal is to familiar themselves with the product development process, and to

some extent identify potential areas of improvement in it. These interviews are limited to one hour and are semi structured through a questionnaire (see Appendix A). The questions have got an open character in order to gather broad information, which is useful in an early stage of the investigation to develop an understanding for the respondent's work situation (Collin & Hussey, 2009). At each occasion, both of the authors participate; take terms in asking questions and takes independent notes. The notes are subsequently compiled in independent summaries to assure details and accuracy of data.

At the second interview stage, the data is analyzed and used to design a new questionnaire with questions with greater focus on the problems in the product development process. This questionnaire (seen in Appendix B) has got a character in accordance with the positivistic research paradigm of the thesis methodology. The data gathered from this interview stage is then analyzed to identify a limited area of improvement in which the rest of the thesis work has got it's focus.

In the third interview stage, the authors' aims to further specify the needs of the solution for the identified area of improvement. In this stage, a concept solution is also discussed with project stakeholders to assure a solution with a solid support of the future "customers". This interview guide can be seen in Appendix C.

All interviews but one are carried out face to face and in a more or less open fashion. This approach is considered suitable since it allows the authors to identify details in the answers of the interview subjects with higher accuracy. However, the presence of the authors could affect the interview subject's answers. It can be argued that a questionnaire would be more appropriate and give more objective answers.

2.5.1. Interview Selection

The first interview stage consists of interviews with 10 project managers at ITT W&WWs Product Development Department. Interviewing project managers at this stage is considered the best choice since the authors assumed that they are the ones who had the best over all knowledge of the process.

In the second stage of interviews, 23 employees representing the market department, the operations department and the R&D department were interviewed. These interview subjects were mainly chosen based on recommendations by Christian Wiklund, manager for project management at the ITT R&D department and supervisor of the authors of this thesis. This was not a completely objective approach and is something that the authors take in consideration when analyzing the results of the interviews. Furthermore, another major function in product development projects, the operations department, was not fairly represented since this function isn't located at the ITT headquarters. Of the 23 interview subjects in this stage, only 2 represent production. This is considered a weakness in the data collection and was taken in consideration when analyzing the data.

In the third and last stage of interviews, an additional 4 interviews were conducted with interviewees chosen to match the extent to which the final solution affects them. The subjects consist mainly of decision makers and project managers since the authors consider them to be the ones that would benefit the most from the final communications solution. A complete list of interview subjects can be viewed in the references chapter.

2.6. Analytic work

The method of analyzing is best referred to as triangulation, since the authors use multiple sources of data to produce an end result. (Collin & Hussey, 2009) In the process of analyzing the interview results, the authors individual notes were compared to identify the common denominators as well as discuss irregularities. After each stage of interview analysis the authors agreed upon which areas were of most importance for the future work. See Figure 1.

One method used when analyzing the interview results was the "5 whys"-method. The name refers to the principle that to identify the real cause of a problem, the question "why" should be asked 5 times. Consequently, the core reason for the problem is identified (Shook, 2008). The authors used this method in order to reduce a range of identified problems to a smaller number of root causes. By solving these root causes, a larger number of problem symptoms can be adverted.

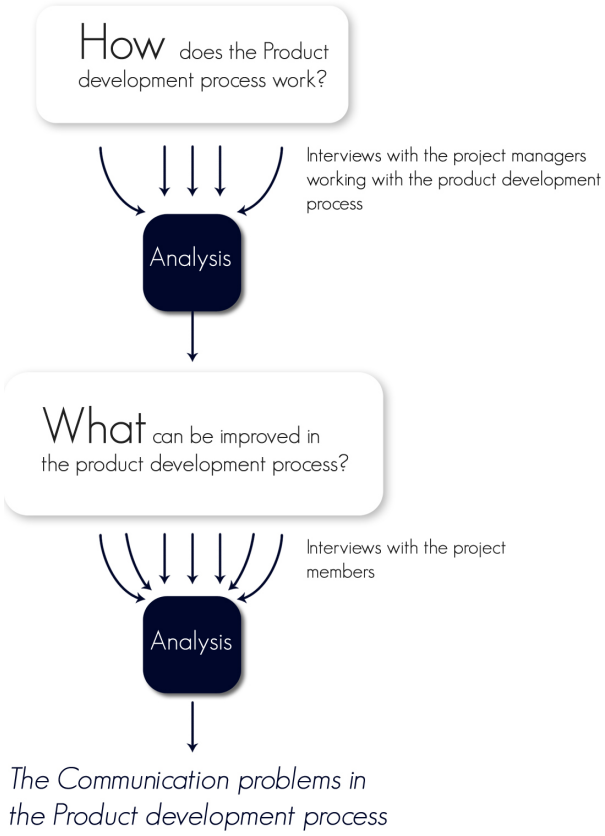


Figure 1. Strategy for Interviews conducted at ITT

2.7. Transmittability

The findings of this thesis are best transferable to organizations of the same size and industry as the studied case companies. However, the authors have a strong belief that the solid theoretical base of the thesis work makes the result valid for many other businesses and company sizes as well, since there are large similarities in how product development project are conducted across industries (Cooper, 2008).

2.8. Planning

A time plan of the thesis work is done using Microsoft Project. The time plan is design to match the product development process used by ITT, with the purpose of investigating how it works while working with the thesis. ITT's product development process is a stage gate process with 6 tollgates (TG0-TG5). The time plan is designed so that a decision meeting with the thesis supervisor at ITT is held at every tollgate. The purpose of the meeting is to review that all necessary work have been done in order to pass the tollgate. Some key milestones are: *problem definition, solution concept, solution productification, solution testing/implementation* and *project ending.* The time plan can be reviewed in detail in Appendix D.

2.8.1. Risk analysis

A risk analysis of the thesis is carried out to identify the most critical risks in the research project and to suggest countermeasures to those risks. The risk analysis is done using the FMEA method (Failure Mode and Effect Analysis). Using this method, the identified risks are graded on a scale from one to ten on the chance that an event will occur, how serious the consequence is, and how easy the error can be identified (Stamatis, 2003). The gradings are multiplied with each other, producing a number that allows ranking of the risks. The original FMEA can be viewed in the Appendix E. This version is reviewed and updated before every tollgate.

2.9. The Author's backgrounds

This thesis constitutes the last 20 weeks of full time studies of a 5-year civil engineering program. The authors of this thesis are Emma Lundberg and Christian Seglert. The academic background of Emma Lundberg is civil engineering studies in Design and Product Realization with ongoing major studies in Entrepreneurship and Innovation Management at the Royal Institute of Technology in Stockholm. She also holds a Masters degree in Industrial Design at Istituto Europeo di Design in Turin, Italy. The academic background of Christian Seglert is civil engineering studies in Design and Product Realization with ongoing major studies in Integrated Product Development, also at the Royal Institute of Technology in Stockholm. Parts of his master studies were carried out at the City University in Hong Kong.

Emma Lundberg has an own company that focus on Product Design and Product Development in both the Italian and Swedish market. Regarding previous knowledge related to the thesis, she has in her own product design business faced challenges in communication with customers. In

addition, she has seen the importance of communication in a process from work experiences at a company dealing with packaging of products. Although this experience comes from an industry different from the case company, it is still considered relevant since their product development processes is similar to ITTs.

Christian Seglert has experiences of running both innovation and non-profit projects at Royal Institute of Technology. He has first hand experiences of the importance of continuous communication with the receiver of a product, from working as project leader in a med-tech product development project. In addition, with experiences from managing a project with project members stationed in both Sweden and China, he has seen the communication challenges that a geographical and cultural divers project group brings. Although these experiences do not originate from the same industry as the case company, the general knowledge of working in project is considered relevant to the thesis.

2.10. Ethics

As any employee at ITT, the authors signed a non-disclosure agreement that states that information sensitive to the company is not allowed to be shared externally. However, since the thesis to most extent address the process of product development and not the product itself, ITT agrees that there is no need for a separate public thesis report where company related information is limited.

The interview subjects are consistently informed about the purpose of the thesis work, and therefore agree on the results from their interview being a source of primary data. It is of great importance that the interview results are not discussed in detail with other parties at the case company. This is so that the interview subjects feel that they can trust the interviewer and be completely honest in their answers. To insure that sensitive opinions of individual interviewees are not exposed within the organization, the interviewees are never directly tied to a specific interview result in this report. An individuals opinion is referred to as “the interviewees opinion”.

PART I

Identifying the problems

In this part of the report, the product development process at ITT W&WW is examined and compared to theories regarding product development. Furthermore, problems existing within ITTs process are identified and their connection to communication is analyzed. Finally, a set of problems that can be solved by improving communication is specified.

3. Emperic Result 1: Product Development at ITT

The following chapter will summarize the empirical data gathered from first and second interview stages and the review of project documents, regarding the Product Development Process at ITT. Problems that exist within it will be described. If not stated otherwise, all statements made in this chapter is based on the interviews made with project stakeholders at ITT.

3.1. ITT Water and Waste Water

ITT Water and Waste Water has its origin in a foundry and forge-business that was founded by Peter Alfred Stenberg in 1901. The business was located in Lindås in the south of Sweden, in the same municipality where one of the company's main production facilities is located today. In 1929 the company started a collaboration with Hilding Flygt who had been seeking a business partner for manufacturing pumps, the first of which where design by Professor Hjalmar O. Dahl at the Royal Institute of Technology in Stockholm. In 1933, the sales of Professors Dahl's vertical heating pump were a great success, offering a number of advantages over traditional pumps at the time. The company's innovation success continued in 1947 when the production of the worlds first submersible drainage pump revolutionized the mining and construction industry (ITT, 2008).

Figure 2. The worlds first submersible drainage pump, accompanied by its inventor Sixten Englesson.

During the second part of the 20th century, the company started sales companies around the world to handle the growing product demand, and eventually also built a production facility in Germany. In 1968, the ownership of the company (called Stenberg-Flygt AB at the time) was transferred through an exchange of shares to the American enterprise ITT, the International

Telephone and Technology Corporation. Afterward the company's product range, consisting mostly of water pumps, expanded to include manure, sewage and propeller pumps as well as mixers. After acquiring a number of companies related to the expanding product range and the growing market demand, the company changed its name to ITT Water and Waste Water in 2008 (ITT, 2008).

Today ITT Water and Waste Water is considered the industry leaders in submergible pumps and mixers. The company is present on over 130 markets around the world, and currently has a yearly turn over of 6,6 billion SEK (ITT, 2008). Today, ITT has 7 product pipelines. Even though pumps are still a major part of the companies business, a large part of its growth is happening in other business areas such as water treatment. Some interviewees' explain this in part by describing the pump market as crowded with limited space to grow, whilst the water treatment market has large areas that have not yet been explored to the same extent.

3.2. Product development at ITT

Ever since the product range started to expand in the 1970s, ITT has been designing and selling a range of products that has more or less in common with the traditional pumps the company started with. As companies were acquired in order to gain know how in these new business areas, their own product development processes where brought along with them. Today however, the same product development process is used in all business units. The process used has its roots in the pump business, and some interviewees mean that it is in some way designed to accommodate development of pump products in particular.

The product development process at ITT is of a Stage Gate nature. The project starts when an identified product need is confirmed, and ends when the product has spent enough time out on the market so that sufficient feedback from customers can be gathered. All in all, the process consists of 6 stages, each ending with a corresponding tollgate where it is decided if the project is ready to enter the next stage or not. When a project is considered to be ready to enter a new stage, it is reviewed at a project board meeting where the project board members agree on the official decision whether the project should pass the tollgate in question or not.

The project board consists of representatives from the three departments: R&D, Production and Market. For R&D, this representative is in general the director of the product development department. The market representative is the marketing director of the product category in question, and for production the representative is the manager for manufacturability of new products.

To aid the project board in their decision, a predetermined set of documents is prepared for every specific tollgate. The purpose of these tollgate documents is to give an accurate and up to date picture of the overall state of the project. In practice however, the content and use of these documents varies. The author of the documents is in most cases the project manager (or the projects market representative in the project startup phase). After the authors reviewed a large

number of tollgate documents, it became evident that both the amount and character of the documents content vary a great deal depending on who has written them. In addition, in what detail the documents are reviewed vary depending on the project board member and the nature of the document. Some documents affect certain departments more than others, and thus they are reviewed in different level of detail depending on which department a board member is representing. Furthermore, individuals that serve as board members to a great number of projects express that they are simply not able to review all documents since this would consume too much time. Some documents are however considered of such great importance that they are always reviewed in detail.

Even though tollgate documents are "official" documents that are to be available to aid in the decision of whether or not a project should enter a new stage, another core purpose of them is considered to be something else. Some interviewees describe them as a mean to ensure that the project manager has considered all aspects in the project**.** Some documents are written more standardized than others because they are considered to be of a greater importance and will therefore probably be reviewed to a greater extent than others. Review of tollgate documents also showed that some types of documents are occasionally not done at all, since their original purpose isn't considered to apply to the project in question**.**

3.3. ITTs Product Development Process

The product development process different stages, their goals and what documents that are to be produced are described in the following section.

3.3.1. Stage 0 - Evaluation of the project idea

The purpose with this stage is to examine the identified project idea, and determine if it is in line with the overall business strategy of ITT. The official deliverable that should make the decision to initialize the project possible is a business hypothesis: a document containing general information about the proposed project and a description of the market need that it will fulfill. The purpose with this is to validate that there is a need for the product that is to be developed so that the company actually will make profit. Furthermore, the purpose is also to ensure that the product is in line with ITTs overall product development strategy. In this stage of the project, there is in most cases no official project manager or group since the official start of the project takes place if this stage is passed.

The market department generally does the business hypothesis since its content originates from their own business analysis process, which takes place before the project idea is officially proposed. However, a project does not always start with an identified market need, some are initialized by the R&D department as a result of development of new technology or improvement of an existing one. In this case, a business hypothesis is done as well, but instead of a market-pull there is an R&D-push. What this means in reality is that the marked department is

asked to identify a need for the technology in question in order to justify the project, instead of starting with identifying a need that then can be met by developing new technology.

Regardless of the origin of the project idea, most interviewees express that the same rules officially apply: the "go" or "no go" decision is based on the content of the business hypothesis. However, some interviewees' mean that in reality informal communication and project lobbying affect this decision as well.

3.3.2. Stage 1 – Project specification

After passing the first tollgate, the project goes in to stage 1. The official purpose of this stage is to more thoroughly examine if the business case of the project is described well enough, as well as to identify the main project risks. To examine the business case further, a business description is written. This can be considered as an evolved version of the business hypothesis with a more thorough analysis of the market and existing competitors. This is done by the project manager who is unofficially appointed during or after tollgate 0, together with the market representative that worked on the business hypothesis in stage 0.

In this stage, the actual content of the project is also described in detail. In a project specification, information such as market conditions, project purpose, customer values, project resources and project risks are presented. This document is somewhat of a summary of other tollgate documents since it generally contains information that can be found (with more depth) in other documents. Other documents that are to be presented in order to pass this stage are product specifications, a first version of a PAR (an financial analysis of the project outcome), a project time plan and a risk analysis with proposed countermeasures.

3.3.3. Stage 2 – Concept development

In stage 2, the main purpose is to present a product concept that corresponds to the original market need, as well as being technically and environmentally sustainable. The product launch plan and the final version of the PAR should also be done. Finally, information about the planed R&D project that is needed to realize the product concept should be available for the project board.

In order to achieve this there is a range of tollgate documents to be presented. One of the key documents is the production checklist that assures that the production department has been consulted in the evaluation of the product concept. Other documents include updates of the project specification, the PAR and the project risks. What is actually presented to the project board in order to pass this stage varies from project to project. The authors' review of these documents showed that the level of detail of the concept varies greatly depending on the project.

3.3.4. Stage 3 – Productification

The third stage is about presenting the final product design in order to allow preparation and investments for the necessary production line. In this stage the actual design of the final product

is done. In order to pass into the next stage, checklists for both production of the product and the actual product design itself needs to be presented.

On the project board meeting in this stage, there is great focus on the PAR since it describes the actual profitability of the project. This is of great importance since costly investments in the production line are going to be done if the project proceeds to the next stage. Furthermore, agreeing on a final product design is by many interviewees' considered extremely important since changes in product design after making investments in productions tools, are both costly and time demanding.

3.3.5. Stage 4 – Production and Sales

During the fourth stage, production is initialized and the sales of the product start. If the product is to replace an existing one in the product range, a discontinuation plan for the current product needs to be made. Furthermore, a plan for handing over the finished product to the future internal product owner (a representative from the technical department) should also be presented.

3.3.6. Stage 5 – Evaluation and project ending

The aim of this stage is to end the product development project. The product has been sold and is out on the market. Initial customer reports are gathered and analyzed in order to solve possible problems that the first batch of products could be troubled by. If the reports show product problems that are serious enough to compromise the overall product quality, actions for adjustments in product design, material selection or production methods can be taken. Another important aspect of this stage is the evaluation of the project.

3.4. Areas of improvements in the product development process

The general view of the product development process at ITT is that it is good, and used as a checklist to makes sure that every important aspect of a project has been considered. One of the reasons for this is by interviewees' believed to be that it is a result of many years of ITT product development experience. Within the ITT organization, this process is considered as a very solid one and many interviewees' argue that the continuous success of ITT as a company is solid proof that the process is working. However, the general opinion is also that there is room for improvement in the process. During the first interview stage, four areas of improvement where identified and is described in the following section.

3.4.1. Market focus in the product development process

There is a strong tradition of technical push product development at ITT. Even though it has lead to a number of successful products and is considered to be the reason for a lot of the success during the 20th century, the general opinion amongst interviewees' is that the organization needs to conduct a more market oriented product development. Some products have a hard time competing on the market that is constantly growing tougher. One interviewee expresses that to

develop a successful product today, matching the true needs of the market is considered more important than ever.

Several interviewees have expressed a need for a better communication of the market perspective to the entire project group, meaning that there is a communication gap between the market department and the rest of the organization. Furthermore, interviewees express that the production and design engineers are often hard to reach. Production representatives in the Lindås factory says that they have little direct communication with the market department since most communication takes place through the project manager.

One interviewee believes there is a lack of information flow between ITT and the market, meaning that there could be a better general business understanding in the company. However, just sharing market material more openly would probably not help. He believed that the R&D department and the market department are very polarized, and just forwarding more market material to R&D would probably just make them skeptical.

Given the large amount of experience that exists within the organization there is a strong belief amongst the engineers that they already know what the customer needs are. However, one interviewee expresses that the ways pumps are sold have changed from being sales directly to the end users, to becoming sales to a middleman, the actual customer have in some cases changed. Today's customer is not always the people using the pumps; it is the people selling the pumps. A new customer means a new set of needs, and if these are not considered during the development, the success of the product is not guaranteed. Because of this trend, the interviewee believes that an efficient communication between the market department and the R&D department is more crucial than ever.

One interviewee argues that even though the actual needs are known, they have to be expressed very clear. He states:

"The market purpose of the project needs to be clear otherwise it is not a product development project – then it is a technical development project".

However, the communication between market and the rest of the organization is by many interviewees considered to have improved, in part because of more openness from R&D towards market. Furthermore, it has also been a greater evolvement of the market department, which also has lead to a closer partnership between market and R&D. However, some interviewees still believe that the product development process is more focused on developing than selling the. A project buyer expresses the fact that many of the project managers come from a technical background leads to a strong technical focus in some project instead of a market focus.

3.4.2. Time to Market

According to many interviewees there are not many projects that keep the original time schedule, and there is a strong belief that the process could go faster There are several theories about why these delays occur. One being that the product development process is very detailed and thus takes a very long time to follow.

The origin of ITT's process is from when the company's main focus was on developing cast-iron pumps that where to be produced in the factory in Lindås. Today however, the products range from water treatment to monitoring and control systems, and the production facility might as well be located in Shenyang in China instead of Lindås in Sweden. Another emerging trend in ITT's product development process are projects with mostly purchased instead of internally produced components.

All of this is by many interviewees considered to be one main reason why the time to market often is longer than initially planned: the product development process is best suited for traditional pump development and not for development of "less traditional" products. One project manager expresses a need for guidelines that describe which part the process a project manager is allowed to, and not allowed to skip:

"A routine for how to handle stepping outside of the routine is needed".

Another interviewee means that the process itself is a very general one. Concerning how the process and it's set of tollgate documents is to be used within ITT, he believes that every project manager should make project specific judgments calls on how different parts of the process should be used in every specific project. Even though the opinions on how rigid the product development process is differ, it is evident that many feel that it adds bureaucracy that slows down the process.

Another reason for time to market being too long is believed to be because resources are to thinly spread on too many projects. One interviewee expresses that there are too many projects running at the same time making it hard to focus, and thus hard to work efficiently. Others mean that all functions are not consulted when project time plans are made, and consequently those functions will become a bottleneck further on in the process as a result of lack of resources.

When the authors reviewed project documentation, it became evident that there is a tradition of setting very optimistic time plans for projects. This is by many interviewees described as irritating, since the value of the time plan is questionable as a result. Some describes allocating resources efficiently without a realistic time plan as impossible.

3.4.3. The Decision Making Process

The Project Board meeting is the official decision making forum for deciding if a project is ready to proceed to the next stage or not. However, the majority of the interviewees are of the opinion

the decisions are made in advance by informal decisions rather than on the. One project manager explains that decisions are many times based on informal “coffee break”-communication.

The toll gate documents that are suppose to be one main decisions making aid, is usually not read through since it is considered to be too time demanding. One interviewee means that it is impossible to read all the documents because of his tight schedule. The result of many decisions being based on informal communication is by some considered being that they are made either too early or too late.

The fact that tollgate documentations are not read to the extent that they are meant to is evident in different ways. Sometimes unnecessary discussions take place on the meeting. Some interviewees mean that this is because attendees are not informed to the extent that they should be. In addition, the tollgate documents are not always up to date with the current condition of the project since they are handed in one week before the meeting is taking place.

Furthermore, when meetings attendants are not prepared by reading project related documents, a lot more emphasis is put on the presentations given by the project manager on the project board meeting. The project managers mostly prepare their presentations in line with the current tollgate documents. Because of this, some interviewees believe that the presentations are sometimes too detailed with too much data. There is no standard for what presentation material should look like at a Project Board Meeting, and thus the focus and quality of the presentation vary a great deal with the project manager presenting according to one interviewee. A need for a standardized presentation was expressed.

3.4.4. Evaluation

To pass the last tollgate in the product development process an evaluation has to be done. One part of the evaluation is investigating the commercial success of the product and comparing it to the forecast made in the PAR (the economical analysis of the project outcome). When reviewing tollgate documents regarding evaluation, the authors found that the common practice was to investigate deviations from the forecast, seeking the reasons for them. Some interviewees point out that the financial follow up needs to be communicated better to the project group. For example: how much volume a product is selling compared to initial analysis would put the engineers that actually designed the product in better contact with the market according to one interviewee.

Another type of evaluation is a project work evaluation. Focus lies on the project work and how it was carried out, with the purpose of finding out if there is room for improvement in future projects. This kind of evaluation is not standardized in the same way as the financial evaluation, and differs greatly between project managers and the project in question.

However, even though an evaluation is done, many interviewees believed that sometimes the same mistakes are repeated when they shouldn’t need to be. Today the evaluation mostly contains of what was good and what was not good in the project. The “softer” kind of evaluations, for example considering group dynamics, is seldom conducted at the company.

Furthermore, some interviewees express that it is not put much effort to systematically transmitting experience to newer projects since there is no official system or forum for exchanging experiences.

According to some interviewee, it depends on the project manager how the evaluation is conducted since there are no clear guidelines for it. Some conduct a workshop-style evaluation during a project group meeting, others email their project group for input, and sometimes the project manager does the evaluation single-handedly.

Some interviewees question the value of the evaluations that actually are done, meaning that there sometimes was more focus on *conducting* the evaluation than it's actual result. Others believe that there is a need for standardization of the evaluations being conducted in order to improve their quality. However, a lot of experience exchange is by many interviewees considered to be done informally.

4. Theory I: Product Development

This chapter contains theories regarding product development processes, project management, market orientation and decision-making. This reflects the finding of the first empiric results, and both chapters are later used as data for the first analysis.

4.1. The Product Development processes

A product development process is often described as a set of activities that starts with an identified market opportunity, proceeds with development and production of a product, and ends with the sale and delivery of it (Ulrich and Eppinger, 2008). It's a multidisciplinary process that in it contains a number of smaller processes. It involves strategic decisions, market research, an iterative process of concept generation, an organizational process and a commercialization (Kahn and Griffin, 2005). Some mean that since product development is no exact science, the existing processes should be considered to be guidelines to be applied to the extent they are needed in every specific project (Cooper, 1990).

Common for product development theories that exist, is a focus on involving all stakeholders of the process at an early stage to identify potential future problems. The reason for this is known as *the design paradox* seen in figure 3 (Ullman, 1997). The further along the process the development proceeds, the more is learnt about the core design problem and thus it's likely that changes profiting the product will be proposed. However, at the same time many investments in terms of work hours and even production tools could have been made, making changes very expensive since they probably will require additional investments.

At the early stage of the process little is known of the core problem that is to be solved. Meanwhile, the degree of freedom is at its highest since there exist no project specific investments, making changes at this stage "free of cost". The problem is that understanding what direction one should proceed in to avoid future changes is hard. However, by involving as many stakeholders a possible early on, there is a greater chance that their combined experiences will start the process in the right direction, avoiding future expensive changes.

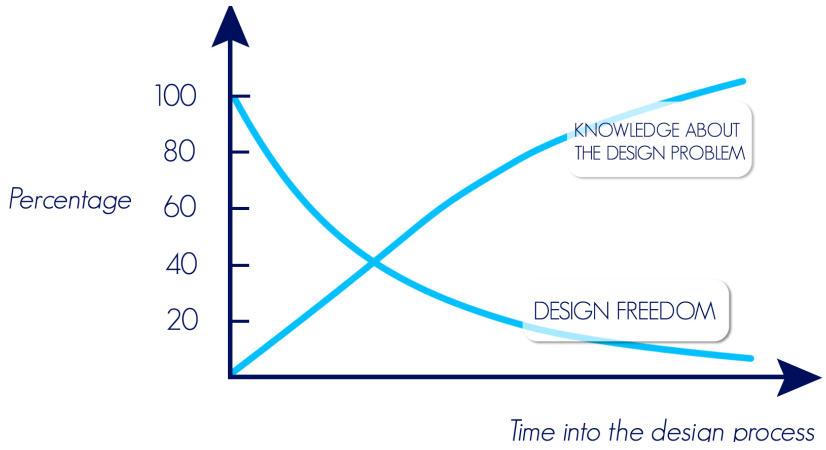


Figure 3. The Design Paradox as described by Ullman.

4.2. The Stage-Gate System

The Stage-Gate system was in introduced in the early 1990s when the tough competition for companies involved with new product development (NDP) resulted in only 50% of new products actually being profitable (Cooper, 1990). Organizations old bureaucratic systems did not allow the creativity needed for developing truly innovative products. Furthermore, many organizations where of the opinion that innovation couldn't be managed, and thus made little effort to do so. The Stage-Gate process was introduced as an innovation management process that would "increase the hit-rate" of new products. It was a process that would provide the freedom necessary for innovation, whilst still allowing the organization to steer the process and keep their vision and strategy intact (Räisänen & Linde, 2004).

The Stage-Gate system is both a conceptual and operational model, and its core principles have become widely adopted by NDP companies as well as product development textbooks ever since it's was introduced (Engwall et al, 2001). Many organizations today have their own unique NDP process tailored to their specific needs, for example the Swedish telecom company Ericsson with their "PROPS" model. However, as many other companies their model is heavily based on the Stage-Gate system (Räisänen & Linde, 2004)

The core concept of Stage-Gate is that the NPD process is divided into a number of stages with quality control checkpoints, called tollgates, in between them. The actual work is done during the stages, and the main business decisions are made at the gates. A project is not allowed to pass into the next stage if it does not pass the quality control at a gate. These quality controls are often carried out by examining if the project has met a predetermine set of criteria. Depending on the outcome of this examination, the projects are given a *go*, a *re-cycle* or a *kill* decision. *Go* meaning the project is ready to enter the next stage, *re-cycle* that it stays in the current stage to mature further, and *kill* meaning that the project is deemed unprofitable or unwanted and is terminated all together (Cooper, 1990).

The gate decisions are made at toll gate-meetings by a multidisciplinary group of senior management. To be able to make the right decisions, the decision makers need to be informed in advance about the status of the project. To accomplish this, the system often uses a set of information documents that summarize different aspects of a projects status. Depending on where in the process the project is, these documents highlight different things (Cooper, 1990). The work of creating these reporting documents is one of the reasons that the system is deemed to be too bureaucratic (Eisenhardt & Tabrizi, 1995).

The number of stages in a Stage-Gate process is not fixed. They vary depending on the organizations nature, but are usually between 4 and 7. The content of each stage vary as well, but a commonly used layout can be viewed in figure 4. Although the system often is described with this kind of figure, the designer of the stage gate system stresses that it is not a strictly sequential process. As with other processes, multiple tasks should be carried out simultaneously to make the NDP as time efficient as possible (Cooper, 1990). However, critics claim that whilst some

tasks can be carried out in parallel within each stage, the stages themselves are in sequence and consequently the stage-gate system is a of the sequential waterfall type (Engwall, 2001). The assumption that product development is a linear process has existed since the middle of the 20th century and by some considered outdated (Kline & Rosenberg, 1986). Others argue that it didn't even fit the reality of the business world when the system was introduced (Melan, 1992).

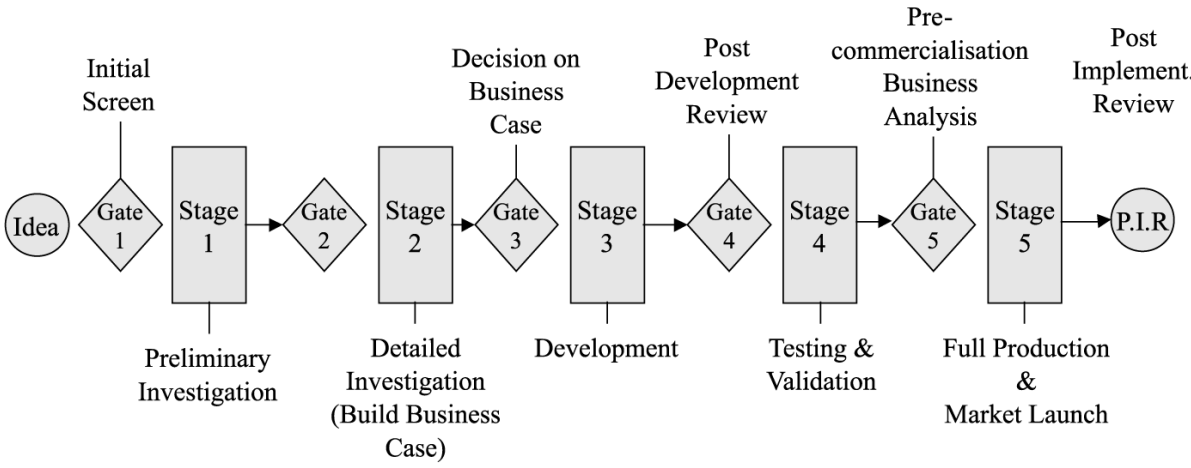


Figure 4. Example of a Stage-Gate process

Another key concept of the Stage-Gate system is to perform a rigorous market research in the early stages of the process. In addition to confirm the market need for the product that is to be developed, a throughout market research results in a better product definition. This definition is turned into product requirements, which are important both to set a clear goal for the NPD as well as creating criteria against which the project will be measured at each toll gate (Cooper, 1990). Even though the market orientation is presented early on in a Stage-Gate process, critics mean that the sequential nature of the stages prohibits true customer involvement throughout the process. The projects start with an identified market need, but the end customer is many times not present until late stages such as testing and validation of the soon to be final product (Engwall et al, 2001).

4.2.1. Advantages and Disadvantages with the Stage-Gate system

In addition to assist the project managers work with NDP, the advocates of the Stage-Gate system argue that it also plays an important role in keeping all the project stakeholders on the same page. Stage-Gate works as a visual road map that makes sure that the project members knows where the project has been, what is going on right know, and where it is going in the future (Cooper, 1990). Critics means that this emphasis on describing *how* to develop product results in a loss of focus on the actual content of *what* is to be developed (Engwall et al, 2001). They argue that it is common practice in NPD to put too much trust in that the predetermined system is enough for a successful project. In reality, creating a well-defined and communicated project goal is of equal or even greater importance. However, the on-off nature of project work means that project members often lack experiences that help them relate to projects specific

goals. One method of achieving this is to create some kind of visual or physical gestalt of the goal, since it greatly increases the ability to communicate it (Engwall et al, 2001). Another method is to focus on communicating the products unique customer benefits, since they are the origin of the project specific goals. Project members are more likely to understand the true meaning of these, rather then a set of project goals (Kahn and Griffin, 2005).

Another common criticism of the Stage-Gate system is related to the notion of it being normative and rigid, and thus only being applicable to larger development projects with characteristics very similar of the predetermined process itself (Räisänen & Linde, 2004). It's described as a ”standardized form of a project” (Engwall et al., 2001), which contradicts the original purpose of project work being a way to manage one-off, non-standardized development. However, Stage-Gate advocates mean that the system is not to be considered a fixed one at all, and that every project should use the parts of it that makes sense for that specific project (Cooper, 2002).

The consequence of the system being thought of as too rigid is that it is not used at all for projects where it is considered not to fit. These projects are often small ones, and it is therefore not consider a big deal if they run outside of the system. However, since an organization often has a large number of small projects, the combined resource demand of theses play a significant roll in the project portfolio (Cooper, 2002). Having a great amount of resources outside of the system makes managing the projects within the system a great deal harder. Consequently, to truly benefit from the system a great deal of discipline is needed from the organization. Another solution for the problem described above is to create a more slimed down version of the process for smaller projects (Cooper, 2002).

Stage-Gate has been described as being a simple concept that is complex to operate (Cooper, 1990). The complexity of it originates from the requirements that the system puts on the organization where it is used. One requirement is that NPD is carried out in project groups with an appointed team leader. Furthermore, the system needs the commitment of senior management in order to work. The reason for this is because the group that makes the decisions at the gates should consist of senior management representing multiple organizational functions. This means that this system requires a lot of resources, but evolvement and support of senior management is described as one of the key factors for successful NPD (Cooper, 1990).

Another common problem in Stage-Gate organizations is that they often experience their resources being thinly spread out on a large number of simultaneous projects, resulting in many projects time-to-market being to long (Cooper, 2008). Some considers this an extremely serious problem, since fast project development as well as timing is among the most critical factors for successful NPD (Iansiti & MacCormack, 1997). There seem to be a will to do too many projects too quickly, and once projects are up and running they get a life of there own and are very unlikely to ever be stopped. Critics mean that this is one big disadvantage with this kind of sequential process: the requirements on the organizations commitment to a projects means that it's very unlikely to be terminated once it actually receives its full commitment (Engwall, 2001). Others mean that having too many projects is due to many of them being ”pet-projects” of senior

employees within the organization, giving them a slightly unfair advantage when they are assessed (Cooper, 2002).

Another reason for the problem described above is that the assessment of the projects is not done properly (Cooper, 2002). Having a working mechanism for efficient termination of projects is a core factor in Stage-Gate, since one of its key strengths is to be able to prevent non-profitable projects to go too far. In order or accomplish this, an organization needs to have a clear set of criteria for when a projects should be terminated. This could be in the form of a scorecard, giving a more objective assessment of the projects business case at every tollgate. Furthermore, an action plan that describes how to proceed with the termination once it is done, is needed (Cooper, 2002).

Some question the idea of using a strict innovation management process at all, since they considered it to oppress the creativity of project members involved (Eisenhardt & Tabrizi, 1995). Their opinion is that applying strict systems to product innovation has made the project work form a victim of organizational rationalization, thus stopping it from being the exceptional and unique innovation process that it supposes to be. One original aim of project work is to give the project group and leader the creative freedom needed for true innovation. When systems with the purpose of ensuring the organizations strategy and vision are applied, the freedom of the project group is being undermined (Räisänen & Linde, 2004).

4.3. Project management

Since product development is carried out in project groups the project management becomes an important part of product development. Product management was not too long ago considered a "management science", and that properly defined goals, resources and timing was enough for successful product development (Thamhain, 2005). Today however, accomplishing this is not enough to guarantee product success since markets are becoming more and more competitive, and thus raising the requirements of a team's flexibility and work pace (Bhatnager, 1999). An important part of a project managers job today, is to be a "social architect" with an understanding of both social and organizational behavior, and having the ability to use this knowledge to move the project work forward (Thamhain, 2005).

4.3.1. Communication in project management

Thamhain (2005) claims that there are 4 factors that determine a team's performance: *work and team structure, communication and control, team leadership* and *attitudes and values. Communication and control* includes effective cross-functional channels, easy access to information, effective decision-making, a clear sense of purpose of the project, and accountability and ownership. Because of this, creating a communication structure that makes information flow easy is a central task for a project manager.

If an efficient communication structure is in place, one must also consider what information to communicate. A key driver in effective team management is to communicate the project goals

since it is of great importance that each project member is made aware of their contribution to the overall product development, as well as the projects role in fulfilling the organizations strategy (Thamhain, 2005). Furthermore, achieving common goals and vision for the project is essential for uniting the project team, and allowing them to create their own personal goals for their project related work. Another important aspect to consider is that the goals themselves should be well defined, whilst the way of realizing them should be very open in order for allowing creativity in the project (Sundström & Zika-Viktorsson, 2009).

4.3.2. Cross-Functional Teams

Many consider working in cross-functional project groups crucial for successful NPD (Jasawalla & Sashittal, 1998). Cross-functional project groups means a group consisting of individuals with different professional backgrounds such as market, design engineering and production for instance. The diverseness of these kind of groups means that they have a greater chance of identifying potential problems, making more qualitative decisions, and also actually committing to implementing the decisions since successful cross functional collaborations means that visions and goals are shared across departments (Kahn, 1996).

However, creating cross-functional groups does not guarantee that the members will actually work together. The diverseness of the team has little importance if there is no collaboration amongst the team members. It has been shown that there is a strong correlation between qualitative cross-functional communication and the market success of the developed product (Souder, 1988). Furthermore, how well different organizational functions are integrated has shown to have an affect on the perceived value of each others contribution to the NPD process. For example, in a less integrated organization the marketing department perceives that their contribution to the NDP process have a greater value than what the R&D department believes it to be (Gupta & Wilemon, 1988). According to Backman et al (2007) the origin of a concept, technology or market, can also have affect it's success. Technology-driven concepts for example receive more support in more technical organizations and vice versa.

There are a number of ways of creating an environment where cross functional collaboration can take place more easily, one of the more effective being related to information sharing. Making sure that all project members have equal and easy access to information will increases cross-functional collaboration greatly. Access to information puts less focus on the project manager as a communication hub, which makes project members more likely to interact with other project members directly, thus improving cross-functional collaboration (Jasawalla & Sashittal, 1998).

4.4. Decision making

There are different aspects on how to look at decision making e.g. the human behavior aspect and the rational and mathematical aspect. Even if there are numerous existing methods on decision-making they are so complex that even today it is hard to use them in practice.

“Decision making is like talking prose- people do it all the time, knowingly or unknowingly” (Kahneman and Tversky, 2000). Decision-making is the process of solving a particular type of problem (Yates, 2001). Wrong decisions can lead to loss of the company’s customers and thus market shares (Marks, 1989). According to Chin and Wong, (1999) a lot of money and engineering hours will be needed if the work of the product development project needs to be redone. Not only money and hours will be lost but it also leads to frustration among the stakeholders, which further leads to an overall decrease in motivation and performance.

According to March (1997) classical rational decision making is striving for a maximum utility based on following:

- The decision maker has a number of alternatives
- The decision maker knows the consequences of alternative actions
- The decision maker has consistent values used in the comparison
- The decision maker has decision rules that are used to select a single alternative.

However this model is not taking into consideration the complexity of an organization. The environment in which the decision makers act will influence the consequences they will anticipate or not, which alternative they will consider or ignore (March and Simon, 1958). According to Kooperman and Pool (1991) decision-making is not neutral, since it is made in a social and political reality.

Because of peoples limited knowledge ability and capability of information processing humans are rational only within certain limits. When a good enough decision is found then the decision maker stops searching for information (March and Simon, 1958). It has also been found that individual preferences can change depending on task demand (Payne, 1982). It has been proven that factors such as intuition (Patton, 2003) and emotion (Zeelenberg et al. 2008) are apart of the decision-making. However they are important since the emotions exist for guidance and prioritization. (Zeelenberg et al. 2008)

4.4.1. Decision making in the concept phase

The concept phase is the beginning of the Product development process where a lot of important decisions are made. Backman et al, (2007) states that the reason why it is difficult to make decisions in the concept phase is because it is more complex than illustrated in the stage gate process. According to Hansen and Andreasen (2004) decisions evolve during a period of time since engineers use certain criteria and information to make tentative decision until the end of the period.

According to Ulrich and Eppinger (2008) structured methods helps to make documentation of decisions taken to be used for future references. They also help to ensure that important issues are remembered and in addition they reduce unconfirmed decisions.

The main method used is the evaluation method. It can be used in numerous ways. One of them is where several alternatives are evaluated in parallel to a certain criteria. Another is when an alternative is generated; it is evaluated directly to the certain criteria. The latter is leading to an iterative and improvement pattern (Dwarakanath and Wallace, 1995). Another method, according to Ulrich and Eppinger (2008) is a decision can be left to an external part, for example it can be handed over to a customer. The person that makes the final decision can vary. Influential team member can make the decision or it can be made by instinct.

To reach a joint decision Pugh (1990) used a rational and open procedure called the structured selection method. It uses objective criteria and consequently it decreases personal prejudice. Evaluation methods assess the value of the alternatives rather than support the decision maker (Roozenburg and Eekels, 1995). The tool that can be used for evaluation methods is the decision matrix, which includes: identify criteria for comparison, weighting the criteria, select the alternatives to compare, generate scores and compute a score. Pugh (1990) matrix compared the solutions to chosen datum, than rated to better (+) or worse (-), or same (S). However the evaluation methods don't take into consideration the fact that there are combinations between decisions. (Dwarakanath and Wallace, 1995)

To conduct a good assessment of a concept, the criteria and the alternative must be handled with the "same language" (Ullman, 1997) The knowledge of the team members can also influence the evaluation in that way that they can use their own information rather than what is written in the concept description (Reidenbach and Grimes, 1984).

Point based strategy tend to quickly unite into a solution and then being modified until it meet the design requirements. At Toyota they use a different kind of strategy called the Set- Based concurrent engineering, where time consuming and costly repeated reworks are eliminated (Sobek et al 1999). The Set- Based model can cause a delay in the decision-making, yet Toyota has the fastest vehicle development cycle in the industry.

When two concepts are very similar then the intuition of the project manager will often be the best selection tool. For a selection method to be efficient also the circumstances, the company itself, the existing product line, the markets and goals must be taken into consideration. (Weiss and Hari, 1997) According to Cross (2006) a participant should be objective but they are often not. They are many times attached to a certain solution and will stick to it as long as possible.

Ullman (2000) proposed the 12-step method: prepare the decision maker (step 1-2), clarify the issue (step 3-4), develop criteria (step 5-7), generate alternatives (8) evaluate alternatives (step 9-11) and decide (step 12).

4.4.2. The Social influence

A decision is influenced by the social mechanisms thus Vroom and Jargo (1974) define "decision making as a social process, with the elements of the process presented in terms of events between people, rather than events that occur within a person". Vroom and Jargo (1974) developed a framework for matching a leader's behaviours to the demand of his situation. A

leader's decision making can be based on different situations. The model of Vroom and Jargo is helping the decision maker to choose the appropriate decision making process for a specific problem.

Vroom and Jargo (1974) states there are two types of solutions; one is classified as a group problem, when a solution has an effect on all immediate subordinates. The other is called an individual problem if a solution only affects one subordinate. As discussed before it's the behaviour of the leader that depends on how a decision is made.

The first approach is a decision made by one self-based on the information already known by the decision maker. The second is to obtaining necessary information from subordinates, which may or may not be told the problem. The decision maker thereafter makes the decision. The third is when the decision maker shares the problem and seeks the opinion of the subordinates individually or by bringing them together in a group. The decision maker later makes the decision. The very last scenario is to share the problem and analyze it together with the subordinates and subsequently reach an agreement. The decision makers own opinion should not influence the group and he or she is open to implement any solution given.

Maier (1963) stated that the effectiveness of a decision is thought to be a function of three classes of outcomes, each affected by the decision process: 1. The quality or rationality of the decision. 2. The acceptance or commitment on the part of subordinates to execute the decision effectively 3. The amount of time required making the decision.

4.4.3. Decision making for innovations

According to Tidd and Bessant, (2009) the world is full of interesting and challenging possibilities for change, however even the wealthiest organization cannot do all. Thus everyone has to choose even if it means to turn away from opportunities elsewhere. Innovation decision-making is mostly to deal with uncertainty. The only way to get certain is to start the project and learn. Knowledge is highlighted as one of the most important remedy against uncertainty.

It is very difficult to know whether an innovation will work technically when it is made, if the market is still interested in it when launched or if the government has changed rules that will affect it. Thus there are always unforeseen things that can affect a project. To choose safer projects can minimize the risk. Incremental Innovations is about doing something that is already known, in other words a knowledge base already exists. Furthermore Radical Innovations can be chosen but they are hazardous since they are unfamiliar to the organization and thus lead to a higher risk.

John Maynard Keynes, a famous economist, pointed out that emotion and intuition play an important part in shaping a decision. He stated that an individual can be persuaded to take a risk by a convincing argument, by expressions of energy or passion, by hooking into powerful emotions like fear (of not moving in the proposed direction) or reward (resulting from the success of the proposed innovation). (Tidd and Bessant, 2009)

To make an effective decision Tidd and Bessant, (2009) proposed a structured development system which should contain clear decision points and agreed rules on which to base go/no go decisions. As longer into the project one comes the more knowledge will be gathered. See figure 5 (Tidd et al, 2009). Therefore it is recommended to make stepwise decisions and not wait until uncertainty is very high.

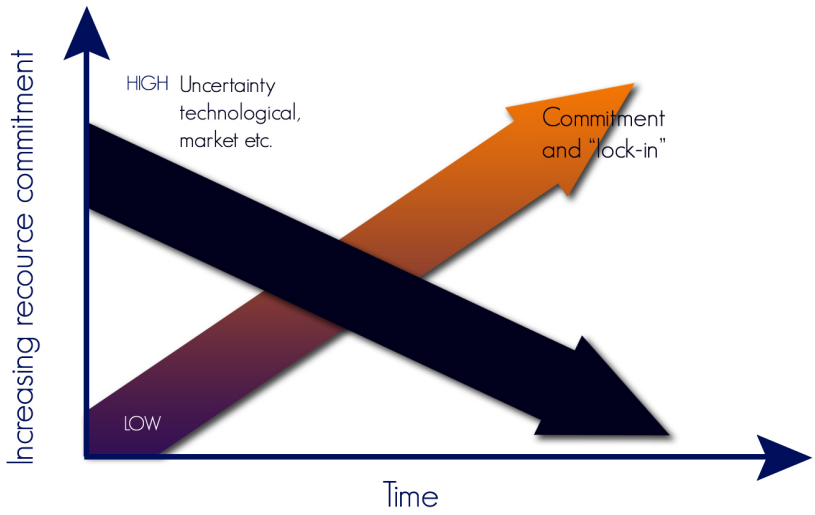


Figure 5. Increasing innovation commitment over time.

The innovation funnel, see figure 6. (Tidd et al., 2009) helps to make decisions about resource commitment. Many times the decision is whether to continue with the project and risk that it will not give any reward or to close the project and risk to miss a successful opportunity.

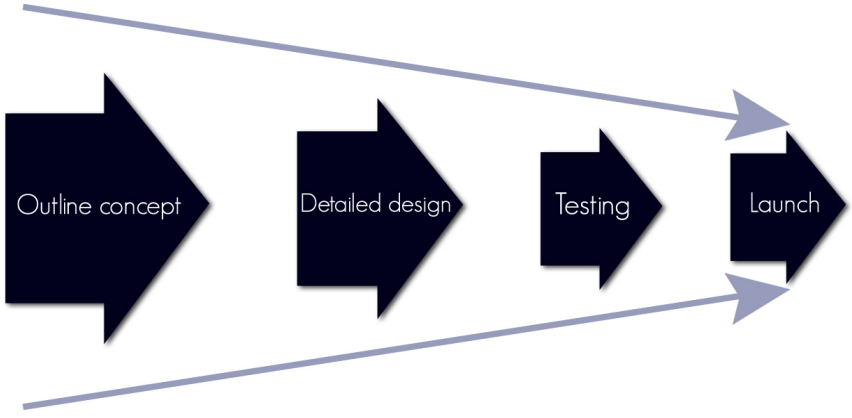


Figure 6. The innovation funnel.

If a company such as Toyota is having a tradition of high –involvement innovation, it is also important to deal with all the suggestions in the right way. Toyota receives several million suggestions per year. (Kolb, D and R. Fry, 1975) To handle these proposals a "policy deployment" (sometime called *hoshin* planning) which strategy is to move decision to lower levels in the organization. It requires coherence for the business and the goals.

According to Tidd and Bessant, (2009) it is needed to put more effort in the business case if the innovation is radical to convince the decision makers since the risk is much higher than an incremental innovation. Many times problems arise from lack of shared perspective on the product development and/or the marketplace into which it will be introduced. It's important to involve all groups at the earliest as possible (Tidd and Bessant, 2009)

According to Tidd and Bessant (2009), organizations as well as humans often selectively perceive and interpret the new situation to match or fit their established worldviews. This behavior is dangerous since small signals for change are often not endeavored to capture and then the need for a radical reframing it is often too late.

The challenges in innovation selection are shown in figure 7 (Tidd et al, 2009). The first zone "Exploit" is showing the incremental innovations where the steady state methods are used. Recourse allocation and project management structures are very clear in this zone. The second zone "Bounded exploration" is innovation selection in new territories however it still takes place in the "business model as usual". Here the decision-making is still lying under a strategic model and a sense of core competence. The struggle for recourses is often tense. Here emotional characteristics play an important part of the decision making.

The third zone "Reframing" is risky and often leads to failure but can lead to emergence of new and powerful business models. New information is needed. The zone 4 "Co-evolve" is where new to the world innovation take place. It is a complex interaction between independent elements that is needed. Selection strategies are difficult since it is impossible to predict what is going to be important. The feedback mechanism is crucial in this stage. In other words it is a complex set of elements that co-evolve. In this zone analytical tools and evidence based decision-making is inappropriate.

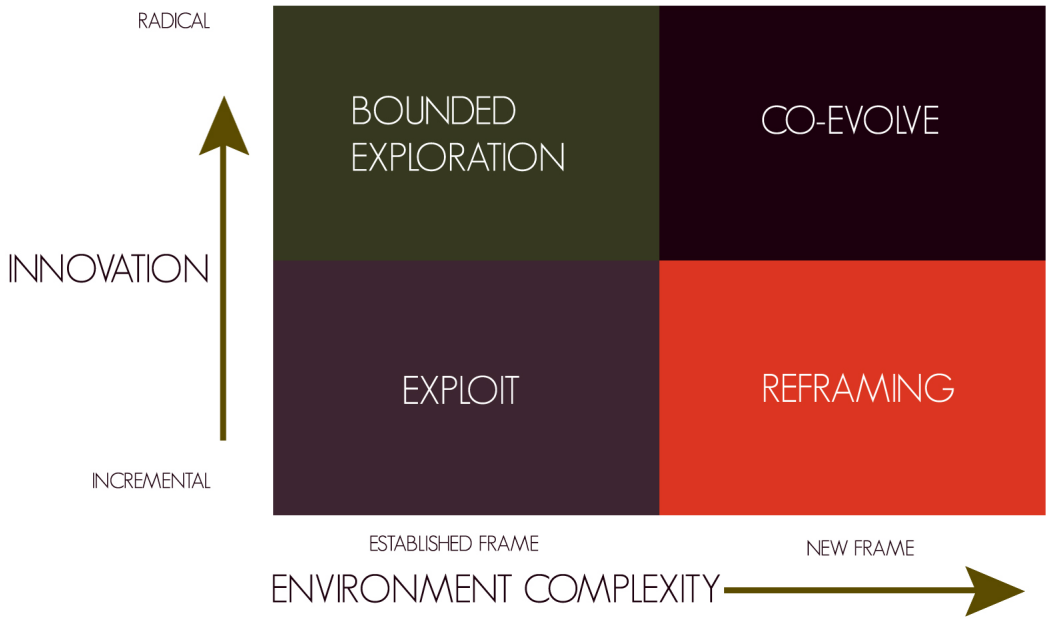


Figure 7. The outline of innovation selection space

4.5. Market Orientation in Product Development

One factor that many agree to play a key part in successful new product development (NPD) is keeping focus on the market (Atuahne-Gima, 1995). This means doing solid research identifying the true needs of the customer as well as the competitors so that the product to be developed can become the most attractive one in its segment. Furthermore, it means successfully translating the findings of the market research into relevant criteria and requirements for the product development. And last but not least making sure that these requirements and the focus on the market is kept throughout the NPD processes (Kohli & Jaworski, 1990).

Market orientation is believed to have a positive impact on NPD for a number of reasons. Some argue that an organization with a market oriented way of thinking creates a set of believes and values of consistently putting the customer first, and thus creating very customer focused NPD process (Deshpande & Webster, 1989). Another benefit of having a market oriented organizational culture is that it creates something very concrete to unify the employees around, and thus creating a better environment for collaboration (Kohli & Jaworski, 1990). A commonly mentioned disadvantage of too strong market orientation is that it in the long run prohibits radical innovation since market research often focus of the markets existing needs (Tauber, 1974).

4.5.1. When market orientation is important

The impact and importance of market orientation in the NPD process varies with a number of factors. In the beginning of a products life cycle, market orientation plays a larger role than later in the cycle. In the beginning the market is turbulent and therefore the actual needs of the customers aren't really determined. The needs can change fast, thus a strong market orientations is needed to be responsive to these changes. At a later stage in the products life cycle the market is more settled and the customers needs are more static and predictable, meaning that the product developer does not need to be as responsive (Atuahne-Gima, 1995).

An exception to the above stated theory is if the NPD is of radical character. If the market is completely unfamiliar with the product, the need for market orientation is not as crucial. The reason for this being that when selling a completely new kind of product, the innovativeness in the technology can be enough as a sales argument. Since the product is new, the customer has no experience of it and consequently has not as many predetermined needs to be identified by market research. On the other hand, when developing an incremental product where the market knows exactly what it needs, a strong market orientation plays a large role in the products success (Atuahne-Gima, 1995).

Competitive markets demand a higher market orientation than the non-competitive ones. This is simply because having many competitors means that the customers have a lot of choices. In order to keep customers loyal as well as to attract new ones, finding the key needs and developing the product according to them is of great importance (Atuahne-Gima, 1995).

5. Analysis I: Problems in the Process

In this section, the first part of the empirical and theoretical data is examined with the purpose of identifying the problems in the product development process that can be solved with improved communication.

5.1. The Product Development Process

The product development process at ITT has, as previously described, very large similarities with the Stage Gate process described by Cooper (1990). Furthermore, it appears to share both its advantages and disadvantages. The belief in the process at ITT is very strong, and reflects Engwalls (2001) statement that Stage-Gate is the highly accepted theoretical and practical standard for product development processes used in organizations today. ITTs track record of successful products is pointed out by many interviewees as proof for the efficiency of the process, and seems to confirm the Stage Gate systems initial purpose, which was to increase the hit rate of new products (Cooper, 1990).

One reoccurring opinion from ITT project managers is that the process with it's documentation serves as a good checklist that insures that all necessary aspects of a project have been considered. This reflects Coopers (1990) theory that says that Stage Gate is a roadmap for the project, showing where it's going and where it's been. However, many interviewees shared Eisenhardt and Tabrizizs standpoint that the substantial documentation of this kind of process made it very bureaucratic.

A number of interviews are of the opinion that since the process is designed for more traditional pump development, this is where it works the best. This is completely in line with Räisänen and Lindes standpoint that Stage-Gate is normative and rigid, and is best fitted for standardized projects. Since some mean that ITTs market is changing, a conclusion is that the flexibility of the process is becoming even more important. However, a number of project managers at ITT also shared Coopers (2002) opinion that the process should be applied to the extent it is needed in every specific project case.

Cooper et al. (2001) argues that if a Stage-Gate process is considered too rigid, multiple versions of it could be created to fit different types of projects within the same company. This could be a way of making it easier for project managers to use the process in various projects. However, as mentioned earlier, ITTs process is by some considered a more conceptual one and thus it's unlikely that several processes will be created. Since this is the fact, the conceptual process needs to be adapted to each specific case, something that requires efficient communication between stakeholders in order to handle the irregularities that occur. Consequently, communication is a very important aspect of ITTs product development.

5.2. Areas of Improvements In the Process

Four main areas of improvement have been identified as a result of the interviews conducted at ITT. The areas have been analyzed with the purpose of identifying which of them that can be solved by improving communication within the process, rather than changing the process itself.

5.2.1. Time to Market

Cooper (2008) expresses that thinly spread out resources are a common problem when using a Stage-Gate process, which is confirmed by many interviewees to be a fact at ITT as well, and the reason for a long time to market. This could to some extent be related to shortcomings in cross functional communication regarding the process of setting project time plans as described in chapter 3, but many signs indicate that the main reason is something else. The lack of an efficient mechanism for terminating projects that are deemed unprofitable, in line with Engwalls (2001) theory that once a project is up and running it is very unlikely to ever be stopped. Since the nature of this study did not include examining the success of previous NPD projects, this conclusion shouldn't be made without further research.

If the projects that are carried out are in fact deemed profitable all the way, the reason for thinly spread resources could instead be in line with Cooper (2008) standpoint that a common mistake is to lack an efficient method of choosing the projects that are to be initiated. Either way, the issue of resource shortage (which leads to a prolonged time to market) is not classified as a communication related problem, rather a process related problem. Therefore, it is believed to be solved mainly by improving the process itself.

5.2.2. Evaluation

Although some interviewees express that there is a lot of informal evaluation and experience exchange after a project is done, it's evident that the lack of a standardized evaluation greatly affects the quality of the evaluation in a negative way. As described by many interviewees, how an evaluation is done depended greatly on the project manager of the specific project. Furthermore, the results of the evaluations are not processed properly. The lack of effort of transferring experience, also affect the quality of the evaluation in a negative way.

The financial evaluations that are done is more consistent between different projects, but could be shared even more amongst project group members. This information is available today, but if it where more actively used when communicating evaluation results, many more project members would actually see it, and thus better understanding their part in the big picture.

Even though the authors agree that there is a communication aspect of conducting evaluations in the sense of communicating its results, the core of this problem is believed to be closer related to the process. Many interviewees express a need for a better evaluation process, and thus this needs to be in place before one could decide *how* to communicate the results of it. With this in mind, the evaluation problem is classified as a process problem and is therefore believed to be solved mainly by improving the process itself.

5.2.3. The Decision Making Process

Many of the interviewees pointed out that tollgate related decisions are done informally before the project board meetings. This is in line with Hansen and Andersen's (2004) theory stating that decisions evolve over a period of time as information is gathered, and reflects how any decision making process occur. Decision-making is not a process that can be completely controlled (Kahneman & Tversky, 2000), but one can improve the quality of it by optimizing how information is communicated.

However, how the information that the decisions are base on is gathered, is noteworthy. Evidently the decisions are greatly based on the information being received informally, since the tollgate documents that should be the official basis of the decisions are not used to the extent as they are intended. This suggests that the different decision makers in the project board are not able to base their decision on the same information since the informal communication (the information gathering) isn't carried out equally amongst them.

Since knowledge of a specific person greatly influence their decision (Reidenbach & Grimes, 1995), this means that consensus in the project board (which is needed for proceeding through a toll gate) can be hard to achieve. Even though all necessary information is available for all decision makers, either formally or informally, the way it is being communicated makes it hard to guarantee its consistency. Since "close call" decisions often are made with intuition (Weiss & Hari, 1997) as well as subjectively (Cross, 2006), this suggest that the project board members are not always making them on the best basis.

Tollgate decisions are considered very complex since the decision maker has to consider a large number of aspects when making them. March and Simon (1958) mean that the rationality of a decision decreases as its complexity grows. If the information that the decisions are based on becomes more accessible, the decision itself would become less complex and thus make it more rationally.

Another aspect of decision making is what happens after the decisions are made. As Maier (1963) states: the effectiveness of a decision is a function of acceptance or commitment of other parts. Since the interviews confirmed that some decisions are questioned even after they have been made, this suggests that difficulties can arise when they are to be carried out. The cause of these discussions has been described as meeting attendees not being informed enough, as a result of the complexity of the tollgate documentation. To better communicate the content in the documentation would therefore lead to decisions which reasons are understood and accepted by more meeting attendees, and thus making them easier to carry out.

Another result of the meeting attendees not reading the tollgate documentation to the extent it is meant to be read, is that discussions are based on the content of the project presentation. Because of the lack of standardization of these presentations, there is no guarantee that its quality is sufficient as a basis of neither discussions nor decisions. Consequently, the quality of the

decisions themselves, and whether they get the support they need to be carried out, cannot be guaranteed.

In the innovation selection space (Tidd et al, 2009) ITT can be described to practice "Bound Exploration", meaning that they are of a innovative nature and that emotions play a part in decision-making. This suggests that there is a need for efficient communication of information to make the information more attractive as a basis for decisions.

As a result of the analysis above, it becomes clear that qualitative decision-making is dependent on qualitative information and thus qualitative communication. Because of this, this identified problem will be solved in part by improving communication within the product development process.

5.2.4. Market orientation in the product development process

The importance of a solid market orientation as a foundation for new product development NPD projects (Atuahne-Gima, 1995) is acknowledge by many of the interviewees. However, even tough a solid market analysis is done in the beginning of a NPD project at ITT, there seams to be a general opinion that there is a lack of a continuous market orientation throughout the projects. This is in line with Engwalls (2001) standpoint that one of the weaknesses of a Stage-Gate is that the end customer is mostly present in the beginning and end of the process. It is also to be considered an important problem to be solved, in line with theories of Kohli and Jaworski (1990).

Not having the customer present all the time could be connected to the way the project goals are expressed and communicated. The official methods of communicating the goals are through the tollgate documents, which are widely diverse between projects both in detail and where they are found. By communicating the products unique customer benefits, as recommended by Griffin and Hauser (1992), the project group would more likely keep the customer present throughout the process. Since having well defined goals is critical for a NPD process in general (Thamhain, 2005), (Sundström & Zika-Viktorsson, 2009), this method would likely help in uniting the project group and thus making their collaboration more efficient.

As previously mentioned, shortcomings in the communication between the market department and the R&D and Operations department, are believed to be a cause of NPD related problems. According to Souder (1988) and Kahn (1996), this kind of communication is in fact a critical factor for success in NPD, which confirms the interviewees opinions. Furthermore, the correlation between good communication and how the different functions value each others contribution to the process (Gupta & Wilemon, 1988) is very interesting regarding this case. If the communication would be improved between these functions, the R&D department would put a higher value on the work of the Market department and consequently use it in a way that makes the NPD projects more market oriented. In addition, this would counter act the trend that some in the R&D department believe they already know the customer needs.

A stronger market orientation would also unify the organization by further strengthening the shared vision of the employees (Kohli & Jaworski, 1990). However, as many interviewees pointed out, ITTs tradition of having a strong technical orientation is the reason for many of their previous successes. Consequently, a too strong market orientation is unwanted, as it would suppress this (Tauber, 1974).

How important market research (and subsequently market orientation) is for ITTs NPD, can be determined by examining the market in which the organization is active. Since the pump market is very established, one could argue that market orientation is not that important since the customer needs probably are static (Autahene-Guma, 1995). However, since the market is a very competitive one, there actually is a very strong need of a solid market orientation since the customer has got a range of producers to choose from (Autahene-Guma, 1995).

As shown in the analysis above, it becomes clear that achieving market orientation is closely connected to communication between the different functions that take part in a product development process. Because of this, the identified problem will be solved in part by improving communication within the product development process.

PART II

Solving the problems by improving project communication

In this part of the thesis, the communication within ITT projects is examined and later analysis with corresponding theories. Finally, a solution for improving communication within the product development process, and subsequently solving the problems identified in part I.

6. Empiric Result 2: Communication at ITT

In this chapter, the communication routines that exist at ITT today are described. They are divided into formal and informal communication. Furthermore, the interviewees' opinion on a potential future project information overview is examined. If not stated otherwise, all statements made in this chapter is based on the interviews made with project stakeholders at ITT.

6.1. Formal Communication

ITT has a number of routines and habits regarding meetings which have been developed over the years. Furthermore, they also have a routine regarding how formal documentation is created and handled. The identified formal communications channels are as follows.

6.1.1. Project Group meeting

Project Group meetings are in general organized by the project managers who gather some or all project members in the specific project. A common project meeting at ITT usually consists of status updates from the members in project group.

Two main standpoints where identified regarding how often project meetings where held: The first being that the project group meet every week, and the second that they meet every 2-3 weeks. In both cases, there is common belief that continuous communication with the project members is crucial to conducting a successful project. However, the project managers organizing meetings every 2-3 weeks argue that weekly meetings take a lot of the member's time, time when more efficient tasks could be done. These project managers call for a meeting when they think it will bring value to the process, thus often resulting in a meeting every 2-3 weeks. A correlation between the experience of the project manager and how often they held meetings was identified. More experienced project managers held meetings less often, whilst more junior project managers tended to have a reoccurring meeting every week.

There are also some alternative ways of project group communication at ITT. In one case, a project room is used where the project group communicates by putting up post-its with their thoughts about a current task. The communication thus goes through this room, and members can visit the room in their own time. In addition, the project members often gather 1-2 times a week to go through the progress of the work.

Most project managers agree on the importance of getting everyone on track and to identify potential project-specific concerns in the beginning of the project. One project manager emphasizes the importance of both early and continuous communication with resources of the project group that are at different geographical location. He achieves this by regular web meetings (since the participants often are at a different location), as well as sharing videos and photos with test results. By doing this he ensures that the project is progressing.

6.1.2. Monday Review meeting

Every Monday, the project managers gather to go through the status of all active projects. An excel sheet where the colors red (behind schedule), green (on schedule) and yellow (might get behind schedule) are used to describe the projects status. The purpose of the meeting is to find out if there are any urgent problems that have come up during last week.

Not only project managers attend this meeting, representatives from other functions are present as well. Other functions are encouraged to join, but some stopped going after a couple of meetings since the level of detail of the information being shared was low. One interviewee believes that she can obtain the same information shared on the meeting, simply by reviewing the excel document in which the status of the projects are recorded.

One project manager expresses that the meaning of the Monday Review meeting is purely to report the status of the projects, not discuss them in detail. It's an efficient way of gathering information that otherwise would require talks with all project leaders in each pipeline individually. Another interviewee believes that there are a lot of "green signs" even though the time plans are sliding. He thinks that this status update should be more honest:

"Being honest in communicating red flags as fast as possible makes it much more easy to act on them"

6.1.3. Project Board Meetings

Decision makers, project managers and other relevant functions and experts are represented on this full day meeting event that is held once a month with the purpose to decide if projects are ready to proceed to the next stage of the ITT product development process. Every project that is ready for a tollgate decision is introduced at the meeting by its project manager. A meeting moderator keeps track of time and makes sure that the presenting project managers follow the agenda. Every project has their specific project board with three decision makers representing production, market and R&D. There is always at least one representative from the Lindås factory at the meeting.

The Project Board meeting is the official decision making forum for the projects tollgate decisions. However, the majority of the interviewees are of the opinion that the actual decisions are made in advance. The routine is believed to be that if a decision maker has uncertainties about something he goes to the project manager and discusses the issue before the meeting. Thus informal decisions are believed to be made before the project board meeting.

Tollgate documents are to be presented to all stakeholders of a project one week before the Project Board meetings takes place. These documents describe the current status of the project. To avoid long discussions that would prolong the meeting, it is important that people attending have read this documentation. However, the common belief is that very few actually have time to read the documents since they are relatively substantial.

Sometimes the process isn't really followed to 100%; tollgate decisions are taken without all the documents in place. It works well sometimes, but sometimes decisions get rushed through. One interviewee claims that rushed decisions can cause errors later on, and handling them at a late stage has by experience proven to be much more expensive.

The over all opinion is that the Project Board meetings fill their function as an effective decision making meeting. However, there are some areas that many agree can be improved. Some discussion on the meeting is considered good, but focus should still be more on the decisions. One interviewee mean that a bit of discussion adds passion to the meeting, making people care more.

Another interviewee expresses that some discussions during the meetings are allowed too much time. *"Once a decision is made, one should accept it and give* ones *all to that task, even if one didn't like it to start with."* He believes that a "consensus culture" is the reason for these kinds discussions. Since these kinds of discussions are allowed, some ideas and opinions re-cycle into the project pipelines even though they have been dismissed. However, he also admits that arguing for once cause is human, and that making the process completely objective is neither desirable nor possible.

"Once a decision is made, one should accept it and give ones all to that task, even if one didn't like it to start with."

Sometimes a senior executive representative attends the meeting. There is a value in this since it spreads knowledge through the organization, but it doesn't make the meetings that effective. A lot of time is taken to explain to the person what the projects are about since these individuals are normally not updated on the details in the projects. In addition, some mean that they tend to drive the meeting, which is not the official purpose.

Today, most project managers structure the presentations in line with the tollgate documents that are prepared for the meeting. The information given on power point slides, but are sometimes considered too detailed and with too much data. One project manager expresses that he likes to include a brief technical description first if any senior executives are present at the Project Board meeting. Another uses a "tabloid-technique" that imitated the same disposition as newspapers use in order to capture the audience.

The presentation of each Project is 20 minutes and there is currently no standardized structure regarding what shall be presented. Therefore the content varies a lot among the different projects, and a need for a more structured presentation material was expressed by several interviewees. However, some mean that a standard may be difficult to produce because of the individual needs of the different projects. Others also make the point that the information isn't hundred percent updated since it has to be handed in a week before, making late additions to a presentation very common.

The most important things in the presentations are considered to be that the information shared is relevant and easy to understand. A focus on the original purpose of the project as well as any current problems in it is preferred. However, some interviewees are of the opinion that it doesn't matter what a presentation contains because the actual decision is considered to be made before the meeting.

Some interviewees mean that presentations are at there best when the project manager really communicates the voice of the project group. If not, the decision makers are in one sense getting 2nd-hand information. The ability to involve the project group while creating the presentation often reflects how good it is.

There are many small decisions in the projects that officially need to be discussed or approved by the project board. However, communication with the individuals on the project board can be difficult since they are very busy. To get around this problem, one project managers arranged so that the project board delegated smaller decisions in order to more easily proceed with the project.

6.1.4. Project Priorities

Every 3 months, a project priority meeting is held. Market directors representing all of ITT's business units discuss project priorities together with the project management department. The project priority list that this results in is to reflect the current market demand, and is to insure a market-pull product development strategy. Projects that are close to being ready for sale-start automatically receive a high priority even if other projects have a higher market demand. This is simply because these projects are close to generating profit.

The reason for project priorities is to insure ITTs market-pull product development strategy, as well as to solve potential resource conflicts between projects. The opinions on whether these priorities are used or not, and if they actually help, differ. One project manager says that the priorities are only used if a situation where there is a resource conflict between two projects emerges. Having a clear priority list is very helpful and saves a lot of discussions in these cases.

On the other hand, for some departments the priority list doesn't help as much since there are no priorities across project pipelines. One interviewee talks about the fact that she is working with multiple projects across pipelines, and because of the lack of cross pipeline priorities, situations where priority conflicts emerge are not that uncommon. Furthermore, other interview subjects doubt that the priorities are known across the project group. The "big and important projects" are known thru out the organization, but other priorities are not. However, some interviewees questions if priorities really needs to be known by everyone, meaning that they mostly help the project mangers in their work.

6.1.5. Documentation

There is a range of different documents that are used at ITT containing information about an on-going project. All documents are saved in a standardized folder structure located on a server and

accessible to all project members located at the Sundbyberg headquarters. The documentation is accumulated from various recourses, but mostly administrated and written by the project managers.

Protocols

One common document is a meeting protocol, often written by the project managers after the project group meetings. Some send out their protocols regularly but they suspect that it is most of the time only read by the most involved resources. Others always write the protocol but do not always send it out, leaving it accessible in the project folder for the project members to go and read it there. One project manager expresses that he sends out meeting protocols to everyone in his project, even those who are not presently active in the project. Regardless if they are participants who will either enter the project in a later stage or that have already performed their tasks, he sees a value in sharing the information actively with them.

Tollgate Documents

The tollgate document process has been developed since about 1997 and in its whole, it is considered to work well. Many believe that there is a healthy focus on these documents. However, some project managers see some of the tollgate documents as more of a burden than help since a lot of them contain similar information. A need for a way of linking similar texts together is expressed so that the same work does not need to be done multiple times.

The tollgate documentation not only serves the purpose of providing information to pass a tollgate, some are also classified as legal documents. Some of the documents are required by law, while others are internal policy of the global ITT Corporation. Furthermore, if a project manager enters a project at a late stage in the process, the previous documentation is one of the most important assets to get updated. Consequently if the documents are not always updated, it creates a very difficult situation for a new manager who enters the project.

One interviewee expresses a problem with tollgate documentation when working with many projects at the same time. The large amount of projects results in large amounts of information that project members have to keep track on. It takes long time to produce all the documentation and it is hard for people to access the information in them. He believes that there is a need for a fewer amount of running projects at the same time, so that keeping up to date with all projects becomes easier.

Accessing documentation

Some consider the folder structure at ITT very complex, but at the same time it seems to works for most parts. The folders are easy to find if one is familiar with the system, but a person new to the organization might have difficulties with them. One project manager expresses that it is often hard to get project members that are not daily users of the folder system to actually use it. He believes this is in part because of that different project managers use the folder system in different ways. Furthermore, since there is a wide spread culture of informal meetings and

information sharing at ITT, having a working "formal" communications system for sharing formal documents becomes very important.

The general opinion is that technical project documentation should not be shared openly in the same way as the non-technical documents are. Access to technical project documents should be limited to the people working in the project, preventing sensitive information to spread outside ITT. On the other hand, many agree that non-technical documentation should be shared as it could make the project more popular.

How well project members receive the information from within the project documentation differs a lot on the individual project member. Everyone relates to this kind of communication differently. For instance, some project members take initiative to actively search for information and try to attend as many of their projects meetings as possible. Other project members on the other hand have a more passive way of receiving information. Many interviewees expressed the need for the individuals' commitment in receiving information: "Communication is not a one way information flow" argues one project manager. Another interviewee agrees, meaning that a person has an own responsibility to stay informed. A third interviewee describes the communication at ITT as "transparent if you want to find information".

"Communication is not a one way information flow"

6.2. Informal Communication

A common habit at ITT is to hold spontaneous informal meetings with various project members when the need emerge. One project manager expresses that he does a lot of "*management by walking around*", which seems to be a very common routine in the company. Other try to not use mail that much because they value having eye contact with the individual instead. On large advantage of speaking face to face is believed to be that it is easy to get a feeling of the other person's actual work situation. One project manager believes that many times a personal relation to a colleague makes the work a lot smoother. He feels that it is good to know whom you are working with, which is also made easier if you have worked in the company for some time.

Obviously, spontaneous meetings can't be conducted with project members in the Lindås factory or other geographically distant locations. In these cases, e-mail and telephone is used to communicate. There are some clear downsides with this. One project manager believes that sometimes mail conversation can be unclear and prevent that issues are handled straight on.

6.3. Communication with the Lindås Factory

The project members located at ITT's main production facility, the Lindås factory in the south of Sweden, often attends the project group meetings via Internet. One interviewee states that he receives his general update through weekly web meetings. When these are skipped, problems are more likely to arise. All in all, he thinks that there is room for improvement regarding the

communication between the two locations. For example, when project managers are creating the time plan of the development project, he feels that sometimes the time plan of the Lindås factory is not taken into consideration.

Another interviewee working in Lindås conducts meetings once a month before the Project Board meetings to get updated by the project coordinators. He also send out a weekly letter to his department to keep them updated about the projects, in part by sharing information he gathers during the monthly project board meeting in Sundbyberg. However, he thinks that his colleagues lack some information about the status of the projects. In general there is very little insight in what is happening in the projects at the product development department at Sundbyberg. However, he hasn't actively been searching for the information himself, even if he believes that it is available if he looks for it.

Previously it has been a sort of "we and them" mindset between Lindås and the company headquarters in Sundbyberg. However, many interviewees agree that this is not the case anymore. For example, one interviewee says that face-to-face meeting with project colleagues in Lindås happen more often in today's projects. He believes that this kind of meeting can be really productive for a project and that it should be conducted even more frequently.

6.4. Project Overview

Many of the interviewees agree that there is a strong need for some kind of project overview that describes the current state of the project. Not only to reinforce the motivation while working in the projects but also by showing the big picture and to keep focus. Regarding if this would actually work, there are two main positions. One is very positive to creating a better overview with the belief it will make the entire project more successful. The other is skeptical to if the added value would make the extra work needed to create the overview worth it.

Some of the interviewees mean that it is not easy to see what's going on throughout the company. The company's strategy should be traceable from every task in the entire company, and a relevant question that everyone in the project group should be able to answer is: Why do we do this? At the moment, this is not obvious for everyone because of the lack of a project overview. However, some interviewees believe most project members know about the project status and have a clear view of the project goal.

Several interviewees pointed out that an overview of a project could keep up motivation. Design engineers can spend a lot of time on a small detail and easily loose their motivation if they're not aware of their own role in the big picture. In general, interviewees believe that a common goal for the project and the project group needs to be stronger communicated.

Furthermore, another reason for creating a project overview is believed by some to create and sustain a good communication between different functions as well as geographically different locations. It's sometimes considered hard to see a connection between a project and the product it involves today. One interviewee states some project members in the Lindås factory feel like

the information is kept secret as a result of them not having access to the project folders. He stresses that giving full access would not be a good idea, and thus a project overview would be a good alternative. Another interviewee agrees that a web based project tool would ease the work in geographically diverse projects.

One project manager believes that an introduction of an overview will meet some resistance since new things tend to do that. He believes that this is solved in part by being consistent: the overview should be the only method allowed, older systems should be shut down. Another aspect he believes to be important is that the new method has to show clear advantages that makes the project members want to use it.

6.4.1. Project Overview workshop

A Workshop was conducted with the topic "content of project overview". The majority of the participants agreed upon what the content of a project overview should be. See figure 8.

The main result of the workshop was that the most significant information needed in a project overview was the business case. The project members need to understand what will make the product sell. A similar piece of information that was considered almost as important was the customer benefits of the product. The third most important piece of information was considered to be the financial data of the project, how the profitability of the product is affected by the development time. As expressed by the workshop participants, this information "*should be set in stone"*. Since this information was considered most important, is should be at the center of the project overview.

Other important information the overview should contain was considered to be the quality goals and the time plan. The tollgate dates and where in the process the project is currently should be visible. Since TG4 is a crucial TG for a project this should be highlighted. Furthermore, project activities in the near future should be clear. A sign that indicates if the project is on time was also considered important. This could be symbolized with a red color meaning the project is delayed or a green color where it is on time. Recent decisions and upcoming decisions were also mentioned as important information. In general, the participants agreed that traceability in decisions where important.

The workshop participants agreed that images and graphs should be used to a great extent, as this was considered to ease the communication. Furthermore, project risks should be highlighted. Finally, information about where the product is to be produced should also be present on the overview.

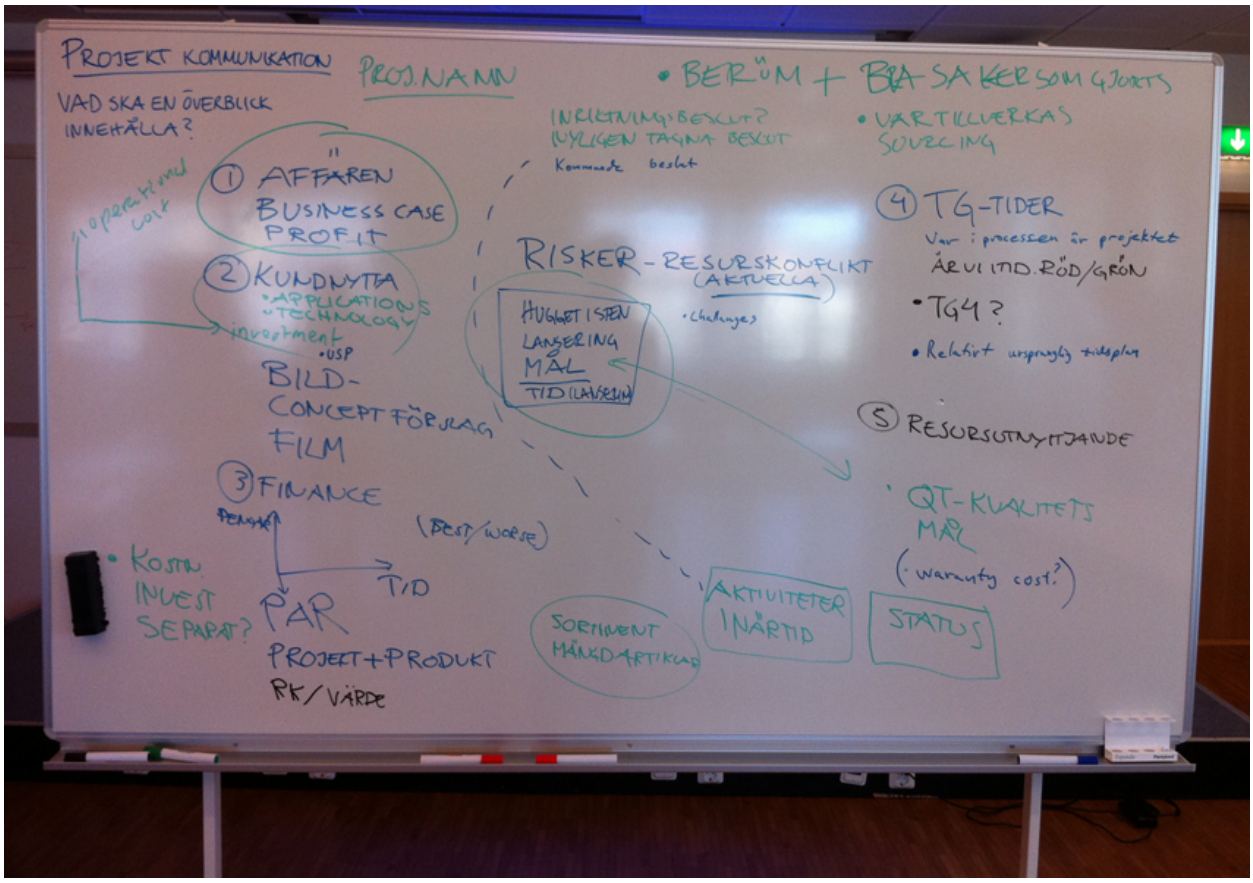


Figure 8. Workshop with the topic "content of project overview" conducted at ITT, May 2011.

7. THEORY II: Communication

Communication in a project takes place all the time, both internally in the project group and externally with other stakeholders. In the following chapter theories about meetings, reports, documentations and project tools will be described. These theories will be the base for the analysis of how to improve communication at the case company.

7.1. Formal communication

The difference between communication and information is that the first is two-way whilst the second is one-way (Tonnquist, 2008). Formal communication is a set of different activities acknowledged by the company to be the official ways of communicating the information in a project. The methods described in this in this thesis are mainly meetings and documentation.

7.1.1. Meetings

A lot of time is spent on project meetings during a project. There are meetings such as information meetings, work meetings, decision meetings, negotiation meetings and evaluation meetings. Project meetings should be held once a week and be part of the project plans scheduled activities. The project board meetings also play an important part if unforeseen events occur or a tollgate is to be decided upon. These meetings should also be scheduled in the project plan since the project board often has a busy schedule. (Tonnquist, 2008)

By gathering the Project group formal decisions can be made, information can be shared and at the same time an opportunity for informal communication between the project members can be created (Axelson and Thylefors, 2005). It should be taken into consideration that participants of the product development project should meet throughout the development work. However, it is not always effective in an economic perspective to integrate all functions during all the projects phases (Song, Thieme and Xie, 1998).

Project Review Meetings

The purpose of project review meetings is to efficiently determine if projects follow their time plan. They are handled differently depending on the number of projects a company has. The truck manufacturing company Scania has a large project portfolio. They hold project review meetings every Monday, where a large amount of project status reports is reviewed. To be able to see the status of all projects a big matrix is used, and each project has a column. They use magnets in different colors symbolizing the status of each project. The red symbolizes an activity differing from normal. The yellow symbolizes an activity differing but a solution is already found, the green is ok and the white means nothing important is happening at the moment. (Tonnquist, 2008)

Scania uses this method because they want everyone to have the same view of the portfolio. Since project managers and line managers share the same information this triggers knowledge

sharing. It creates a healthy dialogue, and is often pointed out as one of the reasons of the company's success. (Tonnquist, 2008)

According to Tonnquist (2008) the majority uses digital scorecards at project review meetings in order to present a project status. It normally shows the project performance in relation to the project goals, the delivery time, the budget and the risk level.

7.1.2. Documentation

During the execution phase of a project, all activities should be documented. For a project manager to have control over the situation, information from the project group needs to some extent be received and reported formally thru documentation. The project manager needs to know what the team members have accomplished. With the given information the project manager can communicate the project status to the project board: the results, the deviations, the time and the costs. (Tonnquist, 2008)

As the project proceeds, more and more information is gathered and soon a great deal needs to be handled properly. A good supporting system for handling all these documents is vital, and one solution is a web-based project support service. (Tonnquist, 2008)

According to Kahn (2005) critical problems will occur if experiences are not well documented. Preserve personal knowledge is crucial in an organization where team members frequently shift product areas.

7.2. Informal Communication

Informal communication has a major significance when conducting a project and it is many times as important as formal communication. To encourage informal communication the project team should sit close to each other to be able to contact each other easily and exchange information, ask smaller questions or make agreements (Lönnqvist, 1992). Effective teamwork is dependent on the group being gathered in one location. The preferred would be if each project had an own project office where the entire project group could be.

Preferably there should be a wall in the room containing the project schedule where updates of the results and changes can be communicated throughout the project. The awareness of the project group will increase if the updating is shown visually. Task of what needs to be done and what should be prioritized should be communicated in visual form since it will enhance the progress of the project significantly. The visual communication will also make stakeholders visit the project office room and take part of the information shared. (Tonnquist, 2008)

Informal communication within a project can occur through e-mails, project portals and direct conversations. Of the previous mentioned, a conversation face to face is seen as the most effective (Hewitt, 2006) The human being has a better perception when she is exposed to real meetings since all the senses are used and it is easier to read body language, vocal pitches or visual impressions.

Furthermore, emails are especially important for companies that are spread out over different geographical locations. However, too much information has become a problem for most people and therefore to filter and sort the information sent and received by e-mail has to be done. Email is a communication tool that has increased dramatically in usage and when the amount of e-mails exceeds a certain limit the receiver risks to miss important information because some e-mails are not read carefully. (Hewitt, 2006)

7.3. Project Overview

The need for communication structures varies with a company's size. The larger the company is, the more important it is to have a working communication structure since the project board and the project manager needs to be able to keep an overview of all the ongoing projects (Vinten, 1999). There are a vast number of project management tools existing today, most of them in electronic form. They help both in planning and overview, but it is important to note that using a project management tool does not automatically make a project better (Hydén, 2006).

Hydén (2006) argues that it should mostly be the project manager that updates the project overview after receiving reports from the project group. Project members should just be able to look at the project platform and not be able to change any information.

When implementing a project overview method, an organization goes through a transformation where new goals are to be achieved and work methods and strategies are affected. The starting point is to visualize and communicate the goals for the change – What the true purpose and goals are. Communication is a key factor in managing change. (Tonnquist, 2009)

7.3.1. Project Portals

According to Rheingold (1993), Butler (2001), Hagel and Armstrong (1997), online spaces for interpersonal communication are important for organizations. To enhance formal internal communication, project portals or interactive databases are used. By gathering the documentation of the project in one place, the project members can be kept updated even on the parts that are not their main areas of work. By doing this the internal formal communication can be encouraged. The information shared can also be limited if it's necessary (Tonnquist, 2006). A great deal of information can be shared and communicated in a way that is tailored for the specific organization using these systems.

Everyone in a project needs different information. Detailed information is of no need for the project board but crucial for the project manager. The project group needs information of the problems and countermeasures. Stakeholders outside the project organization need first and foremost an overview of the project progress. As a results, a desired function of a project portal is the ability to filter it's content suiting the individual user (Tonnquist, 2011).

Projectplace

Projectplace is an online project tool that assists the project manager and the project group in communicating and collaborating throughout the project. The functions are designed to answers the questions; who is in the project? What do we have to do and when? And who is in charge? See figure 9 (Projectplace). It contains the project description, important dates, project members, scheduled work of the project and the projects conversations. The first page of the platform is used to communicate with the project group.

The main advantage with this online-based project overview is said to be that all project stakeholders can communicate easily regardless of where they are geographically located. The tool also sends out a weekly request to all members to fill in what tasks has been done. This information is then sent to the project manager who chooses what he needs to bring up for the steering committee. (Tonnquist, 2009)

Figure 9. Projectplace

Microsoft Office SharePoint Server

Microsoft Office SharePoint Server is another project portal located on a company's intranet, which can be tailored to the company's specific needs. SharePoint is integrated with Microsoft Excel, Word and Outlook. Documentation can be stored within the platform from different locations, and is later accessible thru a very powerful search engine. Because of the collaborative workspace, the presence of all stakeholders is necessary to insure that information is up to date. Information is only accessible by a project member if permission has been given by an administrator. If the project manager is managing several projects they can be presented in one shared place by connecting the own personal collaboration site to other sites. It allows you to work both offline and online. (Tonnquist, 2009)

Microsoft Project 2010

Microsoft project 2010 is a tool used to improve management, scheduling and overview of the project, See figure 10 (Microsoft office). It has a built in Microsoft SharePoint Server, and thus all the above mentioned functions. In addition to providing tools for creating and managing time plans, one core function is the ability to produce custom made reports based on data within the SharePoint system. The purpose of this is to be able to automatically generate reports without having to manually write them, and thus saving a lot of administrative time (Microsoft office).

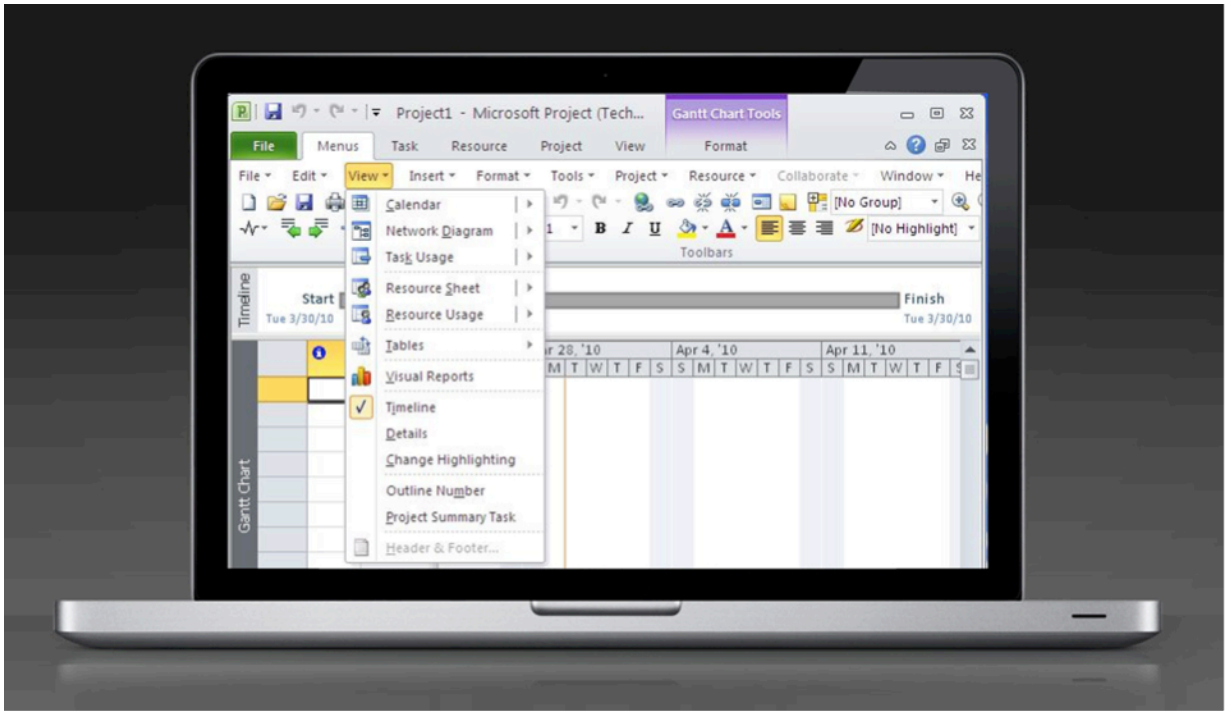


Figure 10. Microsoft Project 2010

7.3.2. The A3 method

The A3 model is a project overview method developed by Toyota to bring problems into light and to make proposals for improvement. It is a hands on method used to delete waste in the system. It is often a physical document in the shape of an A3 paper that the project manager fills in with a pen, but it can also be an electronic A3 (Shook, 2008).

The A3 model should make it possible to explain and make decisions in less than 5 minutes. This is only possible if only the essential information is used. Therefore, bullet points are preferred rather than full sentences for example (Tonnquist, 2009). Issues presented on the A3 are discussed with the stakeholders and it is later revised accordingly. The A3 works as a storybook that has its beginning and end. The owner/storyteller knows how to effectively frame the problem so that everyone can better understand it in both depth and context. Every A3 should have a signature and date to clearly show who is responsible for the problem or proposal and the progress of the work (Shook, 2008). A layout of a typical A3 can be seen in Appendix D.

According to Shook (2008) an A3 typically includes the following elements:

- *Title* - Names the problem, theme or issue.
- *Owner/Date* - Identifies who "owns "the problem or issue and the date of the latest revision.
- *Background* - Establishes the business context and importance of the issue.
- *Current conditions* - Describes what is currently known about the problem or issue.
- *Goals/Targets* - Identifies desired outcome.
- *Analysis* - Analyzes the situation and the underlying cause that has created the gap between the current situation and the desired outcome.
- *Proposed Countermeasures* - Proposes some corrective actions or countermeasures to address the problem, close the gap, or reach the goal.
- *Plan* - Prescribe an action plan of who will do what when in order to reach the goal.
- *Follow-up* - Creates a follow-up review/learning process and anticipates remaining issues.

Managing is all about thinking and developing the right way of approaching a problem. Leading is a matter of making other people to think, take responsibility and initiatives. All this can be achieved with the A3 model. Kanban democracy is where authority is pulled to where it is needed when it is needed. The A3 model helps people to step up and lead, manage and take action when they have proof/ data of the problem. Even if the A3 has an owner it is not a single player game, rather a highly developed team sport. It shows individuals how to gain authority, agreement to get the right things done and the possibility to develop the skill to sustain learning (Shook, 2008).

During the creation of the A3 the PDCA method is useful to have in mind. PDCA (Plan, Do, Check, Act/adjust/action) is a management cycle based on the scientific method of proposing a change in a process, implementing the change, monitoring and measuring the results, and taking appropriate action. It was introduced in Japan in the 1950s by W. Edwards Deming. (Shook, 2008)

The best A3 has been revised several times and is a little bit messy. The steps of the A3 should be carried out one after another and plan of action comes after you have found the problem. As a leader it is suggested to guide the person responsible for his or her A3 rather than exactly tell them what to do, because then you take away the responsibility from them. (Shook, 2008)

As a project manager it is tempting to solve the problem fast and even before the root of the problem is found. Using the A3 it is important to remember to never try to retrofit a solution because it looks good. An inexperienced A3 user is often eager to solve the problem as fast as possible. However the first step is to grasp the situation of the project then to go to the "gemba" and breaking down the problem by finding out the root cause of why the problem is occurring. "Gemba is the Japanese term for "actual place", and describes the place where value-creating

work happens. In essence, gemba reflects a philosophy of empiricism – "go to the gemba to discover the truth". (Shook, 2008)

The Five Why's approach also helps to discover the root cause of the problem. Five is how many times the A3 owner should ask the question *why* when facing a problem. Rich data is important for this, and when the root cause is found this is where the countermeasures should be directed (Shook, 2008).

Nemawashi , "ne" meaning root and "mawashi" meaning twist, refers to that before you can put a plant in entirely new soil, you must pull it up with its root in its new location and ensure organic and sustainable growth. Literally translated as *preparing the ground*. It's about aligning the organization around broad and specific goals. The philosophy of Toyota is: before giving a solution you have to find the real problem. When the problem is found and translated into an objective, the challenge is to create a *Hoshin kanri*: "Strategy/Policy deployment" the process of creating alignment around objectives and actions. (Shook, 2008)

A new objective leads to change and that can be difficult to accept for those whom it may concern. A reoccurring expression of the individual who need to change their way of work is: Why should I change and not the others? As a new leader many times decisions are made on the basis of what others want, rather then what is the best solution. An answer to those who oppose your proposal a returning question could be: - How do you know this is not a good idea? As a new leader it is important to push the people in the organization to explain their thinking. It is good to have a set of potential countermeasures rather than just one. (Shook, 2008,)

When an A3 is accomplished the story doesn't end. Continuous improvement is a key word in the Toyota model. "Evolutionary learning capability "Takahiro Fujimoto, Toyota Scholar. The word LAMDA (look, ask, model, discuss, act), also known among the Toyota employees is the cycle of knowledge creation. (Shook, 2008,)

7.4. Information Overload

Miller's (1956) thought that the humans can only process seen chunks of information (plus or minus two) and according to Fletcher (1995) cultural settlement also influences the management of information overload. Information overload is the state of an individual (or system) in which not all communication inputs can be processed and utilized, leading to breakdown (Rogers and Agarwala-Rogers, 1975). Quentin et al (2004) conducted a research that proved information overload has an impact on the behavior of humans. Firstly they stated that people respond more likely to simple messages and secondly people is more likely to stop participating if the mass interaction increases and finally users are more likely to respond shorter answers as the overloading of mass interaction grows.

Conversational overload is when too many messages are delivered, so that individuals are unable to answer adequately (Whittaker et al. 1998). Information entropy according to Hiltz and Turoff (1998) is when incoming messages are not sufficiently organized. They are hard to recognize if

they are of importance or not in the conversation history. Consequently a well-structured information flow is necessary.

Virtual publics are symbolically delineated, computer-mediated spaces, such as e-mail lists, newsgroups and Internet relay chat (IRC) channels that enable a potentially wide range of individuals to attend and contribute to a shared set of computer-mediated interpersonal interactions. They can therefore be considered as relatively transparent and open. Historically, communication technologies have been enablers of only a limited range of social interaction. Humans have limits of how much information they can handle. Hiltz and Turoff (1978) showed that if a group of people interacting is too small they do not sustain interaction. Some stop using the system and others switch to larger systems. Therefore too small spaces don't work.

7.5. Communicating market needs

QFD is a method that many believe to enhance an organizations market orientation by efficiently converting market research data to engineering attributes (Griffin & Houser, 1992). The matrix-based method was introduced by the Japanese company Kobe Shipyards in 1972 and was adopted by many companies, especially in the car manufacturing industry, throughout the following decade. Even though matrixes had been used before to define relations between inputs and outputs in a process, this was the first time it was applied to connect the marketing world with the engineering world (ReVelle, 1998).

The main purposes of QFD are to convert customer needs to applicable design characteristics, and then implementing them in the design process. This is believed to results in a final product with a very high correspondence to the customers actual needs, as well as greatly reduced developing times and costs thanks to it creating clearly defined project goals (ReVelle, 1998),(Hauser and Clausing 1988).

The most well known part of QFD is the ”House of Quality” seen in figure 11. In the box to the far left, the customer requirements are entered and their importance is set with a weight number. In the top box, design attributes that are needed to fulfill these requirements are listed. In the most lower box, these design attributes are given ”Engineering measures” to allow for follow up of the set requirements. The matrix that occurs between these boxes is used to describe their connections, with different symbols showing how strong the connection is. For example, a customer requirement regarding cars headlights is strongly connected to design attributes regarding electronics. In the top triangle, the internal connections between the different design attributes are defined, thus showing how one design decision affect another (Griffin & Houser, 1992).

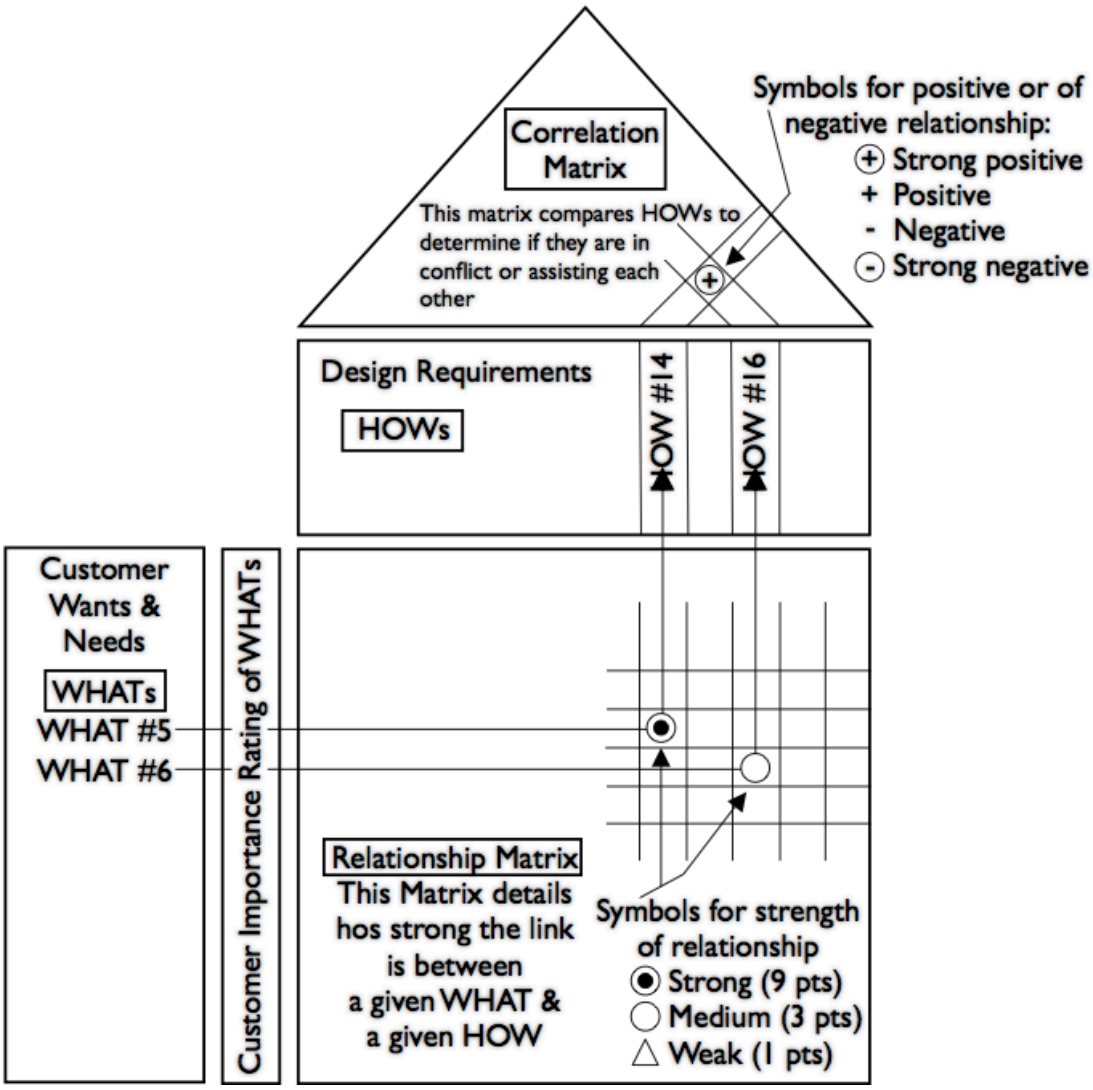


Figure 11, The House of Quality

Advantages of QFD are considered to be that it clearly defines the design process, showing each team member their contribution to the final product. Furthermore, it's an efficient visual representation of the design activities, including their relative importance in the process (ReVelle, 1998). Finally, it is described to create a very transparent way of communicating, since all functions in a NPD process agrees on the decisions made, as well as understanding the implication if some of the decisions where to be changed. To create a house of quality, input is needed from all participating organizational functions, meaning that the process itself encourage cross-functional collaboration (Griffin & Houser, 1992).

8. Analysis II: Improving Communication

In this chapter, the empirical and theoretical findings are used to determine how communication should be improved at ITT. In addition, a specific solution in form of a project overview is proposed and it's content is described.

8.1. Improving Communication in ITT Projects

ITT has a very informal business culture where informal communication is widely used, in part since they work close to each other. Although this is one of the best ways of communicating (Lönnqvist, 1992), there is a risk that too much informal communication results in crucial information not reaching all stakeholders. Email is another informal communication tool, which is widely used at the company. However, both theoretical (Hewitt, 2006) and empirical findings (Goike) confirm that there are disadvantages with this method, suggesting that it should not be relied on to heavily.

The meetings conducted at ITT today serve their function, however there is room for improvement since the different projects have different routines in terms of the meetings reoccurrence. Tonnquist (2009) states that project meetings should be held once a week, and although this would not fit all projects at ITT, the authors conclude that communicating some kind of information every week regarding each project is necessary. It shouldn't be a meeting since some projects do not need this every week, but a place where updated information about the project could be shown.

Today, the protocols written after the project meetings serve as an update of the project at ITT. However since project managers handle the protocol differently, this information is not always a reliable source of update across projects. Status updates are crucial for a successful project (Tonnquist, 2009), and consequently this suggests that another method is needed. Even if every project is different and needs to be handled independently, some routine should exist.

According to Tonnquist (2009) a project room for each project is the optimal choice for keeping all stakeholders up to date, but since ITT has employees spread over the world it will not work for every project. Thus a web-based project overview - a virtual project room - could be a solution. Implementing such an overview across all projects would result in a common routine for how project members are kept up to date, whether they are located at the office in Sundbyberg or elsewhere, and thus improving teamwork (Lönnquist, 1992). The overview would communicate the information deemed necessary by the Marketing, the R&D and the Operation department.

Some project members search for information in the folder system while some don't since they considering it confusing. Some interviewees express that communication is a two way street and that project members do need to actively go out and get information. However, if information is hard to access many will stop searching for it (Quentin et al, 2004). This suggests that easier

access will make project members more likely to actively search for information. Consequently, using an accessible project overview as a method of sharing information will likely increase the communication thru out the project group. Furthermore, a new project member entering a project at ITT would be more likely to actively access project information if it's standardized across projects, solving the problem that new employees have a harder time adapting the current folder system.

The proposed overview can replace some of the tollgate documents entirely. For example the project specification that contains a lot of information that can be found in other places as well. However, some documents such as the production checklist and the financial projections should not be replaced since they serve a very specific purpose. Other documents could on the other hand be automatically generated by using a system such Microsoft Project 2010 as a platform for the overview. This would greatly lower the amount of administrative work the project managers are forced to today while creating different tollgate documents, and would thus making them more willing to use the new project overview system.

Interviewees working at the factory in Lindås expresses that there is shortcomings in the communication between them and Sundbyberg. Even tough some project information should be shared more actively; there is an agreement that all information does not need to be accessible to everyone. A web-based overview would make it possible to share information with the project stakeholders to a different extent depending on the level of their involvement in the project. Despite some limitations, this communication would bring the project stakeholders in Lindås closer to those in Sundbyberg since it triggers knowledge sharing (Tonnquist, 2009).

The overview will not satisfy the need for face to face meetings which are proven to be the best way of communicating according to Hewitt (2006). However, a web-based overview could implement video chat meetings, and thus creating a possibility for project members to see each other.

The content available through a project overview describes *what* is to developed, not only *how* it is going to be developed which is the case of a product development process (Engwall, 2001). Furthermore, an overview would put less stress on the project manager being a communication hub, which suggests that project members would communicate with each other more directly and thus improve the cross functional collaboration (Jasawalla & Sashitta, 1998). This is its turn, suggest that project members would value each others work higher (Gupta & Wilemon, 1988).

8.1.1. Solving the identified problems

During the Project board meeting decisions are made which are supposed to be based on the information in the large amount of documentation provided by the project managers. The documentation is seldom read, and consequently the current documentation system doesn't work to base decisions on. An overview would make the crucial information more accessible for the decision makers and therefore a more qualitative decision can be.

An overview will also allow other attendees of the Project Board meetings easier access to information about the projects. This suggests that discussions that occur as a result of lack of information will become fewer, thus making the meetings more efficient.

The standardized overview should be the basis of the presentation held by the project manager. The presentations would themselves therefore become better structured and easier to understand, making them a better basis for both discussions and decisions. As stated by one interviewee, a presentation is good if it reflects the whole project group, something that would be achieved since this is the focus of the proposed project overview.

By designing the content of this overview to put more focus on the business case of the project, the market orientation will become stronger communicated thru out the project group. The content of the overview will play a strong roll in achieving market orientation, which will be explained further in the following section.

One of the main functions of the QFD method is to translate market research to engineering goals (Griffin & Houser, 1992). This suggests that using this tool would improve the understanding between the R&D and the marketing department, showing more clearly how their work affect each other. However, since some interviewees expressed that there wasn't a need for tools that created more work, the implementation of QFD would have to be on the condition that it didn't add tot much extra work.

8.2. Content of a Project Overview

The analysis shows that a project overview of the projects at ITT is necessary. The content of the overview is determined by comparing the theoretical findings regarding project platforms and communication, and the correlating empirical findings.

The "5 whys"-method stating that a A3 user should always ask 5 whys every time he faces a problem, is a good way of truly understanding the different parts of the project overview. By consistently showing summaries of different project areas, but allowing more in depth information on pages dedicated to each section if it is needed, it gives the user the possibility to answer the question "why" if an uncertainty about some part of the overview occurs.

The results of the "project overview"-workshop suggest a project overview that includes nine different key sets of information, see figure 12. The workshop results had many similarities with the A3 model, See figure 12 and Appendix 3. Since the A3 model shows the importance of understanding the problem before it can be solved, which corresponds to the importance of understanding the customer benefits, this suggest that it is a good basis for the content of the suggested project overview. In figure 13 on page 62, a final proposition of the projects overviews content and layout is introduces. The different sections in the project overview are described in the following section.

WORKSHOP	A3 MODEL
• *The Business Case* – What is the background to the project? • *Customer Benefits* - What will make the product sell? • *Financial Data* – What are the financial goals? • *Quality Goals* – What are the products functions and performance needs? • *Time Plan* – What important dates exist in the project? • *Activities in the near future* • *Is the project on time?* • *Project Risk?* • *Production Facility?*	• *Title*- Names the problem, theme or issue. • *Owner/Date*-Identifies who "owns "the problem or issue and the date of the latest revision. • *Background*-Establishes the business context and importance of the issue. • *Current conditions*-Describes what is currently known about the problem or issue. • *Goals/Targets*- Identifies desired outcome. • *Analysis*-Analyzes the situation and the underlying cause that has created the gap between the current situation and the desired outcome. • *Proposed Countermeasures*- Proposes some corrective actions or countermeasures to address the problem, close the gap, or reach the goal. • *Plan*-Prescribe an action plan of who will do what when in order to reach the goal. • *Followup*-Creates a follow-up review/learning process and anticipates remaining issues.

Figure 12. The results of the conducted project overview workshop and the content of the A3 model.

Title and Owner

This section should briefly mention the project name, project number and project manager. In addition it should highlight in which pipeline it is conducted.

The Product

A section introducing the product that is to be developed shortly should be present. This should not go into detail, just briefly describe the type of product and how it should be used. Since visual elements such as graphs and images was agreed upon to enhance the communication in the overview, and is also confirmed by theory (Song et al, 1998), an image visualizing the product should be present here. Depending on how far along the project is, this image could either be an actual concept or just an image illustrating the product category.

Customer Benefits

The most important part of the overview was according to the workshop attendees' focus on the products customer benefits. This is in line with findings from many interviews, and its importance is supported by theory (Kohli & Jaworski, 1990). This part of the overview corresponds with the A3 models *proposed countermeasures*, since a product with customer benefits would serve as countermeasure for the identified market demand.

Furthermore, the customer benefits should be expressed in 3 ways: *Quality Goals, Time Goals* and *Cost Goals*. *Quality Goals* describing the actual functions and performance of the product, such as water velocity/pressure curves. The *Time Goals* should state when the product needs to be ready for the market. The *Cost Goal* should state what the manufacturing cost needs to be. If all these goals are achieved, the product will meet the financial targets.

This will make the project members aware of how these three factors affect the market success of the developed product. The goals should be described in short summaries and incorporate links to the business case analysis page that further explains the "why" - the reasons for the goals.

The Business Case

To justify the goals in the customer benefits section, the background should be available by describing the business case. This addresses the need for describing the business case made by the workshop attendees, as well as the *Background* and *Analysis* section in the A3 model (Shook, 2008). On the overview, a summary of the market analysis should be present, incorporating a link to a page with the full business case analysis. Communicating the reason for customer benefits makes it easier for project members to understand the project goals (Griffin, 2005)

Financial Data

This part of the overview should visualize the expected profit of project. This corresponds to the workshop result, as well as the *Goals/Target* section of the A3 model (Shook, 2008). By visualizing the expected financial outcome, the project members are given an understanding of their contribution to the organizations activities. On the overview, this section should provide a clear summary of the key financial figures. In addition, a link guiding the user to the full set of financial documents should be provided.

Time Plan

This section should give a clear picture of the projects time plan as well as what is happening right not. It will incorporate the *Time Plan, Activates in the near future, Recent Decisions* and the *On time* sections that was described as important in the project overview workshop. Furthermore, it will correspond to the *Plan* and *Current Conditions* section of the A3 model (shook, 2008).

A *Time Plan* area of this section should contain a summary of the important dates in the project – the scheduled tollgate dates. Furthermore, it should be noted on this time plan if the project is keeping up or slipping behind, something that could be updated during the Monday review meetings. A *Recent Activities* are should summarize work that have recently been done and decisions that has recently been made. A *Future Activities* area should contain activities in the near future.

Project Members

This section should contain a list of the project members along with their photos. This will give a quick overview of who is actually working with the project (Projectplace). In addition to who the project members are, there location should also be described to allow for face to face communication when it is possible. Finally, a list summarizing the different geographical locations included in the project should be present: *Development*, *Marketing* and *Production.*

Project Risks

This section should highlight the project risks identified in the start up phase of the project. A summary of the risks should be provided and a link to the full risk document containing proposed countermeasures should be present.

Some risks could be generated automatically. Because of the lack of cross-pipeline priorities, a problem emerges when individuals work in multiple pipelines, not knowing which project to prioritize. This section should visualise this problem. If a resource is active in two highly prioritised projects in different pipelines, the *Project Risk* section can highlight this automatically. This will raise the awareness of a potential resource conflict, and thus letting project managers discuss it before it

Comments

This section is where the imperativeness of the project overview is present. According to Hydén (2006) it is the project managers' task to change in the project files, and the authors agree that it should be the project managers' responsibility to update of the project overview. However, the authors also believe that there should be a possibility for the project group to make comments since communication is a two way street (Tonnqvist, 2010). This suggest that the project manager should be the main "owner" of the project overview, but that it should be of a interactive nature that allows project members to comment and thus communicate through it.

This is achieved in the *Comments* section. On the project overview page, users are able to write comments on what is currently going on in their work areas. In addition, a comment function is available in all other project pages, and if a comment is made here there it is also visible on the front page. This is very much inline with the interactive nature of the A3 model (Shook, 2008).

8.2.1. Implementing a Project Overview

Since the introduction of this overview would mean a change for both the project managers creating and the project members using it, it would most likely be met with some resistance (Shook, 2008). However, a potential introduction would be made in such a way that stakeholder are not given an option not to use the overview. The result will likely be some drop in efficiency in the beginning, but since stakeholders are obligated to use it, it will eventually be generally accepted.

PROJECT NAME

Project number:
Project Manager:
Project Pipeline:

TIME PLAN

TG0 TG1 TG2 TG3 TG4 TG5

For more information

The purpose of this project is to produce a propeller pump to be sold in the north merican market in the summer of 2012.

For more information

BUSINESS CASE

Summary of the market analysis.
Why is there a need for this product?

Lorer sim nissit estin el ut at.
Duisim do odo dignis nis adiam, conullamcore delisse magna amet, sed tatetue volore veliquisi. Duis ea aciliscin vel in venis erat pratie faccum init volessed tat praesecte faciliquam, qui ea feum euisl ea feuiscinit nonulluptat.

For more information

ACTIVITIES

Decisions made

the performace on the prototype is concidered sufficient, even though it only meets 95% of the specified performance.

Upcoming work

Additional test of the first prototype.

Meetings

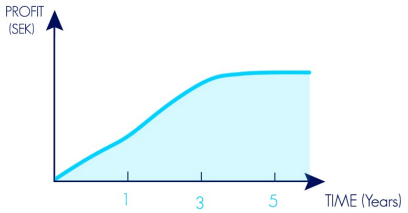
Project Group meetings on the 7/6 2011
Project Board meeting on the 30/6 2011

Other Activities

Test of prototype run.

For more information

FINANCIAL DATA



For more information

CUSTOMER BENEFITS

Quality Goals

The functions and the performance goals

Time Goals

The time for delivery

Cost Goals

The goals for production cost

For more information

PROJECT RISKS

Recources

Project member XX is active in 2 high priority projects. A risk for recource conflict exists.
Project is not on time.

For more information

PROJECT MEMBERS

Development

take place in

Production

take place in

Market research

take place in

COMMENTS

NN Posted in Quality Goals:

-Is it really necessary for the pump to be able to do this?

For more information

Figure 13. The proposed Project Overview

9. Discussion

In this chapter, the findings in the thesis are questioned. The effect of the limitations that have been made are discussed and further research is proposed.

9.1. The identified problems

As was concluded in the first analysis chapter of this thesis (chapter 5): creating a stronger market orientation within the product development process, and being able to make more qualitative decisions, are both strongly dependent on communication within the process. Since the proposed project overview would improve project communication, it would therefore also solve these identified problems to some extent.

One question regarding the conclusions drawn in this thesis is if the two main problems are only related to communication. The authors come to the conclusion that they are to a great extent, but that the problems could have been solved by other countermeasures as well. Even though there might be other solutions to the problems, the authors made the limitations to improve product development projects at ITT with the use of communication only. Therefore solving the problems by improving the process itself has not at all been investigated, even if it in some case might have been more effective.

The problems in focus (lack of market orientation and information based decision making) were chosen because the authors believed they could be solved by communication countermeasures. However, the other issues (time to market and lack of evaluation routines) have not been investigated further because of the time frame. Improving communication could in part solve them. Time to market would most likely becomes shorter when collaboration increases, which is one result in improving communication. Evaluation on the other hand would probably need to have a better defined process in order to be of greater value. However, if communication is improved, informal evaluations and experience sharing would most likely be as well.

Another question to discuss is if the result of the thesis will actually solve the problems at ITT, since it would mean interfering in the very strong routine existing today. The authors believe that even though project members at ITT are very comfortable in their routines, there is still a strong will of improving. Furthermore, organizational changes are already planned for the company, which creates a great opportunity to change communication routines as well. In addition, the management of the project management department is very committed to make changes in how they work, so there exist a force of leadership to accomplish the change. Finally, one must always remember that a change needs to be motivated in order to be achieved, meaning that all project members needs to be properly informed about how to use the new system and what the direct advantages are.

9.1.1. Other causes of the identified problems

Furthermore since the project managers at ITT mostly have a background in R&D, this could also be the cause of the lack of market orientation in addition to problem being related communication. The project manager department is part of the R&D department, which suggest that some project managers might have a harder time weighing the needs of the operations and marketing department objectively. An organizational change creating a project management office that is completely department-independent might shift some focus from the R&D heavy project management that occurs today. As stated previously, since many project managers have a background in R&D, an organizational change might not have any affect since it would be regarded a change of technicality. Even though this is believed to be a cause of the lack of market orientation, the authors still believe that it could be helped greatly by improving communication.

9.2. Affect of Thesis Limitations

Because of the geographical distance to the production facility in Lindås, there is a definite lack of information from the operation department in this thesis. Consequently, the focus has mostly been on the marketing department and the R&D department, and only to some extent the operations department. This gives the results of the thesis certain limitations. However, the proposed solution for improving communication is (as pointed out) believed to enhance the working environment for project members located in Lindås as well.

When implementing a new system, modifications to the system have to be made based on feedback from the users. To incorporate project members in Lindås when receiving this feedback would insure that the system is adapted to their needs as well. However, for them to willingly start using the system, their opinions and ideas should be considered before actually implementing it, since they most likely would be more open minded towards the change if they take part in designing the system.

The authors' supervisor Christian Wiklund indirectly selected the interviewees, thus creating some questions about the objectivity of this selection. However, after researching the constellation of a common project group at ITT, it became evident that the interviewees where a good representation of these. This still does not guarantee a completely objective result, but when examining the result the authors believe that the range of different opinions amongst the interviewees points to a fair selection. The relatively large number of interviews made (37) also helped to create a result showing the "average" opinion of ITT, insuring that the identified problems were consistent and not just individual occurrences. However, a more random selection of interviewees would have given an even more objective result.

The authors' background being very similar to one another might also influence the result because of a lack of different perspectives of analysis. However, since the authors have knowledge in product development, innovation and communication, we believe this is a good

basis for making a qualitative analysis. Off course, a third part could have added another perspective to the analysis and thus resulting slightly more solid conclusions.

The literature was chosen to be able to question the empirical findings thus provide knowledge to create the best results, in contrast to first conduct a wider theoretical research and subsequently conduct empirical studies guided by that. This strategy could be a bad choice since it didn't allow for a wider theoretical research. However, the authors believe the used method was the right one because of the timeframe and the very open character of the thesis questions. Starting with a theoretical study would probably result in a lot of research not being applicable to the specific case. Even though this in it self would substitute a value, the time would probably not allow the authors to produce the same results as the chosen method allowed them to.

Furthermore, Tonnquist is a basis of quite a large part of the analysis, which might suggest that it is not done objectively enough. However the literature of Tonnqusit inclueds different project management tools that are widely used today, so the authors believe the data is relevant for this thesis and more objective than one initially might believe. However, a wider theoretical research of the areas described by Tonnquist would bring more substance to the final conclusions.

An aspect to consider regarding the workshop conducted on project overview content, is the selection of attendees. Almost all attendees were project managers, and thus a project member perspective is missing. However, since many of the opinions expressed by project managers correlated with established theories, the result was considered a good basis for the analysis. Even so, incorporating project members in deciding the content of the project overview is important for other reasons. If they are part of designing it they will be more likely to adopt it once it is introduced.

9.2.1. General discussion

Another thing that should be pointed out is that the authors believe there is a great value in the technically oriented product development culture within the company. As theories confirm, to just focus on the market demand could make the company lose their innovative abilities, something that by many is described as the reasons for ITTs current success. Even the interviewees that argue for a more market oriented product development points out that the innovative culture is an important part of ITT and something that should be preserved. This is an opinion that the authors share, which might not be evident because of the strong focus on market orientation that exists in this thesis. The communication improvement should be done to improve the market orientation within the product development process, but not take over it completely.

9.2.2. Suggested future research

As mentioned previously, a more solid theoretical research should be made to further strengthening the conclusions. Furthermore, the result of the case study is only directly applicable to the company at which it was conducted. Even though the correlation between the

empiric and theoretical results suggest that the results are transferable, the study should be repeated at other case companies to strengthen this statement.

9.3. Conclusions

Based on the discussion in this chapter, the conclusions of this thesis is as following.

Four main problems where identified in the product development process

- A lack of project evaluation routines
- Too long time to market
- A lack of market orientation in the product development process
- Decisions being made based on insufficient information

Of these problems, the later two was concluded to be closely linked to insufficient communication.

To improve communication in the case company's product development process, a project overview should be introduced. Its characteristics should be as following

- Web based for access regardless of where project members are located.
- Focus on key customer benefits.
- A low level of detail initially, but with access to substantial information if needed.
- Interactive so that project members can communicate through it.

The proposed project overview is by the authors believed to improve communication at similar companies as well. The workflow of this study, including the different findings, is presented in figure 14 on page 67.

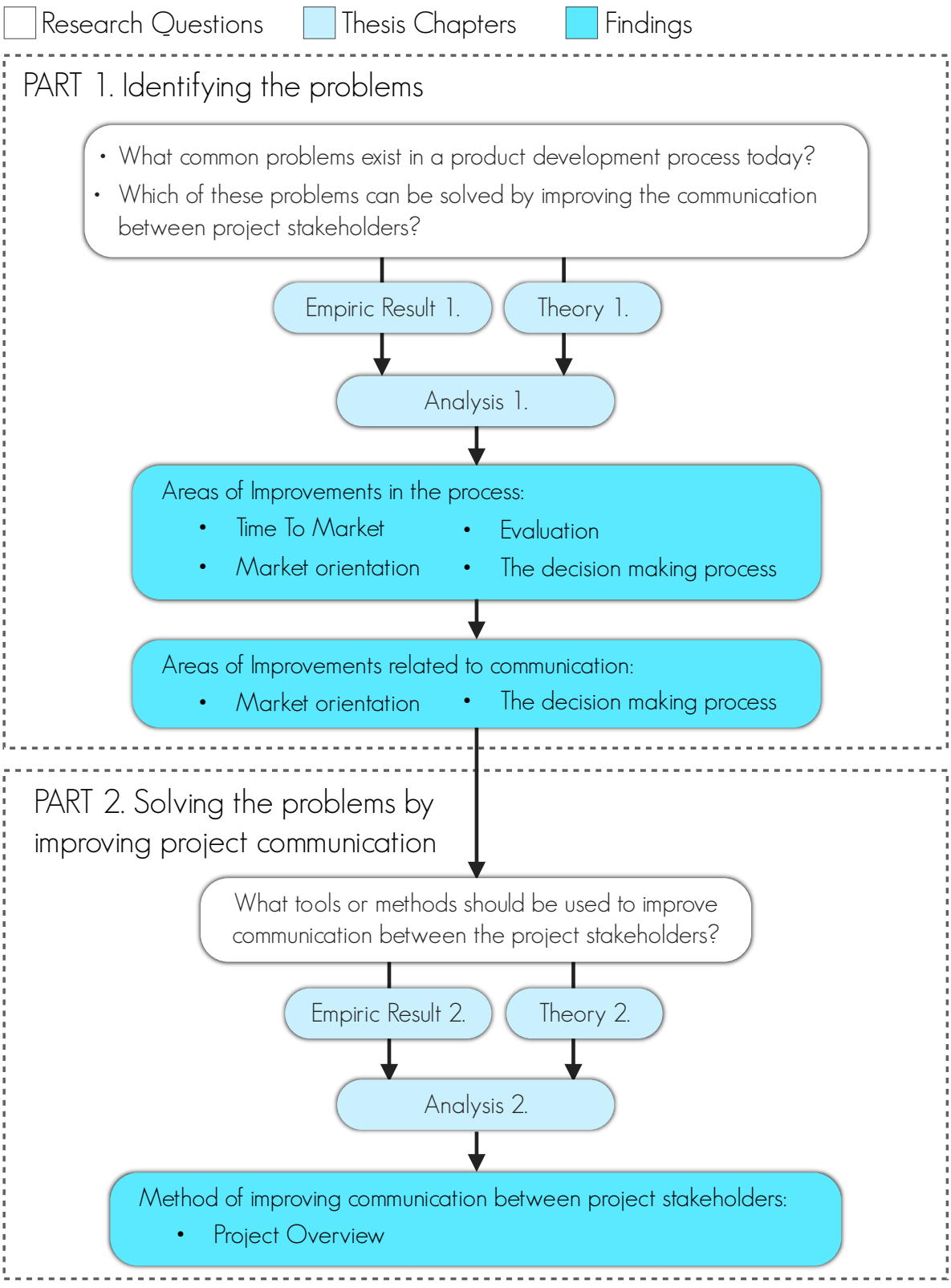


Figure 14. The workflow of the study

10. References

Atuahne-Gima, K. (1995) *An Exploratory Analysis of the Impact of Market Orientation on New Product Performance*, Journal of Product Innovation Management, Volume 12 Issue 4, Elsevier Science Inc

Axelson, B.L. Thylefors, I. (2005) *Arbetsgruppens psykologi*, Natur & Kultur, Sverige

Backman, M., Börjesson, S., Setterberg, S. (2007) *Working with concepts in the fuzzy front end: exploring the context for innovation for different types of concepts at Volvo Cars.* R&D Management, Volume 37, Issue 1

Bhatnager, A. (1999) *Great Teams,* Academy of Management Executive, Volume 13

Butler, B. (2001) *Membership size, communication activity, and sustainability: A recourse- based model of online social structures*, Inform, System Res, Volume 13, Issue 4

Chin, K., Wong, T.N. (1999) *Integrated product concept development and evaluation*, International Journal Computer Integrated Manufacturing, Volume 12, Issue 2

Cooper, R.G, Edgett, S.J., Kleinschmidt, E.J. (2001) *Portfolio management for new product development: results of an industry practices study*. R&D Management Volume 31, Issue 4, Blackwell Publishers Ltd, USA.

Cooper, R.G, Edgett, S.J., Kleinschmidt, E.J. (2002) *Optimizing the Stage-Gate Process: What Best-Practice Companies Do - II,* Research-Technology Management, Volume 45 Issue 6,Industrial Research Institute

Cooper, R.G. (1990) *Stage-Gate Systems: A New Tool for Managing New Products,* Business Horizon, Volume 33 Issue 3

Cooper, R.G. (2008) *Perspective: The Stage-Gate® Idea-to-Launch Process—Update, What's New, and NexGen Systems*, Journal of Product Innovation Management, Volume 25 Issue 3

Cross, N. (2006) *Designerly ways of Knowing*. Springer- Verlag, London

Deshpande, R., Webster, F.E. (1989) *Organizational culture and marketing: defining the research agenda,* Journal of Markefing, Volume 53

Dwarakanath, S., Wallace, K.M. (1995) *Decision-making in engineering design: Observations from design experiment,* Journal of Engineering and Design, volume 6, Issue 3

Eisenhardt, K.M., Tabrizi B.N. (1995) *Accelerating Adaptive Processes: Product Innovation in the Global Computer Industry,* Administrative Science Quarterly 40

Engwall, M., Magnusson, P. Marshall, C., Olin, T., Sandberg, R. (2001) *Creative Approaches to Development: Exploring Alternatives to Sequential Stage-gate Models*, Fenix Research Program, Stockholm School of Economics

Fletcher, R.J. (1995) *The limits of Settlement Growth: A Theoretical Outline*, Cambridge University Press

Griffin, A. Hauser J.R. (1992). *Patterns of communication among marketing, angineering and manufacturing – a comparison between two new prodict teams,* The institute of Mangament Science, Volume 38, Issue 3

Gupta, A., Wilemon, D. (1988) *The Credibility - Cooperation Connection at the R&D - Marketing Interface,* Journal of Product Innovation Management, Volume 5

Hagel, J., Armstrong A. **(1997)** *Net gain: Expanding Markets Through Virtual Communities*. Harvard Business School Press, Boston, MA

Hansen, C.T, Andreasen, M. (2004) *A mapping of design decision making: Proceedings of 8th International Desing Conference*, DESIGN 2004, Dubrovnik.

Hauser, J.R, Clausing, D.P (1988) *The House of Quality*, Harvard Business Review, Volume 66, Issue 3

Hewitt, P., (2006) *Electronic mail and internal communication: A three-factor model*, Corporate Communications: International Journal, 2006, Volume 11, Issue 1

Hiltz, S. R., Turoff, M. (1978) *The Network Nation: Human Communication via Computer*. Addison-Wesley Publishing company, Inc., London, U.K.

Hussey, J. & R. (2009). *Business Research – A practical guide for undergraduate and postgraduate students*. Palgrave Macmillan, Hampshire.

Hydén, J. (2006) *KAMP Microsoft Project 2003: Att komma igång*, KAMP Företagsutveckling. Sollentuna kommuntryckeri.

Iansiti, M., MacCormack, A. (1997) *Developing Products on Internet Time,* Harvard Business Review

Jassawalla, A.R., Sashittal H.C. (1998) *An Examination of Collaboration in High-Technology New Product Development Processes*, Journal of Product Innovation Management, Volume 15 Issue 3, Elsevier Science Inc

Kahn, K.B and Griffin, A., (2005) PDMA Handbook of New Product Development, Second edition, John Wiley &Sons, Inc, New Jersey

Kahn, K.B. (1996) *Interdepartmental Integration: A definition with implications for product development performance,* Journal of Product Innovation Management, Volume 13, Issue 2

Kahneman, D., Tversky, A., (2000) *Choices, Values and Frames*. Cambridge University Press, New York.

Kennedy, M.N. (2003) *Product Development of the Lean Enterprise*. The Oaklea Press

Kline, S.J., Rosenberg N. (1986) *An Overview of Innovation: The Positive Sum Strategy,* National Academy Press, Washington D.C

Kohli, A.K., Jaworski, B.J. (1990) *Market orientation: the construct, research propositions, and managerial implications,* Journal of Marketing, Volume 54

Kolb, D., Fry, R. (1975) *Towards a theory of applied experimental learni*ng, Johan Wiley & Sons, Ltd, Chichester.

Kooperman, P., Pool, J. (1991) *Organizational Decision Making models: Contingencies and Strategies*, Wiley , West Sussex.

Lönnqvist, H. (1992) *Faktorer i den lokala forskningsmiljön som påverkar forskares informationsanskaffning*, Kirjastotiede ja informatiikka, Volume 11, Issue 3

March, J.G. (1997) *Understanding how decisions happen in organizations*, *Organizational decision making. Cambridge series on judgement and decision making*, Cambridge University Press, New York

March, J.G., Simon, H.A. (1958) *Organizations*. John Wiley & Sons Inc. New York

Marks, A.P. (1989) *The Sinclair C5- An investigation into its Development: Launch and Subsequent failure*. European Journal of marketing, Volume 23, Issue 1

Melan, E.H. (1992) *Process Management: Methods for Improving Products and Services*, McGrawn Hill, New York

Miller, G.A. (1956) *The magical number seven, plus or minus two: Some limits on our capacity to process information*. Psych. Rev. 63

Patton, J. R. (2003) *Intuition in decisions*, Management Decision, Volume 41, Issue 10

Payne, J.W. (1982) *Contingent decision behavior*, Psychological Bulletin, Volume 92, Issue 2

Pugh, S (1990) *Total design- Integrated methods for Successful Product Engineering*, Addison-Wesley Publishing Company, Wokingham

Ravid, G., Rafaeli, S. Jones, Q. (2004) *Information Overload and the Message Dynamics of Online Interaction Spaces: A Theoretical Model and Empirical Exploration*, Information System Research, Volume 15, Issue 2

Reidenbach, R.E., Grimes, S. (1984) *How concept knowledge Affects Concept Evaluation*, Journal of Product Innovation, Volume 1, Issue 4

Reinertsen, D.G. (2009) *The Principles of Product Development Flow*, Celeritas Publishing

ReVelle, J.B. (1998) *The QFD Handbook,* John Wiley & Sons, Inc

Rheingold, H. **(1993)** *The Virtual Community: Homesteading on the Electronic frontier*, Addison.Wesley, Reading, MA.

Rogers, E., Agarwala-Rogers, R. (1975) *Organizational communication*, *Communication behaviour*, Addison Wesley, Reading, MA

Roozenburg, N.F.M, Eekels, J. (1995) *Product design: Fundamentals and Methods*, Johan Wiley and Sons Ltd, Chichester.

Räisänen C., Linde A. (2004) *Technologizing Discourse to Standardize Projects in Multi-Project Organizations: Hegemony by Consensus*, Organization, Volume 11, SAGE

Shook, J. (2008) *Managing to Learn - Using the A3 magement process to solve problems, gain agreement, mentor, and lead,* Lean Enterprise Institute Inc

Sobek, II, D.K., Ward, A.C., Liker, J.L. (1999) *Toyota´s Principles of Set-Based Concurrent engineering*, Sloan Management Review, Volume 40, Issue 2

Song, X.M., Thieme, R.J., Xie J.H., (1998) *The impact of cross-functional joint involvement across product development stages: an exploratory study*, Journal of Product Innovation Management, Volume 15

Souder, W.E. (1987) *Managing New Product Innovations*, Lexington Books, D. C. Heath and Company, Lexington

Stamatis, D.H. (2003) *Failure mode and effect analysis: FMEA from theory to execution.* American Society for Quality, Quality Press, Millwaukee

Sundström, P., Zika-Viktorsson, A. (2009) *Organizing for innovation in a product development project Combining innovative and result oriented ways of working – A case study,* International Journal of Project Management

Tauber, E.M. (1974) *How marketing discourages major new projects*, Business Horizons, Volume 22

Thamhain, H.J. (2005) *PDMA Handbook of New Product Development,* second edition, Product Development and Management Assosiation

Tidd, J, Bessant, J. (2009) *Managing Innovation- Integrating Technological,* Market and Organizational Change, John Wiley & Sons Ltd.

Tonnquist, B. (2008) *Project Management- A guide to the Theory and Practice of Project, Program and Portfolio Management, A Business Change*, Bonnier Utbildning AB, Stockholm

Ullman, D.G (1997) *The Mechanical Design Process*, 2nd ed. McGraw-Hill International Editions, Singapore

Ullman, D.G (2000) *12 step to robust decisions- building consensus in product development and business*. Trafford Publishing, Victoria.

Ulrich, K.T, Eppinger S.D. (2008) *Product Design and Development*, 4th ed. McGraw-Hill, New York.

Vinten, G. (1999) *Corporate communication in small- and mediumsized enterprises*, Industrial and Commercial Training, Volume 31, Issue 3

Vroom V.H., Jargo A.G. (1974) *Leadership and Decision Making.* Science Institute, George State University, Atlanta.

Weiss , M.P., Hari, A. (1997) *Problems of concept selection in real industrial environment, Proceeding of the 11th International Conference on Engineering Design*, ICED´97, Tampere, Finland.

Whittaker, S., Terveen, L., Hill, W., Cherny, L. (1998) *The dynamics of mass interaction*. Proc. ACM´s Conf. Comp. Supported Cooperative Work, Seattle, WA

Yates, F. (2001) *"Outsider": impressions of naturalistic decision making, Linking expertise and decision making*, Lawrence Erlbaum Associates Mahwah, N.J.

Zeelenberg, M., Nelissen, R.M.A., Breugelmans, S.M., Pieters, R. (2008) *On emotion specificity in decision making: Why feelings is for doing.* Judgement and Decision Making,, Volume 3, Issue 1

Web pages

ITT. (2011-02-20)*Om oss – ITT W&WW,* http://www.flygt.se/1213669.asp

Microsoft Office (2011-05-20) *Office,* http://office.microsoft.com/en-us/

Projectplace (2011-05-18) *Project Place***,** http://www.projectplace.com

Interviews

Akolor, Kalate, *Project Manager*, 4 feb 2011

Arbeus, Ulf, *VP & Director of Product Development*, 3 may 2011

Brask, Patrik, *Manager Product Management*, 8 mar 2011

Bredwad, Viktor, *Manager Assortment*, 1 mar 2011

Camusat, Patric and Stock, Cathrin, *ESH and Sustainable Manager*, 3 mar 2011

Danielsson, Stefan, *Pipeline Manager*, 7 feb 2011

Davies, Rachel, *Product Manager*, 25 feb 2011

Duijvelaar, Bart, *Manager Product & Application*, 28 feb 2011 and 9 may 2011

Ehrnsten, Kim, *Product Owner*, 4 mar 2011

Eldblom, Ingemar, *Project Manager*, 7 feb 2011

Engström, Tobias, *Manager Sourcing Product Development & Value Engineering*, 22 feb 2011

Flachmeyer, Carl-Johan, *Project Manager*, 15 feb 2011

Frössberg, Christian, *Project Manager*, 8 feb 2011

Gatu, Fredric, *Product Manager*, 25 feb 2011

Goike, Johan, *Project Manager*, 9 feb 2011

Holmér, Shekofeh, *Marketing Director*, 18 feb 2011 and 12 may 2011

Ivarsson, Per, *Product Manager*, 3 feb 2011

Jacobsson, Henrik, *Pipeline Manager*, 10 feb 2011

Jergelind, Veronica, *Communication Manager Transport*, 10 mar 2011

Jonsson, Tord, *Design Engineer*, 7 mar 2011

Jönsson, Kristina, *Project Manager*, 10 feb 2011

Larsson, Niklas, *Project Manager*, 31 jan 2011

Li, Lulu, *Project Buyer*, 22 feb 2011

Lindblad, Fredrik, *Techincal Manager*, 1 mar 2011

Ljung, Christian, *Factory Manager*, 24 feb 2011

Lundberg, Thord, *Product Management & Sales Support*, 3 mar 2011

Modigh, Lisa, *Project buyer*, 22 feb 2011

Neitemeier, Dieter, *Directing Manager Marketing Biological Treatment*, 4 mar 2011

Röstin, Mattias, *Pipeline Manager*, 4 feb 2011

Stock, Cathrin, *ESH and Sustainable Manager*, 25 mar 2011

Svensson, Urban, *Manager Manufacturing of New Products*, 24 mar 2011

Tjärsta, Stefan, *Project Manager*, 10 feb 2011

Ullström, Kia, *Technical Writer*, 3 mar 2011

Wiklund, Christian, *Manager Project Management,* 17 may 2011

11. Appendix

Appendix A: Interview questionnaire stage 1

Project manager:

Project name:

Project start and end date:

1. Project Managers background in ITT:
2. Describe an ongoing typical ITT project. What was the problem to be solved?
3. What were the goals of the project?
4. What is the current status of the project?
5. Who is the project members/how does the project organization look like? (Internal and external).
6. How does the communication in the project organization occur?
7. Are all project members kept updated about the project status? Do they need to be?
8. How is the Business Description done? Who is involved?
9. Who is consulted when writing the project risk analysis? How is the risk analysis used during the project?
10. Does the PS meeting serve their purpose? What do you think is the function of the PS meetings?
11. Is the communication during the PS meetings sufficient to make the right decisions?
12. How do you structure your presentation on the PS meetings? Opinions about others presentations?
13. Regarding the evaluation of a project. Have you learned from other project leaders and your own projects to improve future ones?
14. Do you think that ITT´s process for project management is clearly defined? Is the defined process used? Does it help you?
15. General thoughts on the PM process? Is there any obvious room for improvement?

Appendix B: Interview questionnaire stage 2

Interviewee:

1. What is your present position at ITT
2. How does the project process work when you are part in a project managed by the R&D department?
3. How does the start-up process work?
4. Which documents are received/shared with the R&D department?
5. Can you describe a general on-going project at ITT?
6. What is the current status of the project?
7. How is project information shared with the project members?
8. Do you feel that all project members are kept updated about the project status? Do they need to be?
9. How is the Business Description done?
10. Do you attend the PS meeting? What do you think is the function of the PS meetings?
11. Regarding the evaluation of a project. Are there any forum for experience exchange?
12. Are you informed about the priorities of the projects?
13. Do you think that ITTs process for project management is clearly defined? Is the defined process used? Does it help you?
14. General thoughts on the process? Is there any obvious room for improvement?

Appendix C: Interview questionnaire stage 3

Interviewee:

1. What is your present position at ITT?
2. How does the start-up of new projects work? What are the criteria's?
3. How do you get in contact with the product development projects?
4. What TG documents do you read? Are there some you always read/never read? What information from the TG documents is most important?
5. What information do you base your toll gate decisions on?
6. Does the Project Board meetings serve their purpose of being a decision forum? Do they serve any other purpose?
7. How important are the project presentations at PS? What should be the content of the presentation material on the PS?
8. Is there a balance of project information sharing among the three decision makers? Does everybody have the same amount of information when making a decision?
9. When designing a "Project Overview" that helps all project stakeholders, what information do you think it should consist of?
10. Has ITTs product development strategy changed compared to previous years (in terms of types of projects, number of projects)? If so, how? Will it change in the future?
11. Is there any obvious room for improvement in the product development process?

Appendix D: Timeplan

ID	Task Mode	Task Name	Duration	Start	Finish
1					
2		**Stage 0 - Project Startup**	**6 days**	**Mon 11-01-24**	**Mon 11-01-31**
3		Determin area of research	6 days	Mon 11-01-24	Mon 11-01-31
4		Recruit thesis students	6 days	Mon 11-01-24	Mon 11-01-31
5		**TG0 PS**	**0 days**	**Mon 11-01-31**	**Mon 11-01-31**
6					
7		**Stage 1 - Project and Problem Definition**	**43 days**	**Mon 11-01-31**	**Wed 11-03-30**
8		**Product Specification**	**43 days**	**Mon 11-01-31**	**Wed 11-03-30**
9		Interviews	35 days	Mon 11-01-31	Fri 11-03-18
10		Problem description	13 days	Mon 11-03-14	Wed 11-03-30
11		**Project Specification**	**6 days**	**Mon 11-02-14**	**Mon 11-02-21**
12		Timeplan	6 days	Mon 11-02-14	Mon 11-02-21
13		**Litterature Review**	**33 days**	**Mon 11-02-14**	**Wed 11-03-30**
14		LFA Research	33 days	Mon 11-02-14	Wed 11-03-30
15		A3/Lean PU Research	28 days	Mon 11-02-21	Wed 11-03-30
16		Concept/method implementation research	3 days	Mon 11-03-28	Wed 11-03-30
17		**TG1 PS**	**0 days**	**Wed 11-03-30**	**Wed 11-03-30**
18		Half time presentation	0 days	Wed 11-03-30	Wed 11-03-30
19					
20		**Vacation**	**7 days**	**Thu 11-03-31**	**Fri 11-04-08**
21					
22		**Stage 2 - Product/Solution Concept**	**10 days**	**Mon 11-04-11**	**Fri 11-04-22**
23		**Concept Generation**	**10 days**	**Mon 11-04-11**	**Fri 11-04-22**
24		Concept Design	5 days	Mon 11-04-11	Fri 11-04-15
25		Concept Brainstorm	0 days	Fri 11-04-15	Fri 11-04-15
26		Concept walkthrough	0 days	Wed 11-04-20	Wed 11-04-20
27		Prototype Design	5 days	Mon 11-04-18	Fri 11-04-22
28		**TG2 PS**	**0 days**	**Fri 11-04-22**	**Fri 11-04-22**
29					
30		**Stage 3 - Productification of solution**	**15 days**	**Mon 11-04-25**	**Fri 11-05-13**
31		Productification	10 days	Mon 11-04-25	Fri 11-05-06
32		Product finalisasion	10 days	Mon 11-04-25	Fri 11-05-06
33		Product walkthrough	0 days	Thu 11-04-28	Thu 11-04-28
34		Implementation Strategy	5 days	Mon 11-05-09	Fri 11-05-13
35		Replacement Strategy	5 days	Mon 11-05-09	Fri 11-05-13
36		**TG3 PS**	**0 days**	**Fri 11-05-13**	**Fri 11-05-13**
37					
38		**Stage 4 - Implementation Test of solution**	**5 days**	**Mon 11-05-16**	**Fri 11-05-20**
39		Implemenation Plan	5 days	Mon 11-05-16	Fri 11-05-20
40		Replacement Plan	5 days	Mon 11-05-16	Fri 11-05-20
41		Product Documenation	5 days	Mon 11-05-16	Fri 11-05-20
42		**TG4 PS**	**0 days**	**Fri 11-05-20**	**Fri 11-05-20**
43					
44		**Stage 5 - Project ending**	**10 days**	**Mon 11-05-23**	**Fri 11-06-03**
45		Project presentation	10 days	Mon 11-05-23	Fri 11-06-03
46		Presentation Design	3 days	Mon 11-05-23	Wed 11-05-25
47		Presentation Rehersal	2 days	Thu 11-05-26	Fri 11-05-27
48		Presentation KTH	1 day	Mon 11-05-30	Mon 11-05-30
49		Presentation ITT	1 day	Wed 11-06-01	Wed 11-06-01
50		Implementation of opponent feedback	4 days	Tue 11-05-31	Fri 11-06-03
51		**TG5 PS**	**0 days**	**Fri 11-06-03**	**Fri 11-06-03**
52		Delivery to product owner	0 days	Fri 11-06-03	Fri 11-06-03
53					
54		**Report Writing**	**83 days**	**Mon 11-02-14**	**Wed 11-06-08**
55		Background	19 days	Fri 11-03-04	Wed 11-03-30
56		Problem description	13 days	Mon 11-03-14	Wed 11-03-30
57		ITT descrition	6 days	Fri 11-03-04	Fri 11-03-11
58		Theory	11 days	Fri 11-03-04	Fri 11-03-18
59		General about project communication	6 days	Fri 11-03-04	Fri 11-03-11
60		LFA	5 days	Mon 11-03-14	Fri 11-03-18
61		Lean PU	5 days	Mon 11-03-14	Fri 11-03-18
62		Analysis	15 days	Mon 11-04-11	Fri 11-04-29
63		Conclusion	5 days	Mon 11-04-25	Fri 11-04-29
64		Recommendation	5 days	Mon 11-05-02	Fri 11-05-06
65		Content Layout	4 days	Mon 11-05-09	Thu 11-05-12
66		Grafic Layout	4 days	Mon 11-05-09	Thu 11-05-12
67		Spelling check	4 days	Fri 11-05-13	Wed 11-05-18
68		References	4 days	Fri 11-05-13	Wed 11-05-18
69		Abstract	3 days	Thu 11-05-19	Mon 11-05-23
70		Critical evaluation of the report	4 days	Tue 11-05-24	Fri 11-05-27
71		Opponent feedback	2 days	Tue 11-05-31	Wed 11-06-01

Appendix E: Risk Analysis FMEA

Event	Failure mode	Effects	Cause(s)	Occurre-nce rating	Severity rating	Detection rating	Risk Priority Number	Recommended actions
Problem Description	No clear purpose of thesis.	Bad report. Failure to solve problem from the ITT case.	Bad interviews. Lack of support from supervisor and examinator.	5	10	3	150	Have discussion with supervisors. Ensure that we are asking the right questions.
Solution Concept	Unable to find a solution for the ITT case's problem.	Strictly theoretical thesis. ITT gains less from our work.	Unable to find a sufficient problem description. No realistic or relevant solution.	4	8	4	128	Continuous dialogue with supervisors.
Literature Review	Irrelevant or insufficient theoretical background in report.	Bad report.	Unable to find a sufficient problem description.	6	7	2	84	Make a qualitative problem description. Have discussion with supervisor.
Interviews	Failure to do a qualitative analysis	Report lacks in quality	Not enough interviews. We ask the wrong questions.	3	7	3	63	Check with supervisor if number of interviews is sufficient. Book interviews in time. Insure that the quality of the questions is sufficient. Insure that respondents trust us.
Disagreement of opinion with ITT	Work doesn't go in line with expectations from ITT.	ITT isn't satisfied. Less support from ITT.	No common goal with ITT. No communication with ITT.	3	7	3	63	Have a continuous dialogue with ITT. Openness. Have good arguments for "why" we do something.
Presentation	Unclear presentation. Hard to understand our point.	Failure to raise interest about the thesis. Bad grades for authors.	Insufficient background and presentation material	2	10	3	60	Communicate ITT's current process to audience. Be concrete. Test presentation before final presentation.
Report Writing	Nothing to write about.	Insufficient report. Bad grades for authors.	Unable to find a sufficient problem description. Bad communication between authors.	3	10	2	60	Communicate with each other. Get external feedback. Make clear delimitations.
Solution implementatio n	Solution is not used	No improvement of communication at ITT.	Unwillingness to change. Irrelevant problem.	5	5	2	50	Good "sales pitch" of solutions. Strong arguments. Make solution easy to implement.
Time Plan	Not enough time at the end of the project. Toll Gate dates are not met.	Delayed report with lowered quality	Difficulties to estimate time needed. Unable to find a sufficient problem description.	4	5	2	40	Check time plan often. Update time plan at ever toll gate.
Disagreement of opinion between authors	Progress halts.	Behind schedule.	Lack of communication between authors. No common goal. Unequal work load.	2	8	2	32	Have a clear common goal. Have continuous communication. Openness.
Loss of document	No documents	Double work. Behind schedule.	No backup of documents. No structure of storing documents.	1	10	1	10	Continuous backup. Clear document structure.
Lack of resources	Loss of work days.	Behind schedule.	Illness. Failure to return from holiday.	1	7	1	7	Be careful.

Managing to Learn — **Detailed A3 Template**

Title: What change or improvement are you talking about?

Owner/Date

1. Background: What are you talking about and why?

What is the purpose, the business reason for choosing this issue?

What specific perfomance measure needs to be improved?

What is the strategic, operational, historical, or organizational context of the situation?

2. Current Conditions: Where do things stand now?

What is the problem or need—the gap in performance?

What is happening now versus what you want or needs to be happening?

Have you been to the gemba?

What facts or data indicate there is a problem?

What specific conditions indicate that you have a problem or need?

Where and how much? Can you break the problem into smaller pieces?

→ Show facts and processes visually using charts, graphs, maps, etc.

3. Goal: What specific outcome is required?

What specific improvement(s) in performance do you need to achieve?

→ Show visually how much, by when, and with what impact.

→ Don't state a countermeasure as a goal!

4. Analysis: Why does the problem or need exist?

What do the specifics of the issues in work processes (location, patterns, trends, factors) indicate about why the performance gap or need exists?

What conditions or occurances are preventing you from achieving the goals?

Why do they exist? What is (are) their cause(s)?

→ Use the simplest problem-analysis tool that will suffice to show cause-and-effect down to root cause. From 5 Whys to 7 QC tools (fishbones, analysis trees, Pareto charts) to more sophisticated SPC, 6 Sigma, and other tools as needed.

→ Test the cause-and-effect logic by asking "why?" downward and stating "therefore" upward.

5. Recommendations: What do you propose and why?

What are the options for addressing the gaps and improving performance in the current situation?

→ Always start with two or three alternatives to evaluate.

How do they compare in effectiveness, feasibility, and potential disruption?

What are their relative costs and benefits?

Which do you recommend and why?

→ Show how your proposed actions will address the specific causes of the gaps or constraints you identified in your analysis. The link should be clear and explicit!

6. Plan: How will you implement? (4Ws, 1H)

What will be the main actions and outcomes in the implementation process and in what sequence?

What support and resources will be required?

Who will be responsible for what, when, and how much?

How will you measure effectiveness?

When will progress be reviewed and by whom?

→ Use a Gantt chart (or similar diagram) to display actions, steps, outcomes, timelines, and roles.

7. Followup: How will you ensure ongoing PDCA?

How and when will you know if plans have been followed and the actions have had the impact planned and needed?

How will you know if you meet your targets?

How will you know if you reduced the gap in performance?

What related issues or unintended consequences do you anticipate?

What contingencies can you anticipate?

What processes will you use to enable, assure, and sustain success?

How will you share your learnings with other areas?