School of Business and Economics

"The use of Target Costing and Value Engineering at ALSTOM Company"

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Abstract

Title:	The use of Target Costing and Value Engineering at ALSTOM Company
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Authors:	Sandra Lange, Jacques du Boÿs, Karsten Seibert
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Key terms:	Value engineering; Target costing; Benchmarking; Product development process; Stage-Gate System
Purpose:	The purpose of this thesis is to identify the use of value engineering and target costing at ALSTOM and to compare it to the current theory.
Method:	The thesis is built on the case study approach. The empirical data is gathered in semi-structured interviews of ALSTOM employees. To analyse the data, the qualitative method is chosen.
Conclusion:	The conclusion of this thesis is that ALSTOM is using a lot of target costing and value engineering tools. The use of these tools differ from department to department, even they have a standardize Stage-Gate process for the product development.

Abbreviations

CEO	Chief Executive Officer
DFMA	Design for Manufacturing and Assembly
DTC	Design to Cost
EPIC	Electrostatic Precipitator Integrated Controllers
LSC	Local Service Customer
OEM	Original Equipment Manufacture
PDQ	Product Development Quality
QFD	Quality Function Deployment
R&D	Research and Development
RFQ	Request for Quotation
ROI	Return on Investment
SIR	Switched Integrated Rectifier
TC	Target Costing
TQM	Total Quality Management
VA	Value Analysis
VE	Value Engineering
VM	Value Management
VOC	Voice of Customer

Table of contents

1 Introduction 6
1.1 Thesis Introduction 6
1.2 Background 6
1.3 Problem discussion 7
1.4 Purpose 8
1.5 Research question 8
1.6 Limitation 8
1.7 Structure of the thesis 9

2 Methodology 10
2.1 Research Methods 10
2.2 Data gathering 11
2.3 Analysing the data 12
2.4 Reliability and Validity 12

3 Literature review 13
3.1 Target costing 13
3.1.1 Value engineering, value analysis and value management 16
3.1.2 Quality function deployment 18
3.1.3 Design to cost and design to manufacturing and assembling 20
3.1.4 Cost tables 23
3.1.5 Feature to function costing 23
3.1.6 Component cost analysis 24
3.1.7 Process (operational) costing 24
3.1.8 Multiyear product and profit planning 24
3.1.9 Benchmarking 25
3.2 Stage-Gate system 30
3.3 Summary of prior studies 33

4 Empirical findings 34
4.1 ALSTOM Company 34
4.2 Interview Per Ranstad 35
4.2.1 The ALSTOM Facility in Växjö 35
4.2.2 The Local Service Customer system of ALSTOM 35
4.2.3 The supply chain of ALSTOM 36
4.2.4 Target costing core tools 36
4.2.5 Target costing key idea 38
4.2.6 Stage-Gate process at ALSTOM 38
4.3 Interview Christer Mauritzson 40
4.3.1 Customer requirements 40
4.3.2 Benchmarking 40
4.3.3 LSC (Local Service Customer) 40
4.3.4 Payback time 41
4.3.5 Market share 41
4.4 Interview Niclas Lindqvist 42
4.4.1 Target costing key ideas 42
4.4.2 Target costing core tools 43
4.4.3 The PDQ system (Gate system) 44
4.5 Conclusion empirical findings 45

5 Analysis 46
5.1 Empirical analyses 46
5.1.1 Analysis Per Ranstad 46
5.1.2 Analysis Christer Mauritzson 46
5.1.3 Analysis Niclas Lindqvist 47
5.2 Theoretical analyses 47
5.2.1 Target costing key ideas 47
5.2.2 Target costing core tools 49
5.2.3 Stage-Gate System 50
5.3 Abstract Theory 51
6 Conclusion 53
6.1 Theoretical contribution of the study 53
6.2 Reflection on the study 54
6.3 Recommendations for the company and for further studies 54
6.4 Special thanks for the contribution 54
References 55

Table of figures

Figure 1: Target Costing Core Tools and Product Development *15*
Figure 2: Five steps job plan of value engineering (own figure) *18*
Figure 3: Four-phase QFD model (Source: Hauser, Clausing, 1988) *20*
Figure 4: The house of quality is the basic matrix structure used to define the voice of the customer. (Xie, Tan, & Goh, 2003) *20*
Figure 5: Design to cost (Annacchino, 2003) *21*
Figure 6: Fujitsu DFMA System (Miyazawa, 1993) *23*
Figure 7: Benchmarking terminology (Source: (McGeorge & Palmer, 2002)) *26*
Figure 8: Benchmarking process and phases (Source: (Camp, 1995)) *27*
Figure 9:Benchmarking process models (Source: (Camp, 1995)) *27*
Figure 10: Benchmarking process steps (Source: (Camp, 1989)) *29*
Figure 11: Nine-step benchmarking approach *29*
(Source: (McGeorge & Palmer, 2002) *29*
Figure 12: An Overview of the Stage-Gate System (Source: (Cooper R. G., 2001)) *32*
Figure 13: Integrating the target costing tool in the Stage-Gate System (modified version of (Ansari & Bell, 1997)) *33*
Figure 14: Integrating of target costing tools and key ideas in the Stage-Gate product development process and the after sales at ALSTOM (source: own) *53*

Table of Appendixes

Appendix 1: Interview questions Per Ranstad 57
Appendix 2: Interview Per Ranstad 59
Appendix 3: Interview questions Christer Mauritzson 65
Appendix 4: Interview Christer Mauritzson 66
Appendix 5: Interview questions Niclas Lindqvist 72
Appendix 6: Interview Niclas Lindqvist 73
Appendix 7: Characteristics of the interviews 77

1 Introduction

The first chapter gives a short background of the thesis topic and why it is interesting to study, for the business world nowadays, even though the fact, that some of these methods of value engineering and target costing are more than 65 years old. The main part of the chapter is the problem discussion, which gives an introduction to the theory of value engineering and target costing and it ends with the main research questions of the thesis. The Limitation and the Aim makes clear, where the focus of the thesis lie and describes which topics are not included.

1.1 Thesis Introduction

The aim of the thesis is to describe the use of value engineering and target costing methods, which are involved in the Stage-Gate product development System at ALSTOM. Including the describing which methods and tools are used and relating them to the current theory of the value engineering and target costing. Further the thesis gives a comparison between different parts of several departments in the aspects using value engineering and target costing methods in ALSTOM during the R&D work.

1.2 Background

Value engineering is a process to improve the functions and, the values of a product or a service during its conception and realisation. This process is more and more used by companies to become more efficient and competitive. To understand how important the value engineering methods are, it is good to know that the Federal Agencies of the USA have a law that each executive agency has to use value engineering in their processes and procedures (The Office of Federal Procurement, 2001):

> "In General—Each executive agency shall establish and maintain cost-effective value engineering procedures and processes." and article (b) the definition of value engineering: "Definition.--As used in this section, the term 'value engineering' means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or

supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle cost."

This shows how important value engineering seems to be in the economics nowadays.

Target costing was invented in Japan in the 60's as they improved value engineering "Japanese industry took a simple American idea called value engineering and transformed it into a dynamic cost reduction and profit planning system" (Ansari & Bell, 1997). Nowadays value engineering seems to be more a tool of target costing.

1.3 Problem discussion

To compare the theory with the practical use of the applied methods, it is necessary to define the word value engineering and target costing. The next definitions explain the meaning of value engineering, which is used in this thesis:

The core purpose of the value engineering methods is focused on the value of a product or a service. To get this value, it is common to perform a value analysis, which is: "An examination of every feature of a product to ensure that its cost is no greater than is necessary to carry out its *functions*. Value analysis can be applied to a new product idea at the design stage and also to existing products" (Law, 2009). To calculate the value, every function of a product or a part of a product has to be divided by its costs. The function of a product can be defined as "an intent or purpose that a product or service is expected to perform" (Kaufman, 2008) or "A function is an action or feature of a product or service" (Scarbrough, Alpenberg, & Burch, 2009). "In the value engineering, the "value" can be interpreted as the ratio of the function of the evaluation a thing and the cost of the realisation of this *function*. It is the scale to measure the degree of useful things and the comprehensive reflection of the product, function and cost" (Zhong & Zhang, 2009).

"The term 'value engineering' means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or supply

of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle cost." (The Office of Federal Procurement, 2001).

There are several methods to use value engineering; companies are using them as they want, to improve their products or services and to reduce their costs. Their processes are adapted to the branch of the company and their competitors and their investment in time and money in this process. All of the different techniques have the same goal, to improve their economic situation, but the methods are used in different ways and each company probably has their own vocabulary of those techniques.

The interview with the employees of the R&D Department will answer the core research question: How does ALSTOM use the value engineering and target costing methods and how is it related to the current theory of value engineering. To get the answer of this core research question, employees of ALSTOM answered the questions in Appendix 1,3,5.

1.4 Purpose

The purpose of this thesis is to identify the use of value engineering and target costing at ALSTOM and to compare them to the current theory.

1.5 Research question

The use of Target Costing and Value Engineering at ALSTOM Company?

1.6 Limitation

The limitation of the work will be restricted by the information that ALSTOM power will give. The results are dependant of their participation to cooperate. Studying the use of value engineering and target costing at a company needs to have a good contact to the company in order to get information, which cannot be found outside. The interview will be decisive in the term of understanding their use of value engineering in their process.

The thesis does not describe all the value engineering and target costing methods, which are used at ALSTOM, but how they used it in specific departments. The amount of the gathered data is not enough to generalise the results outside of ALSTOM Power but will answer the main research questions.

1.7 Structure of the thesis

The structure of the thesis is based on a description of the background problem in the first chapter, together with the question of why to study this phenomenon and the research question. The second chapter is going to describe the methods that are used. The third part includes the theory of the research question and prior studies. The fourth part presents the results from the interviews of the employees of the R&D and Sales department. The fifth chapter analyses the interviews and then it compares them to each other and to the theory. Part six concludes the main findings and presents the results.

2 Methodology

The second section is the methodology part. First a short introduction and explanation about the applied research method, which is used in this thesis, will be given. This will be followed by the description of how the data is gathered and analysed. In the last part of this chapter the reliability and validity of the collected data will be outlined.

2.1 Research Methods

The topic of this thesis has a focus on the R&D department, because it is the most common department for using the value engineering methods. The aim of this thesis is to compare different departments of those within ALSTOM. Related to this topic the thesis will be based on the qualitative research methodology.

Qualitative studies discussed qualitative data and features of human actions, which cannot be measured easily. Qualitative studies are used to describe relationships, opinions and emotions. Further it is based on the inductive approach, with the goal to create a theory (Bryman & Bell, 2007).

There are a lot of arguments the qualitative method, instead of a quantitative method for this thesis. The application of the qualitative method in this thesis is rather to test the theory than to generate new theories. But as it is mentioned in Bryman and Bell, qualitative methods can also be employed for testing theory.

The case study research design is the optimal choice for this thesis. The research about a part of the single organisation and about a special topic with the case study design will make it possible to get very deep into the subject matter. A cross-sectional study research about this topic would be interesting, but it would be more an overview of how the use of value engineering in practice is applied.

The case study design allows to investigate the question and to have a look at what the single actor thinks about it. The research about the use of value

engineering is based on information from the employees of ALSTOM. It will mostly be from the experience of the R&D Department engineers in Växjö.

To interpret the results of the interview, the interpretative paradigm position has the most advantages of the four paradigms: functionalist, interpretative, radical humanist and radical structuralism. The interpretative paradigm position enables us to understand why the engineers work with these particular tools and not with other tools. It also allows investigation about the meanings and opinions about the particular value engineering system that is used. To make some suggestion for improvements to the use of value engineering within ALSTOM would be an additional part, but this it is not related to the main research question.

2.2 Data gathering

The comparison of the different value engineering and target costing systems of several ALSTOM departments is based on literature studies and semi-structured interviews. The main research strategy is the accomplishment of an interview with employees within several R&D Department of ALSTOM. The interview is about their point of view on the used tools of target costing and value engineering, and how they work with it. This is important to get a better understanding about the topic in practice and to get a better understanding why different strategies either are used or not.

To improve the collected knowledge from the interviews and to know the current status of the target costing and value engineering theory, a further internet and literature research about value engineering is done. In the end of the thesis a comparison and evaluation of the empirical data and the theory is done.

The interview structure that is applied is the semi-structured interview, which is based on the reading and gathering of information and theory in the beginning. It is also in some ways related to the quantitative method, in order to get more information about how people work with value engineering and how they develop and improve it. A part of the interview will be the interaction within the interviewee and the interviewer, to get additional knowledge about particular specialities of the different departments. With the quantitative method it is not

possible to ask about qualitative data, just questions about comparable issues that are outlined in the interview. Otherwise it would take too long to get the high number of persons, which is needed to have, to get a generalize result of the interview for a quantitative research. With the qualitative method, it will be able to derive out a limited but correct and detailed picture to answer our research questions.

2.3 Analysing the data

While analysing the empirical data which is collected, it is necessary to be as objective as possible, because during the interview and at the analysing part of the gained data stage, it is essential to avoid a personal influence. The subjectivity of a qualitative research, which is similar to this research design, is the most common point of criticism. The chosen questions and the personal contacts to the interviewee and the interviews are the fundamentals of this kind of research.

2.4 Reliability and Validity

Reliability and validity is a very important point in qualitative research, in order to establish and assess the quality of the research. The view that the criterion of relevance is considered is also important. A point of criticism is that qualitative research is difficult to replicate and generalise. Unlike quantitative research studies, qualitative studies do not have statistically representative data. “How can just one or two cases be representative for all cases?” (Bryman & Bell, 2007) Qualitative research cases are not representative, but they can give a deeper understanding of the reality and this should help to improve the performance of the company or department, which is studied. To valid the gathered data, the interviewed employees of ALSTOM will sign the interviews to prove the correctness.

3 Literature review

This chapter consist of an overview of prior target costing studies. It defines target costing and value engineering methods and relates value engineering to other concepts as value management for example. For a better understanding of the ALSTOM product development process, this chapter includes a description of the Stage-Gate system.

3.1 Target costing

Target costing has its origin in Japan in the 1960s, the Japanese industry adapted the American idea of value engineering and expanded it into a dynamic cost reduction system (Ansari & Bell, 1997). It is a customer- and market- orientated cost management method, which is conceptually different from standard costs, wherein the costs are driven from the production and internal factors. “Target costing is a comprehensive cost planning, cost management and cost control concept… used primarily at the early stages of product design in order to influence product cost structures depending on the market derived requirements. The target costing process requires the cost-oriented co-ordination of all product related organizational functions.” (Horvath, 1993) An explanation of the target costing goal comes from Robin Cooper (1992) “ The object of target costing is to identify the production cost of a product so that, when sold, it generates the desired profit margins”.

Target costing contains six key ideas, which are mentioned in Ansari S. , Bell, Klammer, & Lawrence (1997):

1. *Price led costing*

   The price for a product is based on the competitive market price, which is the independent variable. The costs are sets by the subtracting the required profit margin from the competitive market price.

   $$C = P - \pi$$

   C = Target cost

   P = Competitive market price

   π = Target profit

2. *Customer driven*

The target costing is a market driven pricing method in order to that the market performance is important. The customer requirement about the quality, price and timeliness are guiding the cost analyses. It is essential to understand what the customers expect and what the competitors actually doing or might do to meet the customers' needs.

3. *Design*

The design of a product and the production process is the core of the cost reduction. The design stage spends more time to design a product, their manufacturing and the delivery process simultaneously. The cost reduction process takes place while the design stage, to minimizes costly features and the need to re-engineer changes during the production process.

4. *Cross-functional product teams*

Cross-functional teams have members of e.g. the design, manufacturing engineering, sales, cost accounting and marketing departments, are responsible form the entire product from the initial concept to the end. This should help to understand how the product works.

5. *Life cycle costing*

Target costing considers all costs of a product over its whole life cycle e.g. purchase price, operating costs, maintenance and repairs. The goal is to minimize the cost of the ownership for the customer and the production costs.

6. *Value chain*

All members of the supply chain are involved in the target costing process, such as supplier, dealers, service and support personal. It is based on an active and collaborative relationship, where all members of the chain share cost reduction techniques.

The target costing and product development processes are divided in two main phases. The first phase is the establishment phase, which contains the product planning stage, where the niche of the product will be defined. As well as the product concept development stage and feasibility testing stage. The attainment phase is the second phase of the target costing process. It involves the design development stage, where the detailed product design will be build out of the feasible concept; it ends with the production stage. (Ansari & Bell, 1997)

According to Ansari and Bell (1997) there are nine target costing core tools, which are applied during the product development process: Value engineering and value analysis, quality function development (QFD), design for manufacturing and assembly (DFMA) and design to cost (DTC), cost tables, feature to function costing, component cost analysis, process (operations) costing, multiyear product and profit planning, benchmarking. (see figure 1)

	Product Strategy	Concept and Feasibility	Design and Development	Production and Logistics
---------- Product Development Cycle (when tools are used) --------- >				
Planning	Multiyear Product and Profit Plan			Multiyear Product and Profit Plan
Marketing	Benchmarking QFD			
Costing	Cost Tables	Feature to Function Costing QFD	Component Cost Process Costing	
Engineering		Value Engineering DTC QFD	Value Engineering DFMA, DTC QFD	Value Analysis
Procurement		Supplier Based Value Engineering	Supplier Based Value Engineering	

Figure 1: Target Costing Core Tools and Product Development

(Source: Ansari & Bell, 1997)

3.1.1 Value engineering, value analysis and value management

Regarding to the scientific articles and books, it is hard to differ clearly between value engineering, value analysis and value management. While some scientists make indeed differences: ”Value management is a method. Value Engineering and Value Analysis describe the application of this method” (Kaufman, 2008), other Authors doesn't see any differences: “Value engineering (often used interchangeably with Value Analysis and Value Management) has been defined by the Society of American Value Engineers, the professional value engineering Society, as “a powerful problem-solving tool that can reduce costs while maintaining or improving performance and quality requirements” (Smith, Lewis, Churchwell, & Benjamin, 2002). In some books about value engineering, value analysis and value management, the authors differ regarding to the product or customer orientation and have very different definitions of value engineering: ”Value engineering: Deals with problems or opportunities involving the physical sciences as the principle discipline in its resolution (product oriented)” (Kaufman, 2008) and value analysis: ”Value analysis: Deals with problems or opportunities involving management, administrative systems analysis and processes as the principle disciplines in its resolution (people oriented)” (Kaufman, 2008). Other scientists define value engineering and value analysis almost equal, and in these definitions is value analysis product orientated as well as value engineering. For example “value analysis: An examination of every feature of a product to ensure that its cost is no greater than is necessary to carry out its functions. Value analysis can be applied to a new product idea at the design stage and also to existing products” (Law, 2009) and “value engineering: Designing a product to eliminate any costs that do not contribute to the value of the product, i.e. the performance (or some other attribute) that leads the customer to purchase the product in preference to other similar products” (Law, 2009). This shows, that there is no common definition of value engineering, value analysis and value management, which is accepted by all scientist. Regarding this, the term value engineering is used in this thesis, without distinguishing between value analysis and value management.

The value engineering methods can be divided in three groups: zeroth look, first look, and second look value engineering (Cooper R. , 1995). These aspects are used in different stages of the product development:

Zeroth value engineering techniques are used at the product development stage. Its objective is to develop revolutionary solution as an integrated function of the product design stage, in order to improve the functionality of the company's products.

First look value engineering techniques are used at the late product development stage and at the whole planning stage. Its objective is to design and develop new products with an increased value by increasing the functionality for the customer without an increase in costs.

Second look value engineering happened at the last part of the planning stage and at first part of the development and product preparation stage. Its objective is to create more value and functionality to already existing products.

The job plan is one of the core methods of value engineering. It is use in the value engineering workshops and it includes five steps: "There are five distinct phases to the value engineering job plan: information, speculation, evaluation, development and presentation" (Green, 1990). In some cases, the steps have to be done several times to get satisfied results, but the developer have to do all of them to avoid problems with the "wrong" idea or to skip "best" solution to early in the process "This (the job plan) is a building-block process in which it is often necessary to repeat a step or two, but the value practitioner must never skip any steps" (Kaufman, 2008).

According to Kaufman (2008) the five steps of value engineering or value management (see figure 2) are:

Step 1: Information: Evaluation of all available information relation to the VM project and translation of that information into function terms.

Step 2: Speculation: Process of developing a large quantity of ideas (not solutions) that address unique and creative ways to achieve those functions that relate to the problem definition.

Step 3: Planning (or Analysis) Evaluation of the ideas previously generated, using weighted guidelines, performance, and other requirements, to sift and sort for the "best" ideas.

Step 4: Execution (or Evaluation) Clustering of selected ideas into proposal scenarios and the evaluation of those scenarios that include financial, risk and implementation plan recommendations.

Step 5: Reporting (or Presentation) Preparation and presentation of recommended VM Team proposals to a management board (or stakeholders), seeking approval and funding to implement those actions to resolve the problem or opportunity objectives.

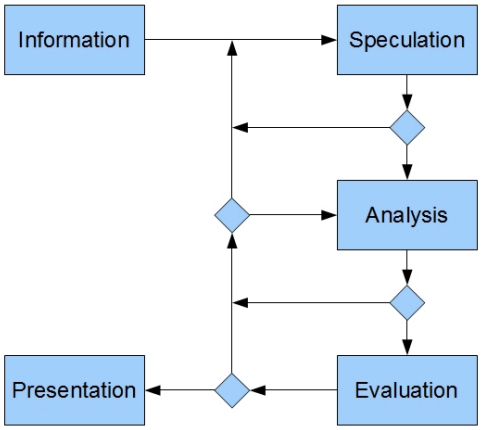

Figure 2: Five steps job plan of value engineering (own figure)

3.1.2 Quality function deployment

The QFD (quality function deployment) is a tool to translate customer requirements into technical features of a product or service "a method for developing a design quality aimed at satisfying the customer and translating the consumers demand into design targets and major quality assurance points to be used throughout the production phase" (Akao, 1990).

An other clear definition give Sullivan (Sullivan, 1986) who define QFD as “a method that helps a manufacturing company to bring new products to the market sooner than competition with lower cost and improved quality”. The definition of Sullivan only includes the manufacturing industry, but the QDF tool can be used in the service industry as well “even when a company is dealing with such intangibles as services, quality function deployment makes it possible to clarify, plan, and design the services to be offered and to conduct quality control activities” (Akao, 1990)

The first introduction of the QDF method was 1966 in Japan by Dr. Yoji Akao. Since then there have been much publications about this topic in Japan, for example by Nishimura and Takayanagi, who introduce the quality charts the first time in 1972. Until Furukawa, Kogure and Akao introduced QFD in the USA with a four day seminar and article in English in 1983, this method was only used by Japanese companies which had became very successful in these years.

The QFD method is know by several names, the most common are the voice of customer (VOC) and the house of quality. According to the four-phase model of Hauser and Clausing (1988), the house of quality is just the first of the four steps of QFD (see figure 3: Four-phase QFD model (source: (Hauser & Clausing, 1988)). The house of quality is the matrix to get the customer requirements in the QFD methodology (see figure 4: The house of customer (Xie, Tan, & Goh, 2003)) and to translate them into the product or service characteristics or functions. The four-phase model is clearly described by Sullivan (1986):

1) Overall customer requirement planning matrix- translates the general customer requirements into specified final product control characteristics.
2) Final product characteristic development matrix- translates the output of the planning matrix into the critical component characteristics.
3) Process plan and quality control charts- identify critical product and process parameters and develop checkpoints and controls for these parameters.
4) Operating instructions-identify operations to be performed by plant personnel to ensure that important parameters are achieved

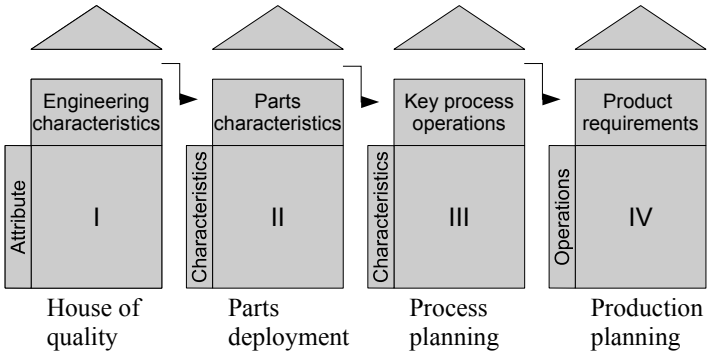

Figure 3: Four-phase QFD model (Source: Hauser, Clausing, 1988)

Another alternative model to illustrate the QFD process is published by Akao (1990), but the four-phase model is more used in the western literature "the four-phase model seems to be more common in the English-language literature" (Xie, Tan, & Goh, 2003).

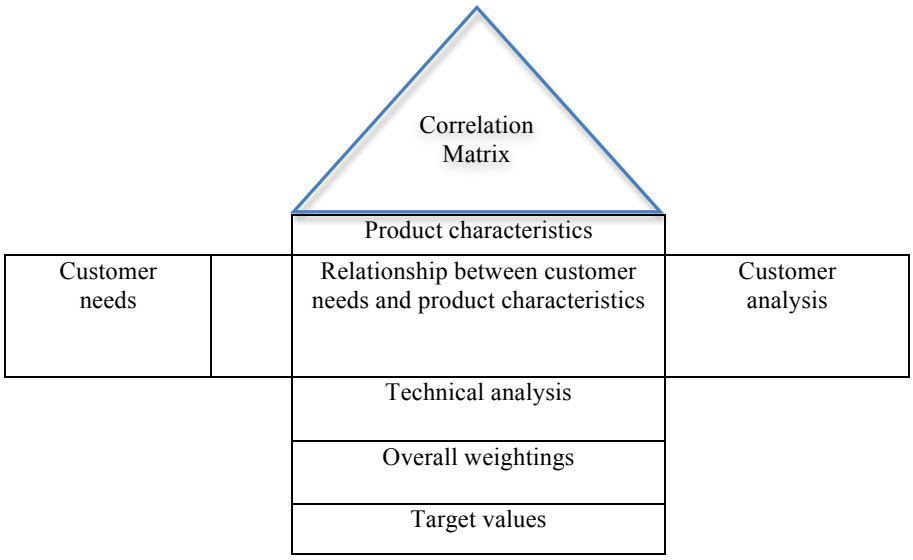

Figure 4: The house of quality is the basic matrix structure used to define the voice of the customer. (Xie, Tan, & Goh, 2003)

3.1.3 Design to cost and design to manufacturing and assembling

Design to cost (DTC) is a product development philosophy, which differs from the traditional product development process in the way of the direction "the design to cost philosophy is based on the principle that the customer has established a perceived value for goods and services, and the manufacturer must develop, manufacture, and market that product at a price not to exceed that

perceived value" (Annacchino, 2003). In the traditional cost plus process, the market price is just the last step of the process. In the design to cost philosophy, the possible market price according to the function and features of the product is estimated in the first step. This estimated market price limits the manufacturing, assembling and distribution costs by a defined target profit margin. The product is then designed to these limits of material, labour and burden (see figure 5: Design to cost).

The design to cost is not customer focused like value engineering "Unlike value engineering, which maximize the customer value, a DTC approach attempts to minimize the cost by using it as a constraint" (Ansari & Bell, 1997), but increasing the production cost is in the most cases necessary to achieve the target costs of a part or function.

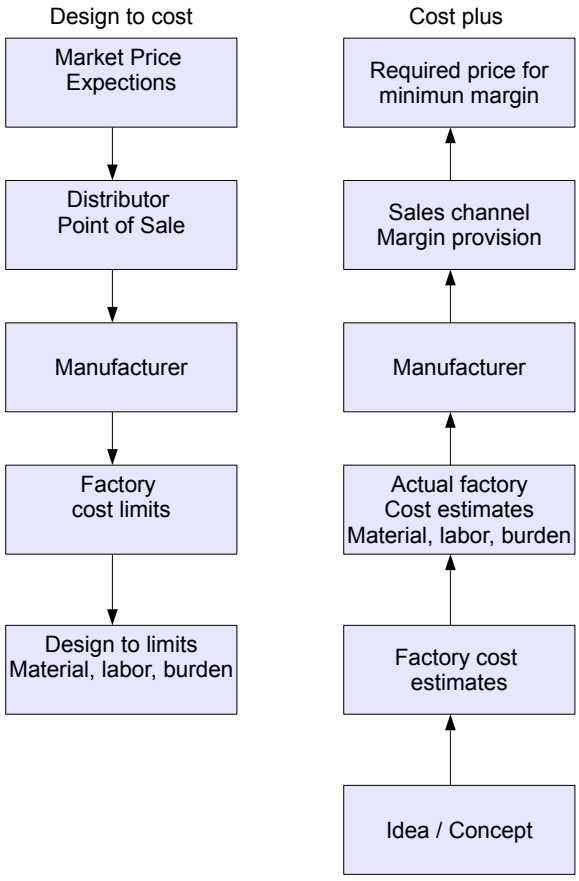

Figure 5: Design to cost (Annacchino, 2003)

Design for manufacturing and assembling (DFMA) is a target costing tool to reduce the production costs by improving the manufacturing and assembling process “Design for manufacturing and assembling (DFMA) refers to engineering processes design to optimize the relationship between materials, parts, and reduce time to market by making it easier to manufacture or assemble parts or to eliminate them” (Ansari & Bell, 1997). The design for manufacturing and assembling tool is able to reduce the production costs early during the design stage “the goal of DFM is to make a product easy to manufacture during the design phase of the development process “ (Ulrich, Sartourius, Pearson, & Jakiela, 1993).

An example for a design for manufacturing and assembling system is the four step sequence according to Fujitsu systems (Miyazawa, 1993):

1) Designers select parts and specify their assembling sequence
2) Pre-existing guidelines are used to evaluate ease of (time for) assembly
3) Parts are reduced or their ease of assembly is improved
4) Design are reviewed against prior design experiences stored in a design data base

The user has to choose, if the step 2 or the step 3 is the best for the current project, they are concurrent and not sequential (see figure 6:Fujitus's DFMA System).

The design to manufacturing and assembling is used to reduce the productions costs, but it can have other positive aspects on the organization itself “DFM forces the development team to think about the production process; it brings representatives from different disciplines into the same room, and it forces a consideration of several alternative detail design strategies” (Ulrich, Sartourius, Pearson, & Jakiela, 1993).

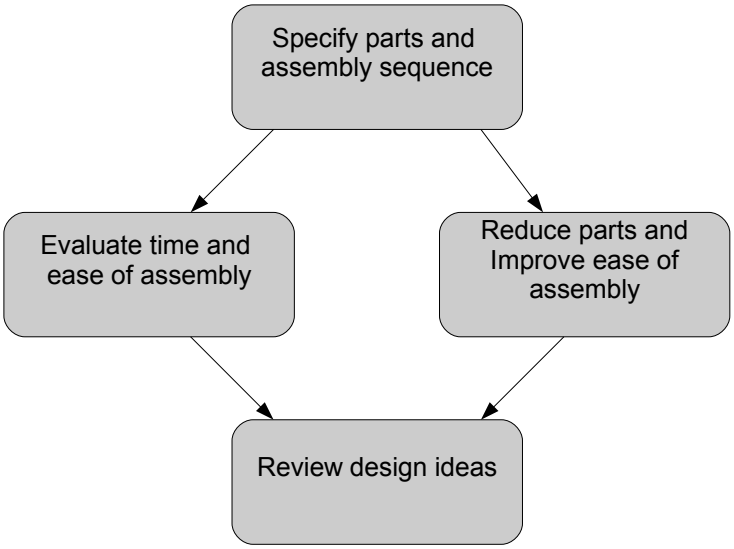

Figure 6: Fujitsu DFMA System (Miyazawa, 1993)

3.1.4 Cost tables

The Cost table is a cost database, which contains specific information about the cost elements, for example row material, processing cost, purchased parts and cost models (Ansari & Bell, 1997). “Cost tables are used as a measurement to decide cost and to be able to evaluate the cost of not only existing products but also future products at the very beginning of the design process” (Sato, 1965).

3.1.5 Feature to function costing

The feature to function costing is a method to cost the different functions and features of a product. A function is ”an intend or a purpose that a product or a service is expected to perform” (Kaufman, 2008) and to fulfil the feature desire of a customer.

The purpose of feature to function costing is to provide cost information about the functions of a product and to show which feature desire of the customer is performed by which functions. When one feature is performed by more than one function, then the cost of each function should sum across of all involved functions, in order to get the cost of one feature (Ansari & Bell, 1997).

3.1.6 Component cost analysis

A component cost analysis is an important tool for the assembly industry, where a lot of subassemblies and components are purchased, instead of a self-production. The purpose of the component cost analysis is divided into three parts (Ansari & Bell, 1997):

- Identification of expensive components in a product
- Illustrate the cost relationship between several components, to identify the leverage of changing costs between different components
- Ensures that no run-off or out of date components are used

3.1.7 Process (operational) costing

The process costing is a method to analyse the cost for each manufacturing or production step. " A cost notion that is closely related to productivity is operational cost. Operational cost can be directly related to the outputs of a business process. A substantial part of operational cost (typically 60%) is labour cost, the cost related to human resources in producing a good or delivering a service." (Dumas, van der Aalst, & Hofstede, 2005)

The purpose of process costing is to identify the cost-drivers within each manufacturing step, in order to obtain information about the high-cost operations. This helps to reject or shift those processes (Ansari & Bell, 1997).

3.1.8 Multiyear product and profit planning

Multiyear product and profit planning is a strategic target costing tool which includes the most important attributes of the product portfolio of a company to improve the long-term decisions "Multiyear product and profit planning integrate many important business planning dimensions. This tool is used to integrate information on revenues, spending, and investments for a firm's portfolio over a three to seven year period" (Ansari & Bell, 1997). The range of this plan depends on the product development and life cycle time of the main markets of the firm "The exact time frame varies by the nature of the given planning cycle in a given industry" (Ansari & Bell, 1997). It is used to get an overview of the companies'

product portfolio over several years and to plan the strategies of new and current products “A multiyear profit plan integrates long-range forecasts of product markets, technology, and investment plans into a product strategy” (Ansari & Bell, 1997).

3.1.9 Benchmarking

Benchmarking is comparison of the own current or planned performance, a product, process or service, with it's competitive. The aim of benchmarking is not to copy competitive products or services, it is to analyse the market to improve the performance “benchmarking: The process of identifying the best practice in relation to products and processes, both within an industry and outside it, with the object of using this as a guide and reference point for improving the practice of one's own organization” (Law, 2009). A more practical definition of benchmarking gives Robert Camp (1989): “Benchmarking is the search for industry best practice that lead to superior performance”.

The competitive performance can come from another department of the same organization, a competitive product or service in the same market or even a different company in a different market. In the last case, the company is just seen as an instrument to make a profit from capital, the return on investment (ROI) for example can be an instrument for the financial benchmarking. In other words, benchmarking is used inside and outside the own organization or even outside the market of the organizations performance and it can be seen as a target costing (TC) or total quality management (TQM) tool or as an individual method to increase the organizations profitability “Benchmarking can take place within an organization, when it may form part of a total quality management (TQM) exercise; in relation to direct competitors, although such organizations may be unwilling to divulge the details of their practices; or in relation to organizations in totally different fields, in which case the main value of the practice is that it forces people to look outside their established patterns of behaviour” (Law, 2009). Robert Camp (1995) define four types of benchmarking:

Internal- This is a comparison among similar operations within one's one organization

Competitive- This is a comparison to the best of the direct competitors

Functional- This is a comparison of the methods for companies with similar processes in the same function outside one's industry

Generic process- This is a comparison of work processes to others who have innovative, exemplar work processes

There are several more terminologies in the field of benchmarking scientist (see figure 7: Benchmarking terminology), but Camp's definitions seems to be very useful, because it describes the four most common types of benchmarking.

Author	Within the organisation	Product-to-product comparison	Different companies in the same industry	Different industries
Camp	Internal	Competitive	Functional	Generic
Spendolini	Internal		Competitive	Functional (Generic)
Karlof & Ostblom	Internal		External	Functional
Blendell et al	Internal		Competitor and functional	Generic
Copling	Internal		External or best practice	External or best price
Watson	Internal	Reverse engineering	Competitive	Process
Peters	Internal	Benchmarking	Benchmarking	Benchmarking
This text	Internal	Not applicable	Competitive	Generic

Figure 7: Benchmarking terminology (Source: (McGeorge & Palmer, 2002))

The benchmarking process can be separate in two different parts, which has to be done: the user benchmarking process itself and the management process which support the benchmarking process "The overall benchmarking task can be broken down into two major processes. There is the user process and the management process" (Camp, 1989). The management process has to start earlier and ends

later than the user process (see figure 8: Benchmarking processes and phases) to prove a sufficient support for the users benchmarking process.

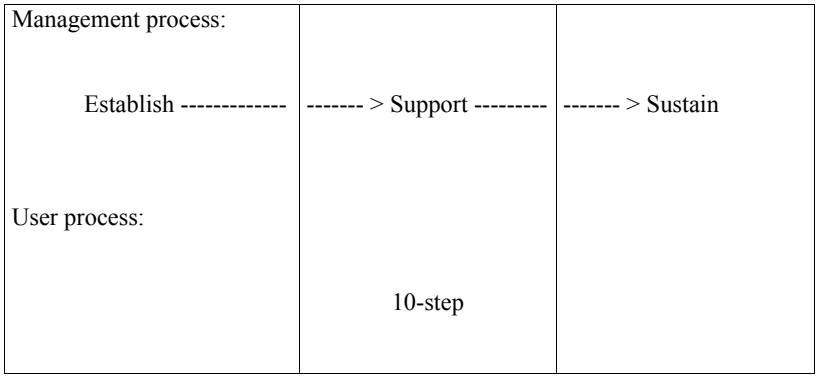

Figure 8: Benchmarking process and phases (Source: (Camp, 1995))

There are several benchmarking processes (see figure 9: benchmarking process models), and it is very common to build a benchmarking process in a company or to order a benchmarking study from an outside supplier or consultant company.

	4-step	6-step	7-step	8-step	10-step
Planning the study	Prepare to benchmark	Plan	Determine functions or process to benchmark Identify key performance variables Identify best-in-class companies	Define business issue Define what to benchmark Define benchmark measures Determine who to benchmark	Identify process Identify partner
Collecting process data	Research process	Research Observe	Measure performance	Acquire data	Collect data
Analyzing data for results	Document best practice	Analyze	Compare performance and estimate gaps	Compare performance Identify actions to close the gap	Determine gap Project future performance
Adapting for improvement	Report and implement	Adapt Improve	Specify improvement programs and actions Implement and monitor results	Implement improvements and monitor results	Gain support Set goal Develop plans Implement plans Recalibrate benchmarks
Number of companies	6	7	8	4	8
Percentage of companies	14%	17%	19%	10%	19%

Figure 9:Benchmarking process models (Source: (Camp, 1995))

An example for a 10-step benchmarking process gives Camp (1989) (see figure 10: benchmarking process steps) and Mc George and Palmer (2002) for a 9-step process (see figure 11: Nine-step benchmarking approach). Even there are different terminologies in the scientific field of benchmarking and in the companies, benchmarking should be performed as a continuous process "Benchmarking is a self-improvement and management process that must be continuous to be effective, it cannot be performed once and disregarded thereafter on the belief that the task is done" (Camp, 1989). That benchmarking is useful for organizations is common knowledge of the benchmarking authors and Jonathan Law (2009) describe three main areas in which benchmarking has its benefits:

• **Customer satisfaction**. An organization wishing to improve some aspect of its performance (e.g., its website) might ask customers how do the product compares with the product of the competitors. By identifying and making improvements the company can expect to improve sales in the long run.

• **Cost reduction**. The benchmarking exercise may identify an area in which the organization has higher costs than competitors. Potential savings may be identified, such as reducing the number of suppliers or making better use of technology. Benchmarking can be applied to all departments.

• **Increased efficiency and effectiveness**. Benchmarking can help to streamline processes and identify ways of delivering a better service. Before introducing benchmarking an organization will have to identify the costs of the exercise and the potential benefits and cost savings. The most significant cost will be the management time.

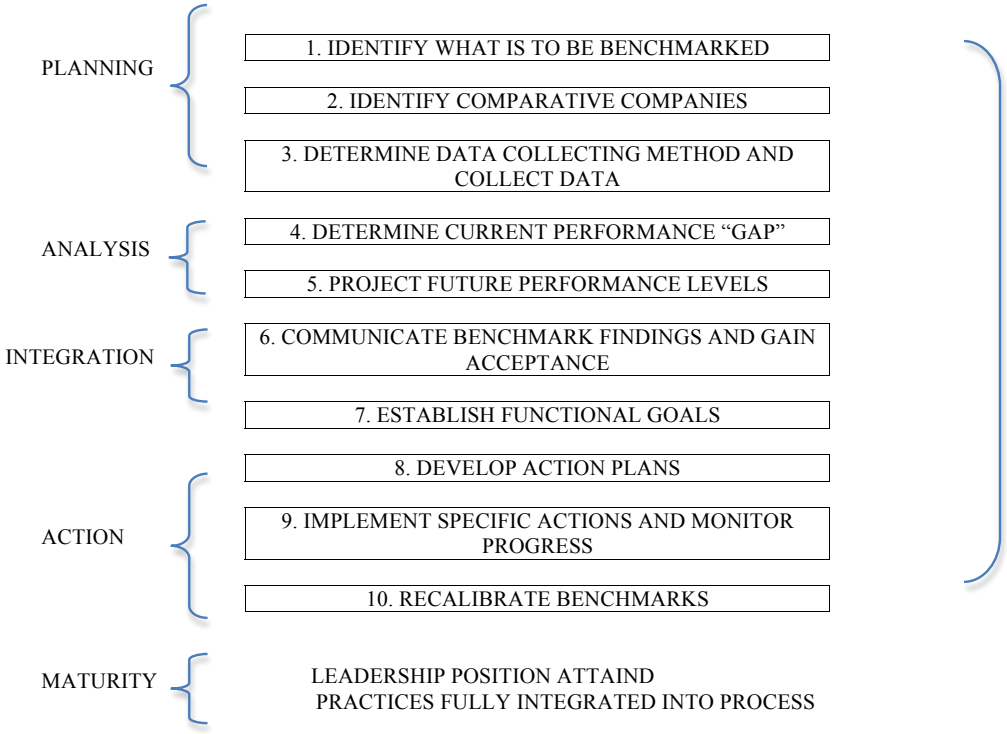

Figure 10: Benchmarking process steps (Source: (Camp, 1989))

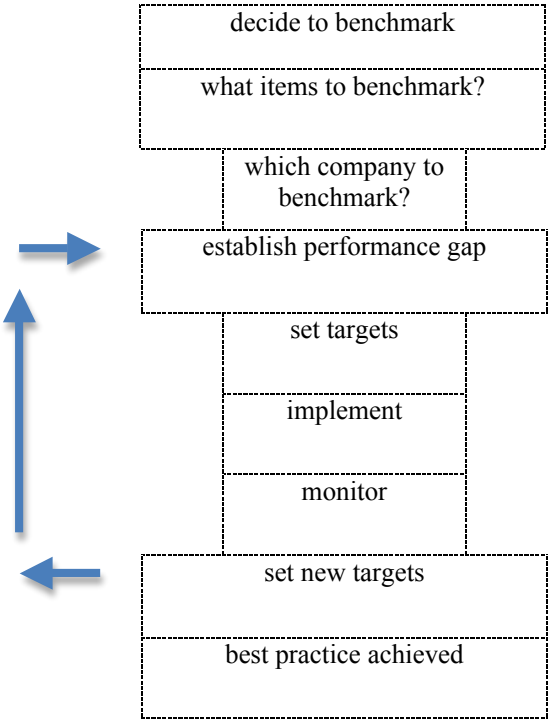

Figure 11: Nine-step benchmarking approach
(Source: (McGeorge & Palmer, 2002)

3.2 Stage-Gate system

Stage Gate System is a process utilized to reduce the cycle time to improve new product from the beginning of the process with the idea, to the end namely the launch on the market. “A stage gate system is a conceptual and operational road map for moving a new- product project from idea to launch” (Product Development Institute Inc., 2010).

Companies need to have a good process to launch their new products, because innovation is the key of growth and benefit. They need to reinvent every time new product, and also often upgrade it. Actually a company without innovation is a dead company. “The desire to develop and launch new product is obvious (…) Most companies are counting heavily on new product development for growth and profitability.” (Cooper R. G., 2001)

This production process is based on several stages, which all of them start with a gate to control the quality of the last stage. So every time the product must valid the qualities control of this gate before to pass for the next stage and continue the process. If not the project will be killed. And we said it is a waterfall system, because there is only one direction where the product can go. It cannot turn back to the last stage if something goes wrong. When a gate is valid you pass directly to the next stage until the end of the process. “The stage are where the work is done; the gates ensure that the quality is sufficient.” (Cooper R. G., 2001)

It is important that there is this kind of quality control, because every next stage is more and more important, contain more information, and also more expensive. This quality control is required to manage the risk of the product. More we advance in the production process, and more uncertain information about the product decrease. “Each stage is usually more expensive than the preceding one. Concurrently, information becomes better and better, so risk is managed.” (Cooper R. G., 2001)

As an example, when we launch a new product there is a risk that the product does not correspond to the demand. This risk as been calculated, “An estimated 46% of the resources that the companies devote to the conception, development, and launch of new products go to projects that do not succeed.” (Product Development Institute Inc., 2010).

And the benefices to use this Stage Gate System are multiple, less time to launch the product on the market, increase the product success on the market, reduce waste of re-work, and ensure a complete process with discipline. To conclude it will be more effective, efficient and faster process to improve your product innovation results. (Cooper R. G., 2001).

In this way, according to certain surveys (Product Development Institute Inc., 2010) the management risk have been improved, almost 85% of the companies which used this process have successfully their launch product on the market. “Between 70-85% of leading U.S. companies now use Stage-Gate to drive new products to market” (Product Development Institute Inc., 2010).

The number of the stages depends of the nature of the product, but in general for a typical Stage Gate System there are 5 different stages (see figure 12):
After finding the idea, the first gate before the first stage is to give the authorisation to put resources on the project. It is some criteria about the project feasibility, market attractiveness, and strategic alignment.

- Stage 1 is preliminary assessment, the inexpensive one. Its objective is to determine market size, market potential, and market acceptance. Second gate is approximately the same as the first one, the project is revaluated with the new information from stage 1.

- Stage 2 is called definition, have to verify the attractiveness of the project with a market research studies, a detailed technical appraisal, and a detailed financial analysis. Then come the next gate, which is called decision on Business Case, the final gate where it is still time to kill the project, before heavy spending. Focus essentially on the results of the financial analysis and the definition of the project.

- Stage 3 is development, consist to develop the product by a detailed test, marketing, and operation plans. Gate 4: Post-Development Review is a check on the progress and the attractiveness of the product and the project.

- Stage 4 is about validation, it test the entire viability of the project. The last gate before the commercialisation is called Pre-commercialisation decision, where we still can cancel the project, they focus on the results about the validation stage, mainly about the financial projections.

- Stage 5 is the commercialisation, where we start the marketing launch and the operations plan, and also the production.

(Cooper R. G., 2001)

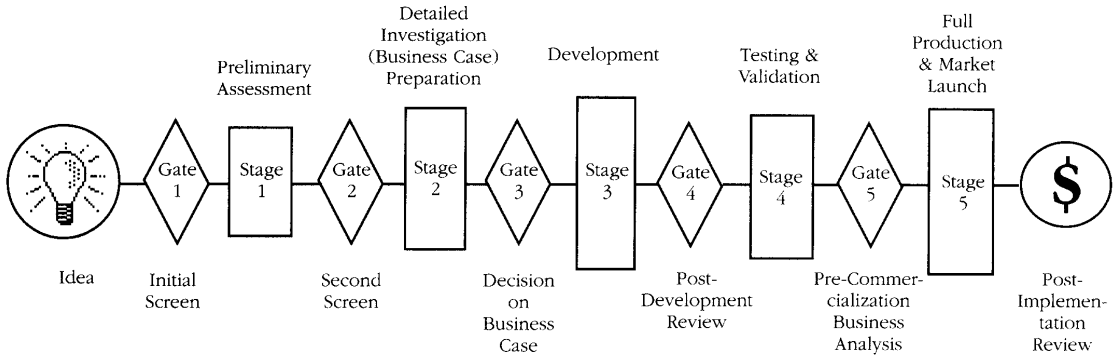

Figure 12: An Overview of the Stage-Gate System (Source: (Cooper R. G., 2001))

3.3 Summary of prior studies

Target costing is a customer and market driven cost management method, which consist of six key ideas and is based on nine core concepts. Those key ideas and core tools can be integrated into the Stage-Gate product development System. During each stage of the process different target costing methods can be applied (see figure 13: Integrating the target costing tool in the Stage-Gate System).

The integration of the core target costing tools and key ideas in a stage-gate product development system				
Development Stages:	Product Strategy	Concept and Feasibility	Design and Development	Production and Logistics
	--- Product Development Cycle (when tools are used) --- >			
Planning	Multiyear Product and Profit Plan			Multiyear Product and Profit Plan
Marketing	Benchmarking QFD			
Costing	Cost Tables	Feature to Function Costing QFD	Component Cost Process Costing	
Engineering		Value Engineering DTC QFD	Value Engineering DFMA, DTC QFD	Value Analysis
Procurement		Supplier Based Value Engineering	Supplier Based Value Engineering	
Target costing key ideas:	Price led costing, cost functional teams, customer driven, design, life cycle costing, value chain			

Figure 13: Integrating the target costing tool in the Stage-Gate System (modified version of (Ansari & Bell, 1997))

4 Empirical findings

In this chapter the empirical part is outlined. In the beginning a description of ALSTOM will be given. This will be followed by the summarised interviews of the ALSTOM employees Per Ranstad, Christer Maurtizson and Niclas Lindqvist (see Appendix 2,4,6 for the whole interviews).

4.1 ALSTOM Company

ALSTOM is a huge French company, which is present all around the world in 70 countries with 76,500 employees working for it. Actually the CEO is Patrick Kron since 2001. The history of ALSTOM trace the origin in 1928 when Thomson-Houston and SACM (Société Alsacienne de Constructions Mécaniques) merger together.

Actually ALSTOM gets two big different departments, one is ALSTOM Transport, which manage the entire transport systems. As to know from the roll stock, to the signalling and infrastructure. For example they manufacture high-speed trains like the TGV (Train à Grande Vitesse) and now the new AGV (Automotrice à Grande Vitesse). They also produce subways, trains, tramways, and locomotives. Moreover ALSTOM Transport propose service to customers like covers maintenance, renovation, logistics chain management or technical advice.

On the other hand this thesis will focus on ALSTOM Power. In many areas they are number 1 in the world, just to cite the most important, they are number 1 in air quality control systems, in hydro turbines and generators, in power plants solutions.

In Sweden, precisely in Växjö they manufacture electronic products for upgrading for the flue gas line. The most common products are electrostatic precipitators like EPIC and high frequency power supplies for electrostatic precipitators like SIR (Switched Integrated Rectifier). In Växjö, they have different sectors, so one for manufacturing, but also R&D, engineering, sales and tendering, product support, logistics, and product maintenance.

4.2 Interview Per Ranstad

Per Ranstad has been managing in the R&D department for two decades now. He is working with the electronic control system for filters, and at the moment he is writing his PhD at the KTH in Stockholm.

4.2.1 The ALSTOM Facility in Växjö

There are two main processes in the facility in Växjö: Engineering and Sales. It can be differ in two activities: one is sales on new environmental products, new plants and products for a new power plants and another is an after market industry service, mainly on environmental control products for the local market. The main products are for environmental control and flux gas cleaning. The end customers for these products are power plant companies and the process industry. In Växjö ALSTOM has their own product range, which are control systems or filters.

4.2.2 The Local Service Customer system of ALSTOM

ALSTOM company have Local Service Customer (LSC) system around the world, which make the business with the local customers. The central product organisations supply their products to these LSC. That is the basic set up in the after sales, after market organisation. The most products of ALSTOM are sold through the LSC office all around the world. ALSTOM has decided to have two organisations: one organisation only for the market, and another one only for the production. The organisation for the customer service LSC have the contact with all the product owners, because they carry out the product folio to the customer. This matrix structure is complicated, but it makes it possible to have only one local service team for the local customer which sells the whole range of the ALSTOM product portfolio. The customer does not want to see, that is the sales person coming from ALSTOM or from some other company with the single product. If they want to talk about another product of the company folio, there comes another person from somewhere else. They want one face. The only way to solve that is to have this type of organisation, but it makes lot of disturbances internally.

4.2.3 The supply chain of ALSTOM

ALSTOM has a lot of external suppliers, sometimes they have influence on the R&D of its suppliers, and sometimes they do not have. It depends on which type of suppliers it is. If it is a huge supplier on semi conductor for example, ALSTOM has no influence at all. If it is small company which produce mechanical parts for ALTOM, they can have quiet a heavy influence. From some extended suppliers ALSTOM are buying parts, in which they have taken very deep part in the development of those parts and these parts are unique for ALTOM. According to this, ALTOM has the entire of all possible supplier relationships. Sometimes ALSTOM have good contact to their supplier and they work together, but sometimes not. There is a conflict of interest between different functions in the company. In the R&D side, they want to partner their sub-supplier. They want to get the best part that they want. The development want to have a long time partnership with the sub-suppliers, but the supplier department, which buys the parts of the product, purchasing department tend to prefer just the specification and the price, so at any time they can go to any supplier to make them competent price. There is a conflict of interest.

4.2.4 Target costing core tools

The term value engineering and function analysis is not used in this part of ALSTOM, but depends type or product, if cost is critical and the product is sensitive to cost, they calculate the costs of the functions. In that case, they put a target cost on the product at the specification stage. That target cost becomes then a part of the specification. The product has to meet the defined specifications, which are evaluated. This process is quiet strict on the specifications. It doesn't leave too much room on invention. That should be done in the very early stage. There are several gate reviews in which set up questions have to be answered. In all this gate reviews, there are a couple of questions coming back, or being identical. One is the specification still valid, or is there a need to update. There are two possible cases: the product has functionality or they have to subtract function. When the estimated cost is too high for a function, a conflict in the specifications is taken place, in Per Ranstads point of view. The products have specified functions and costs and that do not match. If they cannot implement the

functions still meeting the target costs, then they have to make a decision either to skip some of the functions or to accept increased costs. Normally they do not relate each function to its costs. Depends on the definition of the development cost, if it is defined as a cost or as an investment. The definition of costs is very important, if the cost is needed to develop the function or if the cost is needed to manufacture the function. That is completely different. Specifically in the field of software development, where the manufacturing cost is almost 0, all costs are investments. The cost of the development differ from product to product, ALSTOM Power in Växjö is developing hardware, for example metal parts, and software. They have the whole range of different products.

Everywhere they can, they share the R&D work with other parts of ALSTOM, but it is difficult. For examples for the electronics they work quiet a lot with the Power Electronics part of ALSTOM together. In Växjö they make power converts for precipitators. They work together with ALSTOM Transport in this field, because they use a lot of power electronics in their trains.

Cost reduction is too general, in Per Ranstads view. The company always have the choice if they are supposed to be in price, which depends to the functionality they offer. In his point of view, that is an aspect of the idea of value engineering: get with the same input a higher value or to reduced costs. On their filters they have electronics, they can say to their customer: we offer more functions for a little bit more cost.

In some cases, they can reduce the cost of the core product. It is very much related to the size of it. If the core product, the filter, can operate it a little bit smarter, than it gives the same functionality with less material, and that will give a cost benefit. It is done by a smarter control system. Most of the customers of ALSTOM are focused on functions of the product, but also evaluated functionality versus cost.

After an investment in precipitators, there is quiet a lot of lifetime cost. That is good thing for ALSTOM, because it means that after market is a big business. During the lifetime of a plant, a power plant for example, there is much more

accumulated cost in service compare to the initial investment. That applies a row business. The customers very often focus on first cost. It changes it, but still interest on the first cost. In the process of the precipitators, for example, the flue gas is quiet aggressive, so there is a lot of corrosion. Their customers have to rebuild them. There are a lot of operational costs during the life time,and these costs are quiet high. These filter systems have to be rebuild, fixed, and also need upgraded parts. The control system is a typical example for a product which needs updated parts.

4.2.5 Target costing key idea

The Stage Gate System of ALSTOM involved the different parts of the company with engineering, manufacturing, marketing, sourcing.

Cost reduction is quiet important to ALSTOM of course, specifically the major products, the filters. They are very cost sensitive, but they are also low in volume. They do not make thousands of them. They are always customised, build at size. Quart parts are delivery to a standard size, so they are standardize, but the final erection is customer specific. That is quiet cost sensitive. In the other hand, if they have parts of product, which come with the main product, which are not so sensitive to the cost. That some parts as long as it is not dominating the total package. That is the situation, which the control products, the control electronics for precipitators has been in. After some successful inventions in the control of the precipitators, the power supply for precipitators, ALSTOM has a well leading position since some years.

4.2.6 Stage-Gate process at ALSTOM

The product and program development process at ALSTOM is a specified process, that has a number of stages and gates, it is a Stage-Gate system. This process is divided in several gates, first gate is to start an R&D project for a new product. That is the initial gate, the start gate. Next one is to define the specifications, the functions of the product, after that concept of the new product is ready. Third one is design, where the detail design is done and then come the two last one building prototype and building pilot. Design means all the

documentation, which describe the design and sourcing all the other aspects. That process by definition is not to validate by prototyping. After signing the review gate, they can start to build using the draws.

To reduce the cost of their products, ALSTOM has this R&D process, and ones the product is out of that, there is way to continue to develop the product through its lifetime and to decide to replace it by something else. That process is called the Change Order Process (COP), they have a process to change a product.

The R&D process was established ten years ago, it is a relative stable process. Some changes are going on to improve that process, but no huge fundamental changes have been on this process since then. ALSTOM is divided in a couple of segments, and this process is specific for this segment ALSTOM Power, but the other segments of ALSTOM have similar processes. It was established after experiences of very high cost on equipment, which failed in field. At this time, ALTOM had to high costs and they started to manage the risks of their products.

One of the limitations of the R&D process is a very strict waterfall process. There is one step after another, it is not iterative. It is quiet hard to run software development with this process. On the other hand, hardware projects, not talking about electronics but huge steel constructions, in Per Ranstads point of view the waterfall model is quiet good, it is impossible for that kinds of projects. The developer has to decide what to do and have to be strict to that decisions. This process is expected to cover all these aspects, but still it is not a good process for software engineering. Another aspect on R&D process in a huge company like ALSTOM, all of these companies more or less do the same. They want to unify the processes. They want to use the same process, in the R&D for example or in the sales should be done in the same way. That means in a company like ALSTOM with very wide spectrum of activities and products, the R&D process is applied to both: really small projects and very big projects over several years. That very often implies that small project gets too much over. There is too much paperwork by the process, and it might be, Per Ranstad has not been in these real big projects, for the opposite for the big one.

Process does not request enough coordination. It is a difficult for a huge company like ALSTOM to have a unify process, which covers those very small projects and very big ones.

4.3 Interview Christer Mauritzson

Christer Mauritzson is the Sales Manager at ALSTOM Power in Växjö. He has been on the new sales market during 25 years and now he is responsible for the after sales market for the air pollution control products.

4.3.1 Customer requirements

The particular customer needs are is known by ALSTOM, the customer sent a list with all the data and requirements he need for the new product, how many dust he wants to release to ALSTOM Power. For ALSTOM is this requirement the RFQ (Request For Quotation) and they answer the customer by sending out a quotation. These products are Taylor-made and adapted to each customer and their own requirements.

4.3.2 Benchmarking

ALSTOM do benchmarking with their suppliers, they sending out a survey, which is very complete with a lot of different questions. It takes a look on how ALSTOM work with their supplier, their competitors and a lot of different aspects. This survey is not often applied because it is very expensive, the last supplier benchmarking was 3 years ago.

4.3.3 LSC (Local Service Customer)

The LSC is the office for the customer, which are situated in many countries. THE LSC are selling all the product of ALSTOM for example turbines, trains and precipitator. The problem of the LSC system is that they are not specialized and need an additional specialist for technical argument. ALSTOM Power supports the LSC with technical knowledge free of charge in order to increase the sells performance. The LSC are the face to the customer and ALSTOM Power give them a technical support in air pollution control systems.

4.3.4 Payback time

The Payback time is how long it will for the customer to get back his invested capital from the investment. Usually the payback is about 3 or 4 years maximum. To hide the price of the products ALSTOM Power usually uses a package of products, then it is more difficult to compare the price of a product with the competitor.

4.3.5 Market share

The air pollution control is a huge market but ALSTOM have only 2 or 3% of this market, they have the capacity to increase their sales, it is a growth market. The market share in Sweden is approximately 60% at the air pollution control market. The reason is that ALSTOM only have one LSC in each country, but in Sweden they have 8 LSC. The high amount of LSC in Sweden is because of the old structure of the FLAKT company.

Example for the use of Target cost

"If we take the price, about SIR because it is easy to talk about this one. We have the target price, which should not more expensive than the conventional transformer. Because there were already conventional transformer on the market, so we know the price of that. The conventional transformer are first much more bigger, heavier instead of 200kg it is 1,600kg. Everything is very small in our product because it works with high frequency technique. It is nothing new, but has never been apply for this big power level, 120kw or 160kw. You have high frequency technique in your mobile phone. At that time when we started to develop it, we were not really sure that it was so good. We got this fantastic improvement dust emission in the chimney. The first thing was just make a new kind of transformer. The target price was perhaps a little bit more expensive but not that much. For the fourth generation we started to sell it in 2005, but the first development started in 2000. The goal in the project was to be maybe even cheap. But now with the fact in hand it turns out to be twice more expensive, so that was a big miss calculation. We suffer of that on the market. We cannot reuse much things of the last, so you have to start all over. It is not manufacture friendly, it is

too tricky to manufacture. The problem is that we did not have enough people involve in the project on the manufacture inside. Say that you cannot do that, we cannot manufacture that will be too expensive. That a mistake we did. So it is more difficult to sell this one. But if you want to extend the electrical filter with one more field, will cost maybe 10 million SEK, and if you buy a transformer like that it will cost you 700,000 SEK. So it is still a very big bonus to do this way instead of the old traditional way. But in some country we have competition and that is NWL Company in U.S that we were benchmarking with before. Because they also have the same size, but I will say 30% cheaper, so on this market we have a problem on this other no problem. And U.S is one of our bigger market for us, but now it is a dead market because of the financial crisis. Power station do not invent a dollar. That is why our sales last year were that bad, we make only 60% of the budget. Same thing with the new sales. The sales we have done is on other market like China, India, Brazil. The new market, not the traditional western market. Because they are not suffering that much with this crisis."

4.4 Interview Niclas Lindqvist

Niclas Lindqvist is working in the R&D department in ALSTOM power. He is managing the laboratory in Växjö and he is also managing one of the groups, that is laboratory working with the physics discipline.

4.4.1 Target costing key ideas

In the PDQ (Product Development Quality) processes they are working in cross-functional teams and try to take everyone's viewing into the decision. During all the process and for each gate there are people involved from marketing, sourcing, quality, R&D, legal department and so on. Based on that it is not only a technological development, it is also a business development and it takes care of all PR issues during the development phase.

In the physics discipline they are not doing any manufacturing their self. All manufacturing is done by outside contractor, but ALSTOM is taking the design to manufacturing into consideration and how the manufacturer is doing that. Constructability on the other hand is more important, that is how to put the

products together outside where they building the power plant. The main intense is to develop a design that is easy to put together in order to save costs.

4.4.2 Target costing core tools

Doing R&D initiatives in the physics R&D department contains terms of cost reduction, it is almost always a comparison to benchmark, with their existing solutions.

Benchmarking is an important tool, which is wildly and as often as possible used. But there is a big difference, from time to time the price level of the competitors are known, but not the cost levels. And this is the important factor to know, because they are working a lot with the cost than the sales price is something different.

The benchmarking process is based on a need, when there is a need and when there is activity, they use it when they can. ALSTOM is working around the world and looking at environmental control systems, they are very much related to the regulations in different countries. When the regulation gets strict in one part of the world there will be a lot of projects in that part.

In most of R&D projects ALSTOM have a lot of methods for example VE along the line and they are evaluating a lot of different concepts. In that case they use a matrix and models for evaluating different concepts. It is not seldom that they go ahead with more than one concept and take it into the next step as well.

Is a part of the Stage-Gate process to define the function of a product, there is a gate called specification. Where they go though a specification of what is needed, that is after the initiation gate. There they use a kind of a business case and then the next gate is to make a specification of the R&D outcome. The R&D outcome fulfils and matches the business case by using some different tools, for example different types of risk analysis to reach it. It is more a written document.
The QFD is more or less involved in the first Gate and then it will be updated through the process.

Calculating the function to each cost is done, but it is not that detailed. The technical function has a higher priority. There is not a predefinition way of calculating a specific cost related to a specific function.

4.4.3 The PDQ system (Gate system)

The R&D project work in the environmental control systems part in Växjö is according to the PDQ (Product Development Quality) process. That consists of a number of Gates that an R&D project is passing. At different Gates there are different presentations to a review committee. Based on these documents they take a decision whether they stop the project or it will go on and founded it to the next station.

The PDQ process is a huge tool and different units are a using the PDQ process in little bit different way. It is in a way adapted to the different business and they use the best parts of the PDQ process. It is room for interpretation and every business decide what they want to do with it. Even through it is very similar from business to business, all major parts will be the same, and the same kind of documents and the gates reviews will be similar.

According to the PDQ ALSTOM has also some product improvements that do not fall under the PDQ process, but it has nothing to do with the size of a project. It is more related to the nature of the project, whether it involves major design changes or major changes steps in the technology.

The PDQ has four till five different stages until a product is fully released.
The first stage in the PDQ process it is more related to the initiation of a project, to build a business case and make sure that the market is there and that there is a need for the product development.

The last stage is a feedback stage, where the technology and the products are already installed at a couple of plants. Then ALSTOM gather the feedback from the customers and the employees. After that the product it is fully released to be used. The feedback consists the quality and the function and the performance of the product.

In Niclas Lindqvist point of view the PDQ process suits their business quite well. It is a good tool to make sure that they do the right thinks in during R&D process.

4.5 Conclusion empirical findings

The interviews of the employees from ALSTOM Power in Växjö are from three different departments, Per Ranstad R&D department, Christer Mauritzson Sales Manager for the after sales market and Niclas Lindqvist physical laboratory R&D. That give an overview about ALSTOM Power, to understand how they work with which tools and which processes. All of them confirm that they use benchmarking and Target Costing and that they work according to the Stage-Gate System. But Per Ranstad and Niclas Lindqvist do not have the same point of view about the application of the Stage-gate system. Per Ranstad said that they always use it for all the projects, whereas Niclas Lindqvist confirmed that they do not use the process all the time.

5 Analysis

In this chapter the theoretical data and the empirical findings will be analyzed. The first part of these chapter analyse the empirical findings from the three interviews of the employees of ALSTOM. In the second part the empirical findings are compared to the current theory that is outlined in chapter 3.

5.1 Empirical analyses

5.1.1 Analysis Per Ranstad

The interview with Per Ranstad is the first interview for the thesis and the focus is much more about value engineering and function analysis rather than the other target costing tools. They are looking for the customers needs and what they require, the customer define what he wants, so they are working customer driven. The decisions and the possibility for fundamental changes are done in a very early stage of their product development process. This process is a strict stage-gate waterfall system, which makes it impossible to change something important in later stages. They use that process for all projects, for software, hardware, small and big projects. In his point of view, the use of the waterfall method is necessary for hardware or huge steel constructions, but not for the software development. For small projects, this process is too much paperwork. The life-cycle time costs are very in important for their products, because they have a long life-cycle time and the costs during the use of their products are higher than the investment of the new products

5.1.2 Analysis Christer Mauritzson

Christer Mauritzson is the Sales Manager at ALSTOM Power in Växjö. He is responsible of the after sales market in air pollution control. Christer Mauritzson works close with the LSC to give a support to them, because they are not specialist about air pollution control for product and service. He gives some technical support all over the world to the LSC. Christer Mauritzson says that the after sales market is much more interesting to have a bigger margin because the new sales market is very competitive. Every customer is unique with different problems to solve that is the reason why the products are Taylor-made. In ALSTOM Power they use benchmarking to have an overview of the market and to

have information about their competitors or their customers. The last benchmarking was 3 years ago. ALSTOM can improve a lot their sales in the air pollution control or environmental control market where they have only 2 or 3% of the market share.

5.1.3 Analysis Niclas Lindqvist

Niclas Lindqvist is working at R&D Department, he is managing the laboratory in the physics discipline. In his department they have a lot of different methods for analysing the functions and the costs for example value engineering and QFD, which can be applied during the whole product development process. The product development process, which is called PDQ, is based on the Stage-Gate System, during all the process and for each gate they are working in cross-functional teams. A wide use tool in his department is benchmarking, they try to benchmark when they can and when there is a need for example of a changed environmental regulations. Internal benchmarking is also used related to cost reduction when they are doing R&D initiatives.

5.2 Theoretical analyses

This analysis is based on the characteristic table (see appendix 7). All interviewees of ALSTOM Power in Växjö have confirmed that ALSTOM uses target costing in the facility in Växjö. In each department R&D, After Sales and Phisical Laboratory have a different view about how to use target costing.

5.2.1 Target costing key ideas

Christer Mauritzson from the after sales department confirmed that the products are customer driven “every customer need a tailor-made solution. The customer requirement is technical figures, it is very detailed”. To satisfier their customer and to met the market regulations, their products and services are customer and market driven.

All interviewees confirmed that they have a competitive market price, this price depends of the functions and the performance. They hide the price of the product by using package including different services and products.

About the profit margin Christer Mauritzson says that the margin is higher for the after sales service than for new products. “Actually there is a better margin in doing this things (after sales service) than selling new products. Because the competition is tremendous (…) the growth margin is not so big on new product”. The after sales service is also an important business because of the long life cycle time of the products.

All confirmed that the products design and performance are customer driven. One reason for that is that the products need to meet the regulation of each country. “We adapt to the regulations and make sure that we have products that meet the regulations” (Niclas Lindqvist).

In order to save costs and guarantee the quality, the whole product has to be designed that it is easy and save to assemble, “Construct ability is sometimes different, that is how to put it together outside where you building the power plant, that is the main intense for us, to develop design that is easy to put together. To save costs and quality on the sides.” (Niclas Lindquist).

Niclas Lindqvist confirmed that the cross-functional team idea is used at ALSTOM. “During all the process for each gate there are people involved from marketing, sourcing, quality, R&D, legal and so on. In the PDQ process we try to take everyone’s viewing into the decision.” Niclas Lindqvist is very satisfied about the use of cross-functional teams “one of the good things is that you have the cross-functional teams and it is not only a technological development, it is also a business development and it takes care of all PR issues during the development phase and so the sourcing and marketing”.

Per Ranstad mentioned about the life cycle of the product that “during the lifetime of a plant, a power plant for example, there is much more accumulated cost in service compare to the initial investment” and Christer Mauritzson said, “you have to show pay back time. How long time does it take to the customer to get the money back what he has spent”. They follow the key idea life-cycle costing of target costing, because the life-cycle costs are very important in their branch.

During the R&D development process they try to involve the whole supply chain. “It depends on which type of suppliers it is. If it is an example, a big supplier on semi conductor, we have no influence at all. If it is small company might be mechanical parts, we can have quiet a heavy influence. To some extend we are buying parts which we have, where we have taken very deep part in the development of those parts and they are unique for us” (Per Ranstad).

5.2.2 Target costing core tools

About the target costing core tools Per Ranstad told us that they think about the functions and the cost, but they do not use the term “value engineering” in his department. Normally they do not relate each function to its costs, “Sometimes, depends type or product, if cost is crucial, if the product is sensitive to cost”. On the other hand Niclas Lindqvist confirm that they use lot of different concepts during their product development process. For example QFD and value engineering, “We are working with such a range of systems and technologies and it varies from field to field”. In ALSTOM they think about the functions and specifications of their components and products, and their costs, and in some departments they use the value engineering tool, but in other departments they don't use it at all.

The example of SIR from Christer Mauritzson let assume that they did not think about the cost driver of the manufacturing process. In this case we assume that they did not use the process (operations) costing tool, “it is not manufacture friendly, it is too tricky to manufacture. The problem is that we did not have enough people involve in the project on the manufacture inside. Say that you cannot do that, we cannot manufacture that will be too expensive”. In that time, a strict use of the process (operations) costing would have been necessary, but the clear describing of the reason for the problem let assume, that they changed their process to avoid that problem of not involving manufacturing employees.

Benchmarking is a target costing tool which is used in different departments of ALSTOM Power in Växjö. “We of course try to benchmark where we can. Benchmark that is an important tool for us, it is wildly used” (Niclas Lindqvist). A detailed example of benchmarking comes from Christer Mauritzson, “what we do

survey is maybe sometimes benchmarking with other suppliers. Then we have a third party who makes a survey wending out to the customers, our own, our competitors. They ask many different questions about how we work, and how they work, different aspects. The report is 40, 50 pages, very expensive. This happen 3 years ago". Benchmarking is not continuous used they make it when they think that they need it. "I would think that our benchmarking is based on a need. When there is a need and when there is activity. Then we use it when we can." (Niclas Lindqvist).

According to the theory, benchmarking should be used as a continuously process. "Benchmarking is a self-improvement and management process that must be continuous to be effective. It cannot be performed once and disregarded there after on the belief that the task is done" (Camp, 1989). As Christer Mauritzson mentioned that, they do product benchmarking with competitors. "But in some country we have competition and that is NWL Company in U.S that we were benchmarking with before. Because they also have the same size, but I will say 30% cheaper, so on this market we have a problem on this other no problem".

ALSTOM also uses internal benchmarking for its products, refer to Niclas Lindqvist, "if we are doing R&D initiatives in terms of cost reduction, then it is almost always a comparison to benchmark, with our existing solutions".

5.2.3 Stage-Gate System

The Stage-Gate System process is used ALSTOM wide, "there is a specify process, it is internal on ALSTOM, which has number of stages it is a gate process, which involve with engineering, manufacturing, marketing, sourcing" (Per Ranstad). According to Niclas Lindqvist the Stage-Gate system is called PDQ (Product Development Quality) process, "at the environmental control systems, when we are doing R&D projects we are working according to what we call PDQ (Product Development Quality) process. That consists of a number of Gates that you are passing, through the life of an R&D project".

Per Ranstad said that this process is very similar in every department in ALSTOM. “ALSTOM is divided in a couple of segments, and this process is specific for our segment, ALSTOM Power. But different segment have similar processes”.

For Per Ranstad there are some limitations to use this process especially for the software product development, because of the strict waterfall process. “One of the limitations of the process is a very strict waterfall process. First you do this and then you that. It is not an iterative. It is quiet hard to run specifically with software development. But at the other hand, hardware project, not talking about electronics but big steel construction, I think this waterfall model is quiet good. You cannot do it worse. You have to decide what you do on strict to that. And this process is expected to cover all these aspects. But still it is not a good process for software engineering”.

Another critical aspect about this process is that it consists too much work for small projects, “that very often imply that small project gets too much over. There is too much paperwork by the process”. In the same way Christer Mauritzson criticises this process, because it takes much more time because of the bureaucratic work, “The reason we have, is to reduce a lot of quality control, simple quality. We hire a lot of new people to the staff here for improvement quality and unfortunately the quality has not been better. We got more bureaucratic, more paperwork”.

There is a contradiction about the freedom to use or not this process. Niclas Lindqvist disconfirmed that they have to use this process for every project, “we don’t do all projects in this. According to the PDQ we have also some product improvements that maintain from product that does not fall under the PDQ process”.

5.3 Abstract Theory

The use of the target costing tools in the Stage-Gate product development system and the agency theory, it is possible to relate the using of the Stage-Gate process to the agency theory. The top-management of ALSTOM is in this case the

principal and the mid-manager are the agents, which order to use the Stage-Gate system. There is a asymmetric information for the different management levels, as in the agent theory is described " agency theory: The theory of the contractual relationship between a principal and an agent. Agency theory analyses the issues that arise when a principal delegates a task to an agent but there is asymmetric information and an incomplete contract" (Black, Hashimzade, & Myles, 2009).

The agents and the principals have different points of views and different objectives: the top-management want to have a standardize tool to control the projects, in all aspects. The standardisation helps to manage all the different and complicated projects of a huge company like ALSTOM, and this standardisation of the process enable them to transfer the employees in another department if it is necessary. The agent, the mid-management want to have a process, which is optimize for their work in it. The mid-management wants to have a minimum of "paperwork" and the process should be different for the different projects. The comment of Per Ranstad to the process, that is a good process for huge and hardware projects, but the strict waterfall system is not optimal for the software development is a good example for that "The basis of the analysis is that the principal and the agent have different objectives. For example, the owner of a firm (the principal) may wish to maximize profit but the manager of the firm (the agent) aims to maximize a utility function that is increasing in income but decreasing in effort" (Black, Hashimzade, & Myles, 2009).

6 Conclusion

6.1 Theoretical contribution of the study

The interviews show that in different departments of ALSTOM the most target costing tools are used. They have a standardized product development process, Stage-Gate System but there is not a common way to use the target costing tools in that process. ALSTOM power is supplying its customer with customized products and whole solutions that cannot be standardized, so they have a huge focus on the customer needs. In order to meet the customer needs ALSTOM is using a wide range of methods to analyse the functions and the expected performance. How ALSTOM use the target costing tools and at which phase of the product can be seen in figure 14.

Tabelle1

	Product Development Stages						
Product Life Cycle Stages	**Start Stage**	**Specification Stage**	**Design and Development Stage**	**building prototype Stage**	**building pilot Stage**	Production and Logistic	**After Sales Service (Christer Mauritzson)**
Product Develoment & Engineering (Per Ranstad)	Cost Tables	Cost Tables, Design to Cost (DTC), Function Analysis	Cost Tables, Design to Cost (DTC), Function Analysis	Cost Tables, Design to Cost (DTC), Function Analysis	Cost Tables	Multiyear Product and Profit Plan	Benchmarking
Physical Laboratiories (Niclas Lindqwist)	Value Engineering, QFD, DFMA, Benchmarking	Value Engineering, QFD, DFMA, Benchmarking	Value Engineering, QFD, DFMA, Benchmarking	Value Engineering, QFD, DFMA, Benchmarking	Value Engineering, QFD, DFMA, Benchmarking		Benchmarking
Target costing key ideas:	Price led costing, cost functional teams, customer driven, design, life cycle costing, value chain						

Figure 14: Integrating of target costing tools and key ideas in the Stage-Gate product development process and the after sales at ALSTOM (source: own)

6.2 Reflection on the study

This thesis is based on three different interviews with employees of three different departments in order to have a wider point of view, which leads to different opinions and findings. The weakness of this research is, that the empirical data is only based on three different interviews at the facility in Växjö. The findings cannot be generalised for the whole ALSTOM company.

6.3 Recommendations for the company and for further studies

They should think about how they can share and how they are sharing the knowledge about the target costing tools, a pool of these tools, which all departments have access to could be useful to share the knowledge of using the target costing tools.

6.4 Special thanks for the contribution

Special thanks for the interviews and the time to Per Ranstad, Christer Mauritzson and Niclas Lindqvist.

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Appendix

Appendix 1 Interview questions Per Ranstad

These questions are about the use of value engineering and cost reduction methods in your company. It will start with some general questions to get a good overview about the role of your department in the value chain. The second part of the questions will be more detail about the product development and process improvement methodology. It is important to know, that the vocabulary is different from company to company and from companies to the theory in many cases. In order to that fact, we want to find out which names do you use for the methods and relate them to the theory, to make sure that the thesis are usable for both.

1) *(Which stages do you have in your product development process? Is their an ALSTOM wide used system? Are there rules to use it from the Top Management or are the different facilities independent in the way of using it?)* Only for ALSTOM transport

2) *Do your work with other parts of ALSTOM together, with other R&D parts in order to the product and function development process?*

3) *Which methods for analyzing the functions of your products do you use in which stage of the product development process, to improve the performance of the new product?*

4) *One core part of the value engineering concept is the value of the product. The value of a product can be calculated by dividing the function of it by its costs. Do you make a function and cost analysis and at which stage of the product development process?*

5) *The way of the value analysis is to find out which functionality a product or part of a product has and to relate it to its cost. The goal of this method is to get a better view of the value building procedure and to generate improvements. It helps to get more information, for example which part might be too expensive in comparison with its functions and costs, or it helps to combine or eliminate functions of a product. Do you use the value analysis and cost analysis in your process and in which stage?*

6) *The costs are another important part of the value engineering concept. Which cost creating methods do you use and how do you calculate the cost of a new product in the early development stages?*

7) *Have improvements of the value engineering or the cost reducing methods taken place in the last years? If, yes, which were the most benefits of this new methods?*

8) *Are there improvements of the value engineering or cost reduction methods planned for the future? What are the main reasons for that?*

9) *What is your opinion about the methods your use in your process and do you have some suggestions for improvements of your current product development system?*

10) *How did you learn about VE or VA?*

11) *Is the term VE or VA used at ALSTOM?*

12) *Is it a company policy to use VE/VA?*

13) *What are the main processes and what is the role of the facility in Växjö (manufacturing, R&D, marketing, financing or logistics) in the ALSTOM Power company? How many employees work for the different parts?* Only for ALSTOM transport

14) *What are your internal and external customers?* Only for ALSTOM transport

15) *What are your main suppliers for the products and how is the relationship (short or long term, strategic partnership)? Do you have influence on their product development process?* Only for ALSTOM transport

16) *What are the main products?* Only for ALSTOM transport

Thank you very much for your answers and feel free to ask questions about them.

Appendix 2 Interview Per Ranstad

What are the main process and the role of facility in Växjö?

Our two main sales here in Växjö are Engineering and Sales. And two main parts of our activities in Växjö, one is after sales, after market activity mainly on environmental control products for the local market. And another one is for new sales on environmental products. One is industry service and the other one is sales on new plants, products for new plants.

What about your customer? For sure you have external customers, but do you have also internal?

ALSTOM company all around the world have Local Service Customer (LSC), they make the business with local customer. The central products organisations supply products to these LSC. That is the basic set up in the after sales, after market organisation.

Do you have external suppliers for products?

Yes of course a lot, but the product what we are selling mostly sell through LSC office all around the world.

Do you have influence on the R&D of your suppliers?

Sometimes we have, sometimes we do not have. It depends on which type of suppliers it is. If it is an example, a big supplier on semi conductor, we have no influence at all. If it is small company might be mechanical parts, we can have quiet a heavy influence. To some extend we are buying parts which we have, where we have taken very deep part in the development of those parts and they are unique for us. So the entire bad exist.

What about your main products?

It is products for environmental control, flux gas cleaning. Means that our end customer is the process industry, power plant must be the n°1.

Which part are you responsible for?

I work with the electronic control system for filters. And I have been managing on R&D department for one decade or two decades, quiet a long time! But for the time being I am student, right now I am writing a PhD in KTH in Stockholm.

I suppose you have special stages on your program development.

Yes, there is a specify process, it is internal on ALSTOM, which has number of stages it is a gate process, which involve with engineering, manufacturing, marketing, sourcing.

Will be really interesting for us to study this process.

This process is divided, first gate is when you start a project, an R&D project new product. That is the initial gate, the start gate. Next one is specifications, like the functions of the product, and then is concept. Third one is design, detail design and then come the two last one building prototype and building pilot. Design means all the documentation, which describe the design. And sourcing all the other aspects as well. But that process by definition you do not validate by prototyping. First you have to design the review gate, then you can start to build using your draws.

In the first stage on specification, do you calculate for every function the cost?

Sometimes, depends type or product, if cost is crucial, if the product is sensitive to cost. Because then you put a cost target on the product. Than the cost become a part of the specification. You have to meet your specifications. It is of course evaluated. This process is quiet strict on the specifications. It does not leave too much room on invention. That should be done in the very early stage. Of course there is a gate review. There is a set up questions to be answer. In all this gate review, there is a couple of questions coming back, or being identical. One is the specification still valid, do you need to update. That should be your had functionality or your subtract function.

What happen if the cost is too high for the function, how can you manage that?

If you have a conflict in the specifications, that is the way I see it. You have specified the functions, the cost and that does not match. You cannot implement the functions still meeting the cost target. Then you have to make a decision either you skip some of the functions or you increase the cost.

Did you relate each function to cost?

Normally not. Depends on how you look the development cost, if you look that as a cost or as an investment. And when you talk about cost, do you talk about the cost need to develop the function or the cost need to manufacture the function. That is completely different. Specifically if you talk about software, where the manufacture cost is almost 0, all cost are investment.

How much of the cost is the development in your product?

Different from different product, as we are developing both hardware could be metallic parts and software. We have the full span.

What will be your technique to reduce the cost of your product?

What we have in our world. We have this R&D process, and ones the product is out of that, it is a gated process with a number of stages and one it is kicked out the product itself is not cover by the R&D, there is another way to continue to develop the product through its lifetime. And to decide to replace it by something else. So that is what we called the “change order process”, you have a process how to change a product.

Do you share R&D with other department in ALSTOM?

As much as we can, but it is quiet difficult. There are some examples where we can do that. Like some recent examples, we here work quiet a lot with Power Electronics. We make power convert for precipitators. ALSTOM is also strong on transportation, trains use also a lot of power electronics.

Does the R&D process taken big changes in the last few years?

No it is quiet stable, this process which we are working now in R&D project, was establish 10 years ago. And since than, it has been very stable I would say.

That is ALSTOM wide?

ALSTOM is divided in a couple of segments, and this process is specific for our segment, ALSTOM Power. But different segment have similar processes. And this comes from experiences of very high cost on equipment, which failed in field. The costs were too big. As a company, ALSTOM had to manage the risk of products.

This process is really interesting for us. I do not know if it is a secret…

Neither do I, I can check if you can have a copy of it.

What do you think about the R&D process you use?

One of the limitations of the process is a very strict waterfall process. First you do this and then you that. It is not an iterative. It is quiet hard to run specifically with software development. But at the other hand, hardware project, not talking about electronics but big steel construction, I think this waterfall model is quiet good. Because you cannot do it worse. You have to decide what you do on strict to that. And this process is expected to cover all these aspects. But still it is not a good process for software engineering. And an another aspect on R&D process in a big company like ALSTOM, I guess all big company more or less do the same. They want to unify the processes. They want to use the same process if you are in the R&D for example, if you are in sales should be done in the same way, where you are. But that means in company like ALSTOM with very wide spectrum of activities and products, the R&D process is apply to both really small project. Some main year project, couple of months long. That very often implies that small project gets too much over. There are too much paper work by the process. And might be, I have not been in this real big problem project, might be for the opposite for the big one. Process does not request enough coordination. That is a difficult, company like ours because to have a unify process, which covers those very small projects and very big ones.

Is it the way is it going now, to unify every sector together?

No, that happens 10 years ago. So the process have been in place for roughly 10 years. It is going for some changes, but no fundamental changes. It has been some prolonged.

Is there only one department for environment in Sweden, or you work together with the others, also from different countries?

There is a lot of department around the world. We, here in Växjö we have our own product range, which come around control system or filters. But in others part of the world, R&D centre which work with other products. The product we are working, there is no competition in the company.

So you have different specialisation?

Yes, you could say so. In one hand you have the market, in another hand you have the products, which you want to bring to the market. And ALSTOM has decided to have one organisation owning only the market, and another one only the products. And then you have a matrix. So the organisation going to the customer, LSC, they have to had contact with a lot of product owners. Because they carry the product folio to the customer. So they have more than one technical contact, they have to have. As the product owners, they have more than one market contact. They have to have contact for their product to all the LSC, where they have potential customer. So it becomes a quiet complicated structure, but I think it is the only possibility. Because what the customer does not want to see, that is the sales person coming from ALSTOM or from some other company with the single product. And if they want to talk about another product of the company folio, there comes another person from somewhere else. They want one face. The only way to solve that is to have this type of organisation. But it makes lot of disturbances internally.

What about your competitors in the same sector as you?

They are quiet good, but we are better. As you would have expected.

Is there a very competitive market, with lot of R&D?

Yes.

So cost reduction is quiet important to…

Yes, specifically the major products, the filters. They are very cost sensitive. But they are also low in volume; you do not make thousands of them. They are always customised, build at side. Quart parts are delivery to site, so they are standardized. But the final erection is down at size. That is quiet cost sensitive. In the other hand, if you can have parts of product, which come with the main product, which access differentiated then you are not so sensitive to the cost. That some parts as long as it is not dominating the total package. That is the situation, which the control products, the control electronics for precipitators has been in.

Do you have special cost reduction program for the core product?

Yes, now and then. We got it because we need it. Now we have not sold enough for a couple of years, and the analysis said it comes from twice cost, than R&D goes into cost reduction.

But you do not use the word "value engineering"?

I have never heard it before you.

How do you name it? Cost reduction or?

Cost reduction for me is very general. Could be any cost. You always have the choice if you are suppose to be high in price, you could either low your price, or had functionality to your offer. In my perception that is an aspect on value engineering. You get the same with the high value or reducing cost.
On your filters you have electronics, you can say to your customer we offer more functions for a little bit more cost.
Sometimes we can reduce the cost of the core product. It is very much related to the size of it. And if you can operate it a little bit smarter, than you can give the same functionality with less material. And that will give you a cost benefit. That sometimes you can do it smarter control system.

Is electrostatic precipitator one of your inventions?

It is not an ALSTOM invention, it has been for more 100 years. For the beginning it was not use to protect the environment, but use to recycle chemicals in the process industry. It was used to reduce cost. But ALSTOM is one of the real big players for electrostatic precipitator. That is not the only filter we are working. Basically you can subdivide in to two categories, one is water clean flue gases. It is where you take particles. And the other one is where you take gases pollutants, like SO2. And for particles it is either mechanical filters by houses or electrostatic precipitators. On the gases side number of exhausts, depend on which chemical you want to pick up. And one method, which is quiet often used, make the chemical you want, gas you want to collect. Make that react with something and so that become a particle, and then you can collect it. So you had something to the flue gas, you have a reaction, and then you collect. We have a original invention coming from us, which is the control of the precipitator, power supply for precipitator. There, we have a well leading position since some years.

Which kind of control is it?

It is for electrostatic precipitators. Basically it is a set up of electrodes, you have a positive electrode and a negative electrode. Between those you have a high voltage, by doing that you can obtain something which is named "corona this charge". The electric field around one of the electrodes is configured in a specific way, so you have a high field on the surface on one of the electrode. But you can do a lot on how you emit this charge, that is very important and how you control the field between the electrodes. Because that the field which give the force which make the particles drift. And we have been very successfully in controlling this voltage and also generated this voltage. It is a niche, but it has been very successful.

Do you have good relationship with your sub-supplier?

Sometimes we have good contact, we work very much together, and sometimes it

is not as good as well. Than you can see I will say a conflict of interest between different functions in the company. In the R&D side, you want to partner you sub-supplier. You want to get the best part that you want. So to develop it, you want to have a long time partnership with the sub-suppliers. If you go to our supplier department, the one who buy the parts of the product, purchasing department. They tend to prefer justice the specifications. So at anytime they can go to any supplier to make them competent price. There is a conflict of interest. But I know exactly which side I am.

Do the customer will be more focus on function or on the cost?

Yes most of them on the functions. They also evaluated functionality versus cost.

How is the relationship between the investigation of your customer and the lifetime cost?

If you look on precipitators, there is quiet a lot of lifetime cost. That is good thing, because it means that aftermarket is a big business. During the lifetime of a plant, a power plant for example, there is much more accumulated cost in service compare to the initial investment. That applies a row business. The customers very often focus on first cost. It changes it, but still interest on the first cost. If you talk about precipitators, for example the flue gas is quiet aggressive, you have almost over corrosion. So you need to rebuild them. There is an operation on cost, they are quiet high. Because you have to rebuild, fix them, and also upgrade some parts. And the control system is a typical one

Appendix 3 Interview questions Christer Mauritzson

1. *What is your position and what are you doing exactly at ALSTOM Power?*

2. *How do you measure the customer requirements?*

3. *Do you have an example of how you measure the customer requirements? Can be an old product.*

4. *How do you define the functions of the product?*

5. *Which stage of the product development are you working with and how?*

6. *How do you get the target cost of a product and how do you define it, refer to what?*

7. *Do you have some typical methods in ALSTOM Power to improve the sales performance?*

8. *What about the LSC (Local Service Customer) at ALSTOM? Can you explain it?*

9. *Do you think that the sales method is efficient for ALSTOM? And what are the strength and the weakness of this method?*

Thank you very much.

Appendix 4 Interview Christer Mauritzson

What is your position and what are you doing exactly at ALSTOM Power?

As you point out I am the sales manager, this department here we are working with the after market that means we are improving or repairing the efficiency or the product that are already out in the field we do not sell new product. That is the other part of the building. I have been 34 years with the company and I have also worked in that side. In those days we were not divided like we are now because we worked with everything the after market and the new sales. So I have been on the new sales market for 25 years so I know that part also. But then you can say that the new sales was down a bit in the 10, 12 years ago, the after market grow very much so we transfer some people and including myself to work with the after market what we called "service". For maintenance, to improve, and extending existing plant with some more bigger, better things. And one key component in this improvement is service form I was talking about. I will get some brochures… ESP means Electrostatic Precipitators and that what we are mainly working with. This is the transformer; looks a little different depend of the size.

And you got problem with this product in Canada?

Yes, we have no practical problem, but the authorities have change some standards that is always a straggle to get things true so maybe we have to modify some components. The components must have a CSA (Canadian Standards Association) stamp.

It is like CE (Conformité Européenne) stamp in Europe?

Yes, yes more or less. So we are working mainly on the after market and improving, upgrading or sometimes you call it retrofit means improvement, put it in the condition like new. Actually there is better margin in doing these things that selling new products. Because the competition is tremendous, everyone think that environment is a good thing to do, everyone tries to go in there but it is a very tough competition. So the margin, the net margin, the growth margin you make is not so big on new product. You have a better margin on the after market.

When you say upgrade product, was it product that you sell?

I will say 60, 70% are our own products, we also do other OEM (Original Equipment Manufacture) that means other brands. There are perhaps 25 different brands in the world of electrostatic filters. The biggest application we have for the filters is power station. I started here when I left university.

It was like Per Ranstad?

Not as long, he is here 20 or perhaps 25 years. I remember when he was employee here on the electrical department. I am sale and then you can say we have divided the world. Because we worked worldwide, I was just responsible of U.S and Canada, Australia, Japan. We have divided the world, we were 5, 6 people and we have divided the world in big parts. We worked not alone from here, in every

country we have local offices of course. They are the direct contact to the end customer, so we sell product to them. You can say we make internal sales to the other local ALSTOM office. And then they sign the contract with the end customer. And sometimes we make a consortium, we maybe are 3 parts, I was in Chile 2 weeks ago and then we have an agreement with Brazil, because Chile is a small country with small office and they do not have so much knowledge. But they are still the face to the customer, so we have a join venture between ALSTOM Brazil, Sweden and Chile. We are 3 parts to the end customer. It could look different from case to case.

How do you measure the customer requirements?

Well he is very clear what he wants. If a customer wants an upgrade of the project, he sends out the specifications. The main thing is how many milligram of dust can we release. Adapt as we can on the specification, and we can not we have to make an exception in the contract or in the quotation. Because he sends out we call RFQ (Request For Quotation). Then we send a quotation to him. Maybe this customer is asking 5 different suppliers not only us. So we have maybe 5 competitors to this job. And then if you are lucky he will invite you to present your quotation, maybe not because the price is too high, he does not even talk to us. But if you are in his budget you present your quotation, we negotiate, and then hopefully we sign a contract, which the quotation is a part of it.

On new product how you measure the requirements of the customer in general? Do you have kind of survey?

No. The customer requirement we see is to solve a technical problem for him. How much dust he has in his chimney. We are specialist in these fields, we do not need to make surveys, because we worked with this project 80 years in the company. We know that much. What we do survey is maybe sometimes benchmarking with other suppliers. Then we have a third party who makes a survey wending out to the customers, our own, our competitors. They ask many different questions about how we work, and how they work, different aspects. The report is 40, 50 pages, very expensive. This happen 3 years ago. When I see this question it is more for consumers product than industrial product. It is tailor-made, every customer need a tailor-made solution. The customer requirement is technical figures, it is very detailed. They want this gas flow, this temperature, and they want this dust emission. You can say you have one guarantee point, he makes a list of all the data. But then we know by experience than he can never full fill all his data on the same time. You try to extend the guarantee by, we called it correction curve. That means if you are on the gas flow too high or too low, we modify the guarantee to another value. You do not want to increase your risk by going outside his value, but then we try to increase our safety. To measure the dust concentration you have instrument to measure it. It is easy to prove if you are right or wrong. 95% we do give guarantee, if we make a repair or an improvement of course he want to be sure he gets what he pay for it. So he asks for guarantee of that. And if we fail then we have penalty, first of all we have to rectify as much as we can and if we still fail then we have the penalty. Let say maybe maximum 10, 15% of the contract value. Normally you have to include that margin in your calculation, in your price calculation. You make a risk of view and lot of different parameters in your price calculation. You have to put in safety money, but you

cannot offer how much because you have the competitors. It is a very tough balance all the time, it is a challenge. That was all business is about to find the right price level.

Which stage of the product development are you working with and how?

You have met the person who is in the first phase, Per Ranstad. He is more or less the inventor of SIR (Switched Integrated Rectifier). We started to come up with this idea already back in 1987, I was included in this team, and it took 5 years to have a product out of the market for the first version. It is completely new way of thinking, they were no one else at this time. We were the first in the world to have this type of product. Lot of things went wrong on the beginning. We are now on the fourth generation of this product since 1995.
To upgrade your product, you need to be closed to the R&D department?
R&D in the house, yes. Before we were actually one department all of us. We have always worked very closed with them. Unfortunately with the new structure they put R&D a little bit far away, they are still in the house but it is different department. You do not talk as much as before. So that is very bad.

Do you give sometimes some advice to the R&D department?

The R&D they take care about their own technical problem of course. They are more technical that I am for sure. I should more look that we make the right performance to the electrical filter. That is my interest, if I have to sell this I have to know what can we do with this. I am the link between the end customer and the R&D, not only me we are a team of 7, 8 people.

How do you get the target cost of a product and how you define it, refer to what?

If we take the price, about SIR because it is easy to talk about this one. We have the target price, which should not more expensive than the conventional transformer. Because there were already conventional transformer on the market, so we know the price of that. The conventional transformer are first much more bigger, heavier instead of 200kg it is 1,600kg. Everything is very small in our product because it works with high frequency technique. It is nothing new, but has never been apply for this big power level, 120kw or 160kw. You have high frequency technique in your mobile phone. At that time when we started to develop it, we were not really sure that it was so good. We got this fantastic improvement dust emission in the chimney. The first thing was just making a new kind of transformer. The target price was perhaps a little bit more expensive but not that much. For the fourth generation we started to sell it in 2005, but the first development started in 2000. The goal in the project was to be maybe even cheap. But now with the fact in hand it turns out to be twice more expensive, so that was a big miss calculation. We suffer of that on the market. We cannot reuse much things of the last, so you have to start all over. It is not manufacture friendly, it is too tricky to manufacture. The problem is that we did not have enough people involve in the project on the manufacture inside. Say that you cannot do that, we cannot manufacture that will be too expensive. That a mistake we did. So it is more difficult to sell this one. But if you want to extend the electrical filter with one more field, will cost maybe 10 million SEK, and if you buy a transformer like that it will cost you 700,000 SEK. So it is still a very big bonus to do this way

instead of the old traditional way. But in some country we have competition and that is NWL Company in U.S that we were benchmarking with before. Because they also have the same size, but I will say 30% cheaper, so on this market we have a problem on this other no problem. And U.S is one of our bigger market for us, but now it is a dead market because of the financial crisis. Power station does not invest a dollar. That is why our sales last year were that bad, we make only 60% of the budget. Same thing with the new sales. The sales we have done is on other market like China, India, Brazil. The new market, not the traditional western market. Because they are not suffering that much with this crisis.

With your product, which is less expensive, is it also more efficient than the traditional filter?

Of course because I get the same end result. The main result is that came out here on the top of the chimney. In U.S they have a emission limit of how much dust looks like, not how many milligram. They measure smoke in opacity, it is what your eyes see. It is opacity meter, every power station have a opacity meter even in Sweden because it is a relative measurement more or less. It is a very tricky calculation to make opacity into milligram. The legal limit in power station is 20% of opacity whatever that means.

Do you have some typical methods in ALSTOM to improve the sales performance?

I wish we had! Our main struggle in ALSTOM and also in other company, it is how we are organized. As we are a worldwide company, how can we promote the sales the best. If we look on the world market of the air pollution control or environmental control, the business we are in, to improve the collection of dust, gas, SO2 or whatever. If we look on the world market, it is tremendous, we have 2 or 3% only of this market. So we have a challenge to improve it, because the market is huge. But it is for us to reach it, that is the problem. Every country have their own small player, they are less expensive because we are specialist. They can repair the filter as well as we can. But they cannot offer guarantee. Again coming back to the structure, if we look 5 years back I think we have on the world market sales in this after market of air pollution control, we have 60% of the volume in Sweden. It is crazy. Why? Because we have all the small office here very close to each customer. We have 8 LSC (Local Service Customer) in Sweden, instead of 1 in many other countries. Here in Sweden they are mainly focus on air pollution control.

How can you explain that there is 8 LSC in Sweden? Is it because of the Swedish reglementation?

It is because of the old structure of FLAKT. The offices have been there, the people have been there. It is the structure of how we have build up in the world. That makes if we are selling more or less. Air pollution control there is less money in volume than if I sell a big boiler, a big turbine. In the old structure when we were FLAKT, then we were only working with air pollution control, and have LSC in 32 countries in the world. They got specialist in these products. We sold a lot. Because they can explain it very well, that is why they sell it. Now there is only 1 or 2 men in a 20 men office, he is not very skill. He cannot be a specialist,

so he cannot explain very well to the customer when he is trying to sell. That is why we, like myself go out and support this guy for the technical argument and improvement and calculation. It is in our own interest to support them, because if we do not help, we do not sell. We support them free of charge, I mean it is included in the price of our products. But we do not charge them directly.
This afternoon we will have a meeting about how can we improve our sell. We see that our own LSC structure is not enough, we are to few LSC and they are not focus enough according to us. So we need to find other sources also, agencies. Or can we sell to OEM, competitors. I mean in Poland we have maybe 3 or 4 companies making precipitators. Should we sell the SIR to them? If we are not competing on the same job, because if we are we will loose our job. That is what we will talk about this afternoon.

Refer to that, do you think that the sales method is efficient for ALSTOM? What are the strength and the weakness of this method?

That is what we will talk about in the meeting. The weakness is that they are to small and not enough focus. And the problem is that we mix so many projects together, poor LSC they have to sell and be expert on boiler, turbine, generator, maybe even train. It is asking for too much, they cannot be focus. We think that it will be better to cut all the environment business, make it in a separate segment. And we have our own offices, like we had in FLACK.
In Sweden the LSC are more focus on air pollution control, it is a big business. For small industries not so much power station. What is big business now in air pollution control is SO2 collection and in incinerator you have lot of staff coming out from here. Now there is very much to put catalyst to take the NOx like in the car. That has been the biggest business for us worldwide. Now on the new sales it is like 60% of the business. It is a new demand in the world, so Europe has catalyst in every power station. But it is a big big investment. So now here in the latest structure in Växjö is that we are sales responsible for north of Europe, which means Scandinavia, the Baltic countries, UK, Island and so on. We do not need to go to the LSC we can directly from this office go out to Estonia or somewhere. Of course we need to talk to our local offices because they gain the contract should be sign through them. So sometimes you can say that it is just a mailbox but we need to have people there.

Where do you manufacture the SIR?

Here in the work shop, but we have some subcontractors, or we buy components, modules. We have 2,000 components in this one and perhaps 300 suppliers. That is one of the problems that is more expensive.

So it is twice more expensive than the last generation?

Yes, but it is twice power so double power, double price ok. But our goal was absolutely different it was even to have the same price or cheaper. It did not turn like that. The reason we have, is to reduce a lot of quality control, simple quality. We hire a lot of new people to the staff here for improvement quality and unfortunately the quality has not been better. We got more bureaucratic, more paperwork. That is the ALSTOM top management that is putting more and more paperwork on it. And that have met things expensive so now this one is 109,000

SEK and this one up to 310,000 SEK, just because of that. It is still the same technical product, but quality control and other things.

How many of this product do you manufacture every month?

Last year was a bad year, we sold something like 90. The best year was 2005, 2006 when we sold 350. So the goal this year is to sell 225, but I do not think we are gone to make it. That is an another story. We produce when we got the order so there is a delivery time about 8, 12 weeks. But now with the financial crisis, and the Greek, Spanish problems it goes slow down again. It looks very bad now in Europe.

Is renewable energy a threat for your business?

It is good, but the best business drive to have is when a new legislation coming. You need to reduce, take more SO2, NOx, whatever. So in 2008 when there was the new legislation all over Europe, the year before you were extremely busy.

About customer value, functionality versus cost do you use it?

That is something we have improved a lot, you have to show pay back time. How long time does it take to the customer to get the money back what he has spent. We have to show how much more expensive is his maintenance, so we always have to motivate. If it does not come to us, ask for a product we will go and knock door to him and say we have a product like that and if you invest this you will make a lot of money. Otherwise we will never sell it. And he wants to have 3, 4 years maximum of pay back. That is customer value. We know how much does it cost to produce the product, but the question is how much we will charge the customer. Because this is individual pricing depending on the need. We try to make a package, because if you have a competition, then you do not want to show the price for this alone. So you can hide it by making a package.

Appendix 5 Interview questions Niclas Lindqvist

1. *What is your position and what are you doing exactly at ALSTOM Power?*

2. *Is there a company policy to use target costing as a cost creating method? If not, which cost creating methods do you use and how do you calculate the cost of a new product in the early development stages?*

3. *Which specific target costing tools are used? For example benchmarking, value engineering/ value analysis, quality function development (QFD)*

4. *Are you working in cross-functional teams during the product development process?*

5. *Which methods for analyzing the functions of your products do you use in which stage of the product development process, to improve the performance of the new product?*

6. *The way of the value analysis is to find out which functionality a product or part of a product has and to relate it to its cost. The goal of this method is to get a better view of the value building procedure and to generate improvements. It helps to get more information, for example which part might be too expensive in comparison with its functions and costs, or it helps to combine or eliminate functions of a product. Do you use the value analysis and cost analysis in your process and in which stage?*

7. *What is your opinion about the methods your use in your process and do you have some suggestions for improvements of your current product development system?*

Thank you very much!

Appendix 6: Interview Niclas Lindqvist

From our part here, at the environmental control systems, when we are doing R&D projects we are working according to what we call PDQ (Product Development Quality) process. That consists of a number of gates that you are passing, through the life of an R&D project. At different gates there are different that you kind of present to your review committee. Based on these documents you take a decision whether you stop the project or you will go on and founded it to the next station.
And I think "… Your questions look related to products or product development (Thermal and Service) …better to answer from them"

The first question is which methods do you use? Per Ranstad told that they use TC. Which methods do you use, e.g. QFD do you use it and in which stage of you Stage-Gate System?

The QFD that is more or less involved in the first gate and then updated it through the process. In the first gate it is more, I would say, related to initiation of the project and to build a business case and make sure that the market is there and that there is a need for a product development and so on.
And I think TC again applies much more to Thermal and Service, because they are supplying the customer and with products to a much larger extend and then it is easier to talk about TC. While for us it is more of lets say, if we are doing R&D initiatives in terms of cost reduction, then it is almost always a comparison to benchmark, with our existing solutions.

So you more benchmark in the company and not with other companies?

I think that is a big difference, we know from time to time the price level of our competitors, but not the cost levels. And we are working a lot with the cost then the sales price is something different.

And, some theory says that TC is a form from VE? Do you use VE methods as they are in the early years established?

In most of our R&D projects we have somewhere a lot of methods along the line we are evaluating al lot of concepts. And in that case we are using matrixes and models for evaluating different concepts. It is not seldom that we go ahead with more than one concept and take it into the next step as well.

The most important thing for VE is the definition of function. How do you define functions and do you have an example for that?

That again is a part of the Gate-Process, there is s gate called specification. There we go though a specification of what is needed and that we do after the initiation gate. There we have a kind of definitions that there is a business case and then the next gate is to make a specification of the R&D outcome. That fulfils and matches the business case so to say and we are using some different tools to do that. But it is different types of risk-analyses and kind of, it is more like a written document.

Can you calculate each function to each cost, which the function would cost?
I would say it is done, but more in the, it is not that detailed. The technical function has a higher priority during the stages.
So there is no let me say predefinition way of calculating a specific cost related to a specific function.

We missed the first question what is your position here in Växjö and what are you doing exactly?

I'm managing the laboratory here and also I'm managing one of the groups, that is laboratory working with the physics discipline. But in our organisation we are executing the R&D programs. The R&D program is managed by a different department, that owns the PDQ process and the project management. So basically they would be better to answer the questions, but they are situated in Baden.

Do you work in cross-functional teams, in which stage or all the process?

During all the process for each gate there are people involved from marketing, sourcing, quality, R&D, legal and so on. In the PDQ process we try to take everyone's viewing into the decision.

Per Ranstad told that you use the Waterfall system of the Stage-Gate System and that it is not possible to make changes from a further step. Do you think it is good that you have this program for all developments, big projects and small and software projects the same process?

We don not do any software projects here and we don not do all projects in this. According to the PDQ we have also some product improvements that maintain from product that does not fall under the PDQ process.

Is there a special limitations how big a product has to be?

No, it has more to do with the nature of the project. Whether it involves major design changes or major changes steps in the technology.
But I think Thermal and Service is working according to the PDQ process in the same way as we do more or less. But the PDQ process is a huge tool and different units are a kind of using the PDQ process in little bit different way. You find it in a way adapted to your business and use the best parts of the PDQ process.

So you have one process but each department is using it a bit different? Or is it so strict that you can only use it once?

No, it is room for interpretation and you decide what you want to do with it. Even through I think it is very similar from business to business, all major parts will be the same and same kind of documents and the gate reviews would be similar.

Do you use design to manufacturing or design to assembly methods?

No, not really. In our business we are not doing any manufacturing our self. It is all done by outside contractor, of course we are in our times taking that into

consideration, how the manufacturer do it, but it is not our main business, I would say.
Constructability is sometimes different, that is how to put it together outside where you building the power plant. That is the main intense for us, to develop design that is easy to put together. To save costs and quality on the sides.

Do you investigate foreign products by benchmarking or just intern? You cannot investigate the costs of the competitors, but you can search how they do the products or are the products to expensive for that?

No, we of course try to benchmark where we can. Benchmarking that is an important tool for us, it is wildly used.

Is it continuous or is it every 3rd or 10th year, but continuous?

No, we are working around the world and looking at environmental control systems, it is very much related to the regulations on different countries. When the regulations get strict in one part of the world it would be a lot of projects in that part of the world.
I would think that our benchmarking is based on a need. When there is a need and when there is activity. Then we use it when we can.

It is a very big company, do you have influence of this regulations? Is there a decision making, where the companies are in it?

These are political decisions, of course from time to time the regulations are based on what technology is available. We try to develop products to be able to remove as much from the environmental. The components in the flux gas, we try to remove them as high as possible. In that sense I guess it influences the regulations, but we adapt to the regulations and make sure that we have products that meet the regulations.

You said that you use VE and the function analysis and the QFD. Which other methods do you use? Or tools to improve your products?

I think that for our business it is a difficult question. We are working wit such a range of systems and technologies and it varies from field to field. Six sigma is one of the tool, which is used in or development process. I don not have a good answer to this question, it is more related to product development, where you are producing a huge number of similar products and we not do that.

A question to the Stage-Gate System, which stages do you have?

We have four or five different stages until a product is fully released. The last gate is a feedback gate, where we have already installed a couple of plants with the technology. Then it is the feedback and then it is fully released to be used.

And then you can get the feedback from the customer, if he is satisfied or not.

Yes and also on the quality and the function and the performance.

The last question is about you opinion, do you have some ideas or do you think that some processes are not optimal?
Of curse, there are always room for improvements but all in all the PDQ process suits our business quite well. It is a good tool to make sure that you do the right thinks in your R&D process.
I would say we are obviously developing the way we are using the PDQ process all the time. It is not that it is set once and we are working with it like this, because you always find things that you can improve and then you implement them and then it develops all the time. One of the good things is that you have the cross-functional teams and it is not only a technological development, it is also a business development and it takes care of all PR issues during the development phase and so the sourcing and marketing.

So the process you use id always improved a little bit. Per Ranstad told us the whole process and product development they use an almost 10 years old process and they improved it a little bit but not continuous.

I think there are improvements, that being done all the time. But basically it is a goo process.

Appendix 7 Characteristics of the interviews

(+) confirmation; (-) disconfirmation; (0) not mentioned

	Ranstad	**Mauritzson**	**Lindqvist**
Target costing	+	+	+
Is a **customer driven** and	0	+	0
market driven cost management method, which consists of six key ideas.	0	0	0
Price ledge costing: The price is based on a **competitive market price**.	+	+	+
To get the target costs, the required **profit margin must be subtracted** from the competitive market price.	0	+	0
Customer driven: The whole design, performance and service of a product are based on customer requirements.	+	+	+
Design: The design stage spends more time on planning and designing the whole product development process from the development to the delivery.	0	0	+
Cross-functional teams: Cross-functional teams, which consist of members	0	+	+

from every department, are responsible for new product development, in order to understand how the product works and to consider possible problems.			
Life cycle costing: Target costing considers the cost during the whole product life cycle, in order to minimize the ownership cost of the product.	+	+	0
Value chain: All members of the supply chain are involved in the product development process.	+	0	+
Nine target costing core tools:			
Value engineering and value analysis: Is a method to improve the function and the value of a product, by relating each function to its costs.	-	0	+
Quality function development (QFD): A tool to translate customer requirements into technical features of a product or service. QFD is also known as the voice of the customer or house of quality.	0	0	+

Design for manufacturing and assembly (DFMA) and design to cost (DTC): Design to manufacturing means that a product is designed according to the manufacturing and assembly process to achieve the lowest costs for these processes.	0	-	+
Cost tables: Database, which consists of cost structure information of a product.	+	0	0
Feature to function costing: A method to assign the costs to its specific feature and function.	0	0	0
Component cost analysis: A analyse of the cost for components, which are implemented in the products.	0	0	0
Process (operations) costing: The aim of process (operations) costing method is to analyze the cost driver of a manufacturing process and to skip non-value-adding steps.	0	-	0
Multiyear product and profit planning: The	0	0	0

multiyear product and profit planning is a strategic management tool to plan existing and new products for three to ten years including there revenues, life cycles and the overall market strategy.			
Benchmarking: Benchmarking is a method to compare the own current or planned performance, a product, process or service, with its competitor. The competitive performance can come from another department of the same organization, a competitive product or service in the same market or even a different company in a different market	0	+	+
Stage-Gate system			
The Stage-Gate system is a product development process, which is based on different steps of the product development. These steps are strictly separate to each other	+	+	+

by gates, according to the waterfall system.			