MASTER'S THESIS

A Business Improvement Model

Model Development and Case Study at Sandvik

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Sammanfattning

Bakgrunden till detta examensarbete var ursprungligen att skapa en modell för taktat produktionsflöde. Syftet förändrades dock efter att en nulägesanalys genomförts som visade på ett flertal problem i produktionens närområde. Framförallt komplexitet och svårighet med kontroll. Författarna menade att dessa problem skulle kunna ses som ett resultat av ett flertal försök att använda förbättringskoncept, där liten vikt lagts vid att de grundläggande komponenterna i koncepten funnits på plats. Studiens syfte övergick då till att utveckla en modell som företag kan använda för att identifiera samt uppnå de grundläggande förutsättningarna som behövs för att förbättra sin verksamhet och därmed öka chansen att lyckas i dagens marknadssituation.

En modell har utvecklats, the CORE model. Modellen består av ett antal kategorier och kriterier. Modellen konceptualiserades från ett teoretiskt ramverk, bestående av centrala komponenter från ett flertal framgångsrika förbättringskoncept.

Modellen har testats i form av ett utvärderingsverktyg på ett tvärsnitt av PU Sandviken, en produktionsenhet i Sandvik Mining and Constructions värdekedja. Resultatet av utvärderingen visade på ett flertal stora områden inom företaget där förbättringar krävs, speciellt när det gäller struktur och kontroll.

Två förslag till fortsatt arbete gavs till företaget. Det första var en uppmaning att företaget bör starta ett förbättringsprojekt där modellen används i sin helhet. Det andra var en handlingsplan innehållande lösningsförslag på de tydligaste problemen som identifierats.

Resultatet visar att användningen av modellen identifierar områden inom en verksamhet som behöver förändring eller förbättring för att ett företag skall anses ha de grundläggande förutsättningar som studien visar på. Författarna menar att modellen kan användas som grund för självutvärdering, samt att det som utvecklats är användbart.

Abstract

The background for this thesis was initially to create a model for takt-flow production. After a current-state analysis of issues surrounding the manufacturing function where complexity and difficulties in control were identified, the purpose was shifted. The authors argued that these issues could be seen as a result of several attempts in trying to adopt business improvement concepts where little emphasis had been taken to ensure that the fundamental components of the concepts were in place. The purpose of the study was now to develop a model which manufacturing companies can use in order to identify and attain the fundamental prerequisites needed in order to improve their business and therefore increase chance of success in today's market situation.

A model was developed, the CORE model. The model consists of a set of categories and criteria. The model was conceptualized from a theoretical framework, consisting of core components of several successful business improvement concepts.

The model was tested as an assessment tool on a cross-section of PU Sandviken, a manufacturing unit within the Sandvik Mining and Construction supply chain. The result of the assessment indicates several major areas within the company where improvements are required, especially with regards to structure and control.

Two suggestions for continued work were presented to the company. The first suggestion was for the company to start an improvement project, using the model as a whole. The second suggestion was an action plan involving the resolving of the major issues identified.

The result showed that the model identifies areas within a business in need for change or improvement in order to attain the fundamental prerequisites of the study. The authors suggest that this model can be used for self-assessment in manufacturing companies, and that it should be a workable model for immediate use.

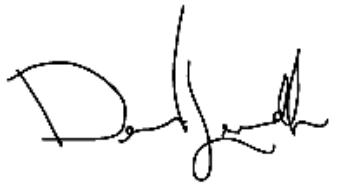
Acknowledgments

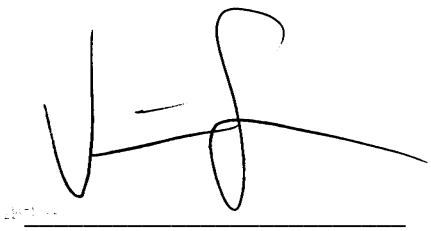
This Master's Thesis was carried out to conclude our studies for a Master's degree in Industrial Management and Engineering and a Master's degree in Ergonomical Design & Production Engineering.

We wish to thank Otto Montell and Fredrik Backlund for helping us in conducting our research. Also thanks to friends and family for giving us support and energy in completing our task.

Special thanks go to Jonas Gustavsson and Sylve Jonsson for helping us in establishing the research at PU Sandviken, Bengt Landblom for supporting the project, and Sune Tjernström who proofread the report. At last, we wish to thank the staff at PU Sandviken. This research would not have been possible without your involvement.

Signature





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Appendices

Nomenclature

The terminology, accounts for definitions of denominations and clarify the abbreviations used in the thesis. This functions as a support for readers.

Abbreviations

SMC	=	Sandvik Mining and Construction
PU	=	Production Unit

Denominations

Below is stated how words/concepts used throughout the thesis are defined by the authors. Most definitions are adopted from the Cambridge online dictionary.

Business	=	A particular company buying or selling goods and/or services.
Company	=	An organization which sells goods or services in order to make money. The term is used as synonym to business.
Control	=	To order, limit or rule something, or someone's actions or behaviour.
Customer	=	Whom a company creates value for. (internal or external)
Decision	=	A choice that you make about something after thinking about several possibilities.
Deficiency	=	A state of not having, or not having enough, of something that is needed.
Fundamental	=	Forming the base, from which everything else develops; more important than anything else
Goal	=	An aim or purpose
Improvement	=	When something gets better or when you make it better.
Improvement concept:	=	A set of tools, principles and management methodologies used by organizations to improve operations toward or beyond “best in class”

		performance.
Management	=	The control and organization of something.
Manufacturing	=	The business of producing goods in large numbers
Objective	=	Something which you plan to do or achieve
Organization	=	A group of people who work together in a structured way for a shared purpose.
Process	=	"A 'process' is an arrangement of resources that transforms input into output that satisfy (internal or external) customer needs" as defined by Slack, Chambers, Johnston, & Betts (2009, p. 4).
Production	=	The process of making or growing goods to be sold
Quality management principle:	=	A quality management principle is defined by ISO/TC 176 as a comprehensive and fundamental rule or belief, for leading and operating an organization, aimed at continually improving performance over the long term by focusing on customers while addressing the needs of all other interested parties. (Hoyle, 2009)
Quality management system:	=	What is commonly referred to as 'quality system' or 'quality assurance system' is according to Bergman & Klefsjö (2001) "an organizational structure, routines, processes, and resources necessary to manage and control a business with respect to quality".
Trade-off	=	A situation in which you balance two opposing situations or qualities or a situation in which you accept something bad in order to have something good
Transformation	=	A complete change in the appearance or character of something or someone, especially so that they are improved
Value	=	Value is defined as any action or process that the customer would be willing to pay for, thus everything else is defined as wasteful
Waste	=	See value

I. Introduction

This chapter introduces the purpose of this study. Starting off with a short introduction, based on the abductive research approach, the background is later discussed in detail. Derived from the background, a research problem is formulated and research questions are defined.

1 Background

This study was initially focused on creating a model for takt-flow production within a production unit of Sandvik Mining and Construction located in Sandviken, Sweden, in this report referred to as PU Sandviken. A current state analysis was performed during the start-up phase of the research that introduced a new perspective to the task (see appendix A). Based on the current state analysis, organizational ambiguity and complexity were identified in the area of production control. Several controlling parameters within production and undefined boundaries between functions could be seen as causes for the complexity.

These identified issues within the organization could be seen as a result of earlier improvement efforts which have increased complexity over time, without first considering underlying instability and structure. The authors argued that this problem could be general for production facilities of today which brought about the following discussion.

1.1 Problem background

In recent decades, the trend in manufacturing has gone from mass production of large volumes of a few selected products to customized mass production. This mean production of large volumes of many different products which differ from each other, based on customer requirements. The production that the market demands today is customer focused and designed to meet all customers' needs (Bellgran & Säfsten, 2008) (Vollman, 1996, pp. 2-3).

Viswanadham (1999) states that companies organized for mass production cannot succeed in today's competition with fast-changing customer demands, short product life cycles, changing technologies, fierce competition, and fluctuating exchange rates. This new type of market situation requires that manufacturing companies are highly flexible and can rapidly adapt to changes

and fluctuations in its customers' demand (Gharajedaghi, 1999, p. 22) (Liker, 2004, p. 8).

Greater competition in markets increases pressure on suppliers. The customers are now setting the demand on quality and delivery precision. Accordingly, a manufacturing company must now constantly strive to find improvements and efficiencies in their operations in order to obtain higher quality while minimizing unnecessary costs. Continuous improvements are now a vital part of most high-performance organizations where tools and techniques are established from top management all the way down to production floor (Bergman & Klefsjö, 2001, p. 41).

1.2 Research problem

The trend, described in the background, driven by customers' changing needs have forced manufacturing companies to transform their businesses. This implies striving to be competitive in today's market situation, finding improvements and efficiencies such as those discussed above.

When a company has been operating for decades and has not effectively aligned itself with its customers' demands, the scope of changes needed increases (Bellgran & Säfsten, 2008, pp. 110-115). In changing their strategies when trying to align its business, successful business improvement concepts are often adopted to customize workshops and improve operational performance (Przekop, 2006) (Liker, 2004) (Brown, 2006) (Hoyle, 2009) (Gunasekaran, 1998).

Even though all these concepts have proven successful, far from every business adopting them has achieved successful results (Liker, 2004). At times, several attempts of adaption have been made through introduction of tools picked out of these concepts with a focus on improving operational performance. The initiatives often start off small, focusing on rapid improvements and obvious changes that can be easily obtained at the operational level (Liker, 2004, p. 7).

There are a vast amount of concepts proven to be successful. The concepts have distinct differences, but the authors argue that these may share some fundamental components needed to enable a successful adoption. The authors also argue that these are commonly overlooked in the pursuit of rapid results by companies with a less successful adoption.

Customization of a traditional workshop is difficult when routines and mentality have been set for decades. Adoption of new practices from concepts could lead to increasingly complex operations, which are difficult to control and manage, if the organization holds on to old practices and structures when trying to adapt (Bellgran & Säfsten, 2008).

These are issues also identified in the current state analysis of PU Sandviken. The authors argue that this complexity could be seen as a result of the adoption of business improvement concepts where too little emphasis has been given to ensuring that the fundamental components of the concepts are in place.

1.3 Aim and research scope

This study aims to resolve those issues described above, by investigating what components of business improvement concepts are considered fundamental, distinguishing these, and further resolving the succinct within them and what they intend to create.

The study focuses on the fundamentals that should be seen as prerequisites for an organization. The purpose is to give organizations a greater insight as to how they can systematically create a foundation needed to reduce complexity, increase stability and successfully align their organization to today's market situation.

1.3.1 Research questions

The following research questions have been defined to fulfil the aim

RQ 1: What business improvement concepts have proven successful in supporting businesses adapting to a new market situation?

RQ 2: Are there components of fundamental importance for the success of concepts within a manufacturing context?

RQ 3: How can a business improvement model, based on fundamental components, be designed within a manufacturing context?

RQ 4: How would the model work at Sandvik Mining and Construction - PU Sandviken?

1.3.2 Limitations

The study is limited to cover only a few chosen improvement concepts and their fundamental components.

Within the aim of this study, fundamental components are to be identified within successful improvement concepts that have had a major impact on manufacturing during the last decades and are considered to be valid in the future. The concepts selected are some of the most successful manufacturing concepts, performance excellence frameworks and well known quality management standards available today and are all seen as improvement concepts in the context of this research.

In order to limit the amount of components extracted into the theoretical framework and with regards to the first research question, only main components that affect management, and only components affecting in-house operations will be selected as candidates for fundamental components.

Due to the limited resources of this study, the test of the reference model is limited to cover a cross-section of the organization at PU Sandviken, described in paragraph 11.

1.4 Outline of the Report

In order for readers to understand the authors' approach in presenting the research within this thesis, it is important to clarify relations between different chapters of the thesis. The thesis is structured in seven main chapters as presented in Table 1.

Table 1: The outline used in the thesis.

Chapter	Content
I. Introduction	The research background and the research problem are presented. The aim, scope and research questions are also introduced.
II. Research methodology	The research design is introduced. Here, a discussion regarding the design of the study takes place, covering approach, research strategy, and methods of data collection and analysis.
III. Theory	The theoretical body used in the study and a theoretical framework are presented.
IV. Conceptualization	The theoretical framework is expanded and its relation to the creation of the model and its workflow is clarified.
V. Case: PU Sandviken at Sandvik	The model is tested on a cross section of Sandvik's production unit in Sandviken.
VI. Results	The results from the research are presented.
VII. Conclusions and Discussion	Conclusions are drawn from the study and the research findings and future research are discussed.

The first two chapters introduce readers to the purpose of the study and how the study is designed from a scientific point of view. The methods used, and the authors' approach to data analysis are also described.

Chapter III, 'Theory', introduces readers into areas of concern in the study. It acts as a reference for readers to use in order to further understand discussions throughout the thesis. In order to reduce theoretical discussions within chapter IV, 'Conceptualization', the authors have chosen to introduce basic theoretical concepts in Chapter III. The paragraph on model conceptualization concerns theory used when creating the concept. Preceding this is a paragraph discussing theory on the model categories identified and creating support for the criteria developed.

Within Chapter IV, 'Conceptualization', a business improvement model is developed. The model is based on categories and criteria that are initially developed followed by a paragraph where the model as a whole , and its use, is developed and explained.

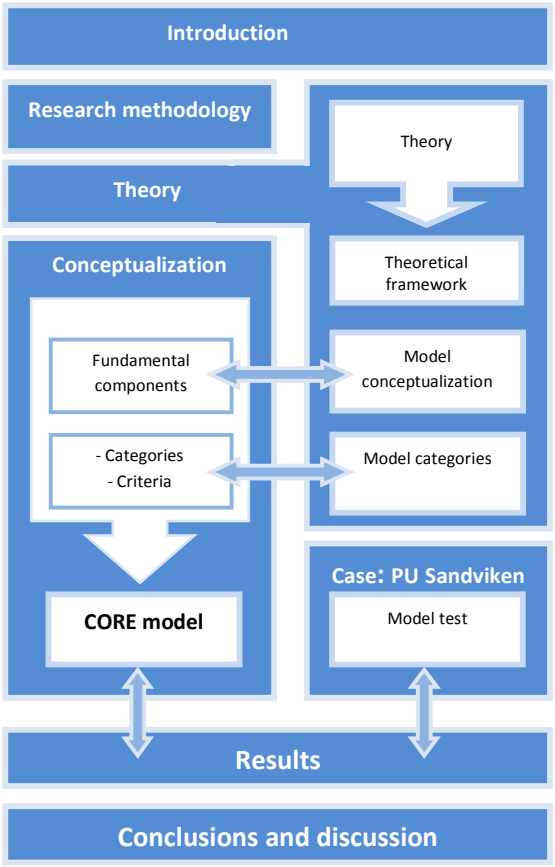

Figure 1: Outline of the Report.

Furthermore, a case study is presented in a separate chapter to further clarify boundaries between discussions. This Chapter V is called 'Case: Sandvik PU Sandviken'. The reference model is tested within a case study and the analysis and results are presented. Results from the overall study on the other hand are presented in Chapter VI, 'Results'. Within this chapter, findings are presented and discussed. Following this is Chapter VII, 'Conclusions and discussion'. An illustration of the outline of the report is presented in Figure 1.

II. Research Methodology

This chapter explains how our research was conducted from a scientific point of view. At first, the scientific research is discussed. Here, the research approach is explained and a research strategy is formulated followed by information on data collection and analysis. Secondly, the research workflow is discussed giving the reader an overview of how the research is conducted. Finally, research validity and reliability issues are discussed.

Outline

2 Scientific research

In order to answer the research questions of a study, it is important to align the research methodology with the aim and purpose stated (Saunders, Lewis, & Thornhill, 2009). In the literature, there are many suggestions of how a scientific research should be designed. The method used in this research is defined by the scientific approach, the research strategy, and the data collection and analysis.

These are further described in following paragraphs and their relation to each other is illustrated in Figure 2, where initially the research approach is defined, secondly the choice of research strategy, and, thirdly, the data collection and analysis methods are defined.

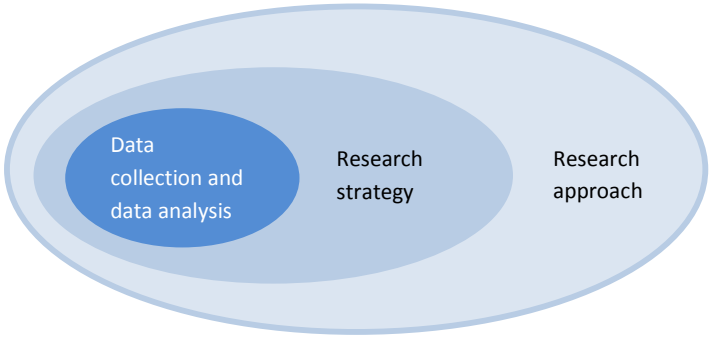

Figure 2: Scientific research methodology.

2.1 Research approach

The most common approaches to conducting research are, respectively, inductive, deductive, or abductive (Levin-Rozalis, 2004). According to Bergman & Klefsjö (2001), the deductive approach applies logical reasoning to derive at a conclusion from a known premise or something known to be true. He also states that the inductive approach establishes a general proposition on the basis of observations of particular facts. Levin-Rozalis (2004) states that the abductive approach is an iterative process where researchers shift between having an inductive and deductive approach as their level of knowledge increases as the research progresses.

This study had an abductive approach, inductively deriving a hypothesis from observations, and later deductively deriving a model from theory.

2.2 Research strategy

According to Andersson and Borgbrant (1998, p. 18 ff), research studies can be grouped into four categories; transformatory, exploratory, theory and model development, and experimental depending on the nature of the research to be undertaken. The choice of research is determined upon the scope of the study, the main objectives, and also in what manner one intend to conduct the study.

The research type applied in this study was foremost theory and model building, especially with regards to answering RQ 1 and RQ 2. An extensive literature review was also used to create a solid foundation for creating the criteria used in the reference model to answer RQ 3.

Based on the context of this study, where the model is meant to be used as a tool for improvement, the model was tested in this context. In order to simulate its intended use and to answer RQ 4 a transformatory research type is used in a case-study at PU Sandviken.

2.3 Data collection methods

Generally speaking, there are three categories of literature sources; primary, secondary, and tertiary. The categories originate in the flow of information, starting with primary and moving toward tertiary. The categories often overlap each other where primary literary sources (reports, theses) can appear in secondary literature such as books and journals. This overlap also applies to tertiary literature where abstracts and dictionaries sometimes refer to primary and secondary sources. (Saunders, Lewis, & Thornhill, 2009)

There are also two types of data, primary and secondary (Kothari, 2008). Primary data is information and data that are collected at the time of the current study using direct observations, experiments or interviews. Secondary data on the other hand, is information that has already been gathered and stored for some other reason. This includes archives of raw data, record of meetings, and published materials. (Kothari, 2008), (Saunders, Lewis, & Thornhill, 2009)

So as to collect the primary and secondary data to be used in the study, several different methods were used. Of the vast amount of methods available, the authors have chosen, with respect to the research strategy, to use a literature review in order to construct a theoretical framework forming a base for answering RQ 1 through RQ 3. Also, interviews were used in order to collect primary data during the case study in order to answer RQ 4.

2.3.1 Research data

According to Saunders, Lewis, & Thornhill (2009), what differentiate qualitative data from quantitative data are both the data collection techniques and the data analysis procedures that are used. Qualitative data refers to information that is non-numeric and collected using interviews, focus groups and published data as examples. Quantitative data on the other hand, refers to numerical information or data that have been quantified. Qualitative data is most commonly used for the deductive research approach and quantitative data for inductive research. (Saunders, Lewis, & Thornhill, 2009, p. 120) (Bryman & Bell, 2007)

In line with the nature of the research, both primary and secondary data was used. Mostly qualitative data collection methods were used with the type of research question in mind, but some quantitative data where used during the analysis within the case study.

2.3.2 Literature review

To ensure that research does not answer questions that already have answers, it is important to map and assess the existing intellectual territory and search for findings of similar research (Saunders, Lewis, & Thornhill, 2009).

The selection of literature for the review has mainly been from databases and e-books available on the library website or on internet. Databases used for finding relevant articles and the main search terms that have been used are presented in Table 2.

Table 2: Databases and search terms used in the study

Databases	Search terms
Business Source Elite	Business improvement
CINAHL	Fundamental components
ERIC	Prerequisites
Scopus	Production control
Google Scholar	Manufacturing
Harvard Business Review	Transformation
Elsevier	Lean
	Six Sigma
	Agile manufacturing
	Malcolm Baldrige
	ISO9000
	Core components

2.3.2.1 Theoretical framework

A theoretical framework was derived from the literature review in order to give the research an intellectual foundation (Sekaran & Bougie, 2009). The theoretical framework acted as a compilation of current theories and concepts to give the authors a comprehensive view of the objectives on which the research questions are created (Saunders, Lewis, & Thornhill, 2009).

2.3.3 Interviews

According to Saunders, Lewis, & Thornhill (2009), an interview is a purposeful discussion between two or more people. A typology commonly used to categorize interviews is concerned with the level of formality and structure of the discussion. These categories are; structured, semi-structured, and unstructured interviews.

Structured interviews, also known as 'closed, fixed-response interviews' use standardized questions and pre-coded answers allowing quantification of the results, making this a method for collection quantitative data. In semi-structured interviews the interviewer has a list of themes and questions that act more as guidelines for the conversation. In this case, additional questions can be added and some original questions may be left out in order to facilitate the natural flow of the discussion. (ibid) (Patton, 2002, s. 349)

Patton (2002) also mentions 'standardized open-ended interviews' as similar to structured interviews, but allowing the respondent to give any answer he or she prefers.

Unstructured interviews or 'informal conversational interviews' are used to explore a general area or topic. These are also referred to as in-depth interviews with the purpose of extending the scope. The discussion is informal, open, where the interviewee is free to talk about the topic of interest. Semi- and structured interviews are methods for collecting qualitative data that are recorded using either, video, audio or notes. (ibid) (Patton, 2002, s. 349)

Within this study, unstructured interviews were used during the initial current state analysis in order to grasp the current situation of the company and to form a basis for the next phase of the study. During the case study phase, semi structured interviews were used to create qualitative data that, together with the model criteria, could be quantified for analysis. Through all interviews there have been two interviewers present to minimize the risk of misperception in order to achieve a higher degree of reliability of the collected data. Summaries of the collected data were documented for future use.

2.4 Data analysis methods

As earlier noted, the choice of data collection methods determine which types of data that are collected, therefore also determine the data analysis methods.

Quantitative data are according to Saunders, Lewis, & Thornhill (2009) of no greater value, if not processed and analysed. The processing of the data refers to turning it into information by coding, structuring, or combining. The information could then with analysis techniques, such as graphs, charts, and statistics be presented in an understandable manner. (Saunders, Lewis, & Thornhill, 2009)

Qualitative data are all data that are non-numerical. Information from qualitative data also needs to be processed in order to enable analysis. Processing qualitative data could either be summarising, categorisation, or structuring. Another way of processing the data is to quantify the qualitative data by counting frequencies of certain events or reasons that have been given or by relating the data to specific references. Doing this will enable analysis of the qualitative data by using quantitative analysis methods. (Saunders, Lewis, & Thornhill, 2009)

The collected data during the current state study and during the conceptualization phase are qualitative and the authors chose to use affinity diagrams and interrelationship diagraphs to analyse the data. As for the case

study, where also qualitative data were gathered through interviews, the data were quantified with the reference model. In analysis, the information was analysed with radar diagrams and GAP-analysis.

2.4.1 Affinity Diagram

Affinity Diagrams are created as a team based activity in order to sort large amounts of information or ideas. In the authors' experience, these diagrams served as a structured approach in identifying solutions or symmetries that are not obvious or when commonalities should be mapped and ordered from a large amount of information. (Bergman & Klefsjö, 2001)

The method stems from one sentence describing the problem that is to be solved; the entire team cooperates in a brainstorming activity where issues or problem solving suggestions are gathered in silence to create a large volume of ideas to pursue. These ideas are later grouped in consensus with all involved and each group is given a summary to address the overall content of the notes within the group. (Bergman & Klefsjö, 2001)

The Affinity Diagram is not used exclusively for brainstorming ideas and possible solutions to a problem. It can also be used as a tool to organize and group a collection of information gathered in other ways than brainstorming. (Bergman & Klefsjö, 2001) (Affinity Consulting, 2000)

Within this study, Affinity Diagrams were used by the authors in the current state analysis during the initial phase as a tool for analysis of the data gathered from interviews in a systematic way. The method was also used in order to group the identified fundamental components into categories in the reference model.

2.4.2 Interrelationship Diagraph

The Interrelationship Diagraph, often referred to as a Relationship Diagram, is used as a tool to illustrate the logical connections between for example a problem or a question (Oakland, 2004). The tool is useful when there is a complex problem with large amounts of data where the interrelationships are hard to establish with logical reasoning (Bergman & Klefsjö, 2001).

When using the Interrelationship Diagraph, identified issues and their cause and effect relationships are mapped as a team effort. This visualization will help to identify symptoms of a more fundamental problem. (Bergman & Klefsjö, 2001)

Interrelationship Diagraphs were used during the current state analysis in order to understand interrelationships between the identified issues and therefore to identify more fundamental problems.

2.4.3 GAP analysis

A GAP analysis is a method where actual performance is compared to desired performance in order to identify the gap between these (Bergman & Klefsjö, 2001). The GAP analysis stems from two main questions that are "where are we now?" and "where do we want to be? (ReVelle, 2004)".

In order to answer the two questions the present performance of the company needed to be identified. Secondly, a desired future state had to be identified. In a gap analysis, these two are compared to find the areas where gaps are present and from these areas of weakness necessary corrective measures are identified in order to reach this future state. (ReVelle, 2004) (Bergman & Klefsjö, 2001)

GAP analysis is a method often used together with reference models where the model defines the desired future state and the organization is compared to this state (International Organistaion of Standardization). In this study, the model created was formulated as basis for GAP-analysis.

2.4.4 Radar Charts

A common tool for visualizing self-assessment results are the Radar Chart. In this type of charts, elements are placed along the rim of a circle. Current performance are then represented on a scale moving from the centre of the circle, with increasing performance as results move closer to the rim. The rim represents a perfect score. (Michael Cowley, 1997, s. 76)

Radar Charts were used after the assessment of PU Sandviken to present the score for each area within the sub categories for further analysis.

3 Research workflow

The study was initiated with a current state analysis at PU Sandviken, upon which the research problem was constructed. Later, the research extended to the second phase where a theoretical framework was created and later used in order to create a reference model. Finally, this reference model was tested with a case study at PU Sandviken.

In Figure 3, the research design presented above is summarized.

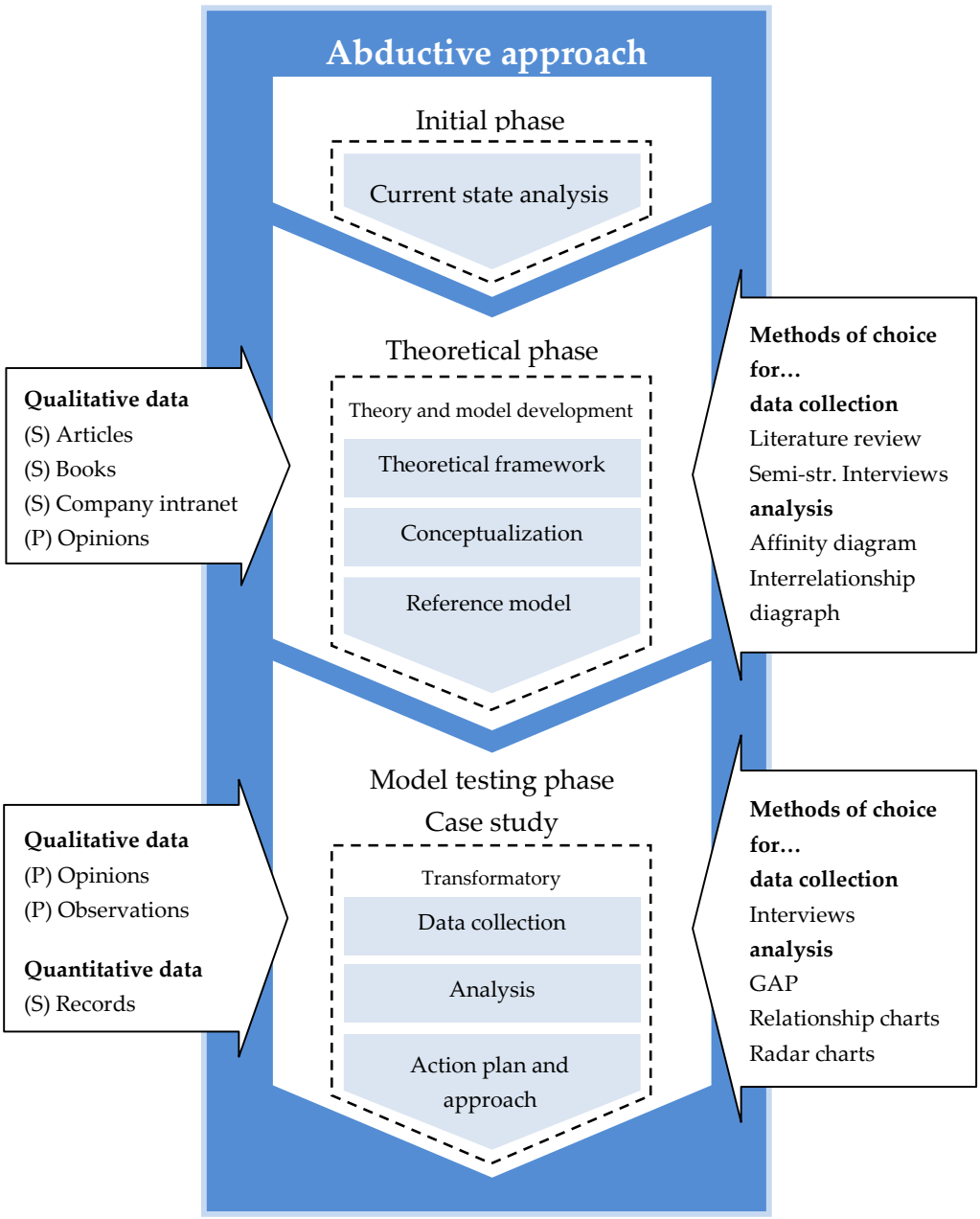

Figure 3: Illustration of the workflow used during the research based on the chosen research design. (P) = primary data and (S) = secondary data.

4 Validity and reliability

4.1 Research validity

Validity of measurements indicates the degree to which the scores from a test or instrument measures what is intended (Zikmund, 2000) (Saunders, Lewis, & Thornhill, 2009)

Generally, in literature, three types of validity are discussed. These are; internal validity, external validity (Saunders, Lewis, & Thornhill, 2009) (Bryman & Bell, 2007), and measurement validity (Bryman & Bell, 2007). Internal validity mainly concerns the casual relationships between variables while external validity concern the generalization of a study, if the results and findings could be used in a context aside from the studied. Measurement validity is vital when a new measure is created during a study and this validity depends on whether the measure actually measures what is intended. (Bryman & Bell, 2007)

According to Zikmund (2000, ss. 282-283) and Saunders, Lewis, & Thornhill (2009, p. 373), there are three basic approaches when discussing measurement validity. Face validity, also referred to as content validity, is the degree to which a measure obviously measures the intended performance or the degree to which study adequately samples what was intended. Criterion validity on the other hand is the degree to which results are related to a recognized standard or criterion, and construct validity is the degree to which a study measures a hypothetical construct linking results to behaviour. (Zikmund, 2000)

Within this study, information has been collected from an extensive literature study ensuring a broad base of understanding within the topic. In order to increase the internal validity the workflow of the study is clearly presented.

External validity within this study is not considered. Many of the business improvement concepts within the study are considered general and are proven successful within other contexts. This implies that the findings may be general, but further research is needed for confirmation.

To increase the measurement validity during the build-up of the reference model, components for the theoretical framework have been collected from already established frameworks and literature summarizing components from

given concepts. As far as the model criteria are concerned, the authors had already established criteria from frameworks previously studied as a source of validation.

4.2 Research reliability

Reliability is concerned with repeatability and consistency of samples. As an explanation, this measure the degree to which a measure of a sample will yield the same result over time, even if for example environmental factors change. (Zikmund, 2000)

Saunders, Lewis, & Thornhill (2009) state that there are three questions that can assess the reliability of findings:

1. Will the measures yield the same results on other occasions?
2. Will similar observations be reached by other observers?
3. Is there transparency in how sense was made from the raw data?

According to Saunders, Lewis, & Thornhill (2009), there are four threats to reliability. Subject or 'participant error' refers to consistency in participant response over time. Subject or 'participant bias' on the other hand refers to errors that might occur from participants not responding their true opinion, having been affected by surrounding factors.

Further, 'observer error' relate to an observers ability to give the same conditions when gathering data. This is for example the ability of asking a question the same way repeatedly. Lastly, there might be 'observer bias' meaning that there are different ways in interpreting a response. (Ibid)

Bryman & Bell, (2007, p. 41) state that the concept of reliability is foremost with a problem within quantitative research.

According to Bryman & Bell (2007, p. 163), reliability in quantitative research can be assessed on stability, internal reliability, and inter-observer consistency. According to them, Stability is concerned with similar reliability as Saunders, Lewis, & Thornhills (2009) first question discussed above. That is, reproducing results. They also state that internal reliability, on the other hand, is foremost concerned with multi-indicator measures and the coherence between indicators within the measure. Lastly, they talk about inter-observer consistency meaning differences and consistency between observer decisions.

In this study, a degree of reliability on collected data was obtained by interviewing multiple respondents, and also complementing interview information with other sources of data such as archived data, and observations.

III. Theory

Theory is reviewed in this chapter. Initially, theory regarding the context of this study is presented by a theoretical overview on the improvement concepts studied within this research. Secondly, a theoretical frame of reference is outlined as a basis for the subsequent conceptualization. Thirdly, theory relevant to the model is presented. Lastly, a thorough discussion about several areas needed in order to support the model categories identified is presented.

Outline

5 Business improvement

As discussed during chapter I of this thesis, markets change continuously. And in order for businesses to respond to this, changes must be made in order to effectively meet customer expectations and demand, and to compete within an ever more competitive market place.

In order to answer the first research question, reviewed below, a literature study was initiated.

RQ 1: What business improvement concepts have proven successful in supporting businesses adapting to a new market situation?

According to Toni & Tonchia (2001) modern business improvement concepts are characterized by their ability to increase overall business performance without trade-offs. Cambridge Online Dictionary (2010) defines a 'concept' as *a principle or idea* and 'improvement' as *when something gets better or when you make it better*. This, along with the context of this study implies a definition of improvement concept as;

"What companies need to have in order to increase their performance"

Improvement concepts come in many varieties, either as a set of principles containing practices, tools, and techniques (Karlsson & Åhlström, 1997) as cited by Anand & Kodali (2009), a set of standards that forms the basis of a quality management system (Bergman & Klefsjö, 2001), or a program with criteria for self-assessment of performance (Balridge Performance Excellence Program, 2010). There is a vast amount of business improvement concepts present today for companies to adopt. Though concepts differ in specifications and focus, there is one thing that is common for all; they have proven to help businesses to achieve excellence, as having best practice, clearly being the best in the industry, or even redefining industry expectations (Slack, Chambers, Johnston, & Betts, 2009, p. 39).

In this study, five concepts have been reviewed. Agile Manufacturing was chosen for its proven ability of enhancing manufacturing companies' ability of being agile (Gunasekaran, 1998). ISO9001 was chosen because of its success in improving businesses in general (Gagel, 2008, p. 170) and with great result having become a worldwide standard of quality management certification (International Organization for Standardization). The Malcolm Baldrige criteria were chosen for their impact on operational performance in American companies during the second half of the 20th century, and also being the foundation of other improvement concepts (Brown, 2006). Lean was chosen for its proven success in the automotive industry and also successful applications in other manufacturing industries over the years (Liker, 2004). Lastly, Six Sigma was chosen because its successes in improving businesses by having a truly structured approach defining the organization around the concept (Przekop, 2006).

Following is a presentation of the reviewed concepts.

5.1 Agile manufacturing

An agile manufacturing company is characterized as a very fast and efficient learning organization (Sharp, Irani, & Desai, 1999). It is not only supposed to be able to respond to changes in current demand, but also to be responsive to future changes with adaptive capabilities (Gunasekaran, 1998). Gunasekaran (1998) define agility by the definition: *"To be Agile is to master change and uncertainty".*

According to Gunasekaran (1998), agility implies two elements; development of internal capacity, and ability to configure the company´s assets to take

advantage of future short-lived opportunities. In other words, it implies the ability to re-organize rapidly and even reconfigure the organization to capitalize on market opportunities.

Avella, Vázquez-Bustelo, & Fernández (2007) state that agile manufacturing during the last decades has been generally accepted as a concept that resolves limitations of lean manufacturing. The agile manufacturing concept stems from lean manufacturing, flexible manufacturing, time-based competition, and fast-cycle innovation. Sharp, Irani, & Desai (1999) clarify that organizations who strive towards becoming agile must start from a stabile foundation and therefore already be world class and using Lean methods.

Lean is still considered to be an improvement of mass production model according to Avella, Vázquez-Bustelo, & Fernández (2007) while agile clearly diverts from mass production and thus creates a new paradigm of manufacturing where high customization of products is the norm (Sharp, Irani, & Desai, 1999). Agile manufacturing emphasizes the use of large amounts of technology present today to increase effectiveness in several areas (Sharp, Irani, & Desai, 1999).

Literature agrees that the agile manufacturing concept could be defined in four dimensions (Avella, Vázquez-Bustelo, & Fernández, 2007) (Gunasekaran, 1998);

- *Enriching the customer*, or total customer focus, entails rapid identification of and adaption to customer requirements.
- *Cooperation in order to enhance competitiveness*, is about building relationships, both inter- and intra-organizational, in order to increase effectiveness. Unique to agile is the construction of a virtual enterprise even with competing organizations if it will enhance competitiveness.
- *Organizing to master change and uncertainties*, emphasize the need to adapt the organizational and managerial structures and technology toward a readiness for change.
- *Leveraging the impact of people and information*, agile manufacturing puts special emphasis on developing the workforce through training and educating them in team-work and information technology.

5.2 ISO 9001

The ISO 9000 family of standards has been developed by the International Organization of Standards addressing the topic of Quality management. ISO

9001 is the standard within the family that provides a set of standardized requirements for a quality management system (Bergman & Klefsjö, 2001). The standard represents an international consensus of good quality management principles towards which companies can be certified (International Organization for Standardization).

Today, many companies require their suppliers to have a certification toward the ISO 9001 standard which imply that many organizations see it as a market requirement (Hoyle, 2009) (Bergman & Klefsjö, 2001). As stated in his book ISO 9000 quality systems handbook, Hoyle (2009) describes the standard as a mean for organizations to stop making promises they cannot keep and help to keep those they can.

The standard includes eight quality management principles that together make the foundation of the ISO 9001:2008 standard, and all requirements within the standard are related to one or more of these principles (Hoyle, 2009). These principles are identified in the ISO 9000 standard as customer focus, leadership, involvement of people, process approach, systems approach to management, continual improvement, factual approach to decision-making, and mutually beneficial supplier relationships (Hoyle, 2009), (International Organization for Standardization), (Bergman & Klefsjö, 2001).

In order to implement a management system in line with the ISO 9001 standard, companies need to identify all processes, to define their order, and to identify and understand how they interact. Secondly, companies need to identify criteria and methods necessary for assuring performance and control of these processes. Thirdly, ensuring the availability of information required supporting functionality and surveillance. Lastly, companies need to measure, oversee, and analyse their processes and take necessary actions. (Bergman & Klefsjö, 2001)

The requirements in ISO 9001 standard is grouped into four categories that together form its body. In the management responsibility category, focus lie on what top-level management should do. This includes creating a vision, setting goals and objectives, and establishing strategies all aligned and linked with customer requirements. Also, responsibilities and authority need to be identified and effective internal communication channels need to be created in order to increase efficiency of decision-making. The standard also implies management to instantly take corrective actions if needed. Lastly the baseline and requirements for management review need to be established. (Hoyle, 2009)

The next category is resource management. Here requirements are focused on the planning, acquisition, deployment, maintenance, and eventually disposal of resources, whatever the type (Hoyle, 2009). Also requirements on human resources, infrastructure and work environment are gathered in this category (Bergman & Klefsjö, 2001).

Thirdly, the product realization category is concerned with understanding customer requirements and transforming them into goods or services (Hoyle, 2009). This involves design and development, purchasing, and production relying heavily on customer communication (Bergman & Klefsjö, 2001).

Lastly, there are requirements on measurement, analysis, and improvement. Here measurements on performance that are directly linked to customer requirements need to be established are defined (Bergman & Klefsjö, 2001). Also tools and methods to control and monitor performance are established in order to enable instant corrective actions, preventive action and continuous improvement.

5.3 Lean Manufacturing

"The emergence of lean enterprise has forever changed the way firms compete",…"lean enterprises react much faster than their mass producer counterparts to changes in the competitive environment", says Cooper (1995).

The improvement concept of Lean Manufacturing has over the past few decades been one of the most dominating concepts (Liker, 2004, p. 7). Womack & Jones, (2003) as cited in Liker (2004, p. 7) describe Lean Manufacturing as a five step process where first customer value is defined and then followed by defining the value stream, making it "flow", "pulling" from the customer, and finally striving for excellence.

Liker (2004) further says that lean manufacturing requires a way of thinking that originates from the customers actual demand and that the essence of lean is to satisfy them in the best possible way. By creating an efficient, low-waste production flow and building a culture in which everyone is striving to continuously improve, this could be achieved.

Lean uses a set of tools and techniques to accomplish better flow and reduce waste throughout the production. These tools are, according to Liker (2004) not the key to becoming lean; they are simply helpful tools on the way there. The

success of lean manufacturing is achieved by working with the culture and the 14 management principles it is constituted from. These principles should permeate the entire organization making it a community of common goals and mindset (Liker, 2004, pp. 34-35).

Liker presents the 14 principles divided into four categories in a model he calls the "4P" model of the Toyota Way. At the base of the *4P* model is philosophy, this is the starting point for an organization. The management principle corresponding to this level is "Base management decisions on a long-term philosophy, even at the expense of short-term financial goals". This means that the company needs to have a long term vision and goals that all activities and functions of the company must strive to achieve. This vision and goals is based on creating value for the customer and society (Liker, 2004).

The second P of the model is *Process* and here the focus is to eliminate all non-value creating activities within the organization processes (Liker, 2004) (Anand & Kodali, 2009). Value is defined as any action or process that the customer would be willing to pay for, thus everything else is defined as wasteful (Bellgran & Säfsten, 2008). Waste within an organization is overproduction, defects, wait, transport, inventory, movement and inappropriate processing; Liker (2004, pp. 28-29) later added an eighth waste, unused employee creativity.

In order to create stability and increase the reliability of process output the lean concept emphasizes the use of standardization. By standardizing the best practices of methods and practices today, but still being open for improving the standards, a firm foundation is created for ongoing improvements. (ibid)

Lean uses a set of tools and principles to ensure that processes are providing the downstream process with the right output. The control principles are based on creating a flow between processes considering the chain of processes as a system focusing on increasing reliability and output of the system as a whole, instead of focusing on each process alone. To increase the view of the system as a sole entity, pull system and Kanban indicators are common tools. (ibid)

By resembling the material replenishment with supermarkets, where products are replenished when levels are getting low a material replenishment system initiated by consumption is created (Liker, 2004). In this way products are only produced when a need has been identified and indicators are used to visualize need of replenishment. The signal is sent to the closest upstream process to

indicate the need for this product. If this process has need of material or products from preceding processes, the indicator proceeds to the start of the process chain, initiating a manufacturing start (Liker, 2004) (Bellgran & Säfsten, 2008).

The third P, *People and Partners,* emphasize on the importance of people and their role within the organization. How important it is for a successful organization to have engaged leaders who truly believe in the company principles and thereby spread their importance to fellow workers. It also emphasizes the involvement of people and partners. Setting up cross-functional teams and provide them with authority and tasks to improve quality and productivity will lead to engagement and empowerment of the work-force when visualizing results. By respecting and challenging partners to help them grow, the organizations could have mutual benefits. (ibid)

The fourth and last P, *Problem Solving,* is about the way problem is to be solved within a lean organization. Problem solving and decisions should be made by understanding, based on facts, thoroughly considering possible courses of action. By including all persons affected by a decision in a cross functional team and making the decision with consensus it is more likely to be a good decision. The involvement of more people in the decision-making will also lead to a more efficient implementation when all is aware of why the decision is made. (ibid)

5.4 Malcolm Baldrige Criteria

Starting in 1988, the Baldrige program was originally designed to promote Total Quality Management (TQM) as the best approach for improving and restoring competitiveness to American companies (Leonard & McGuire, 2007). Derived from the so called Baldrige criteria (developed by US president Reagan's secretary of commerce Malcolm Baldrige (1981-1987) in order to guide American companies into the twenty-first century) the Malcolm Baldrige Award was established in 1988 (Leonard & McGuire, 2007).

The award is considered the highest honour any business can receive (Brown, 2006). According to Leonard & McGuire (2007) The Baldrige criteria offers a powerful set of guidelines for operating an efficient organization that over time has evolved to encompass the overall effectiveness of an organization (Brown, 2006).

The seven categories are; Leadership, Strategic Planning, Customer and Market Focus, Measurement, Analysis, and Knowledge Management, Workforce Focus, Process Management, and Result (Brown, 2006), (Leonard & McGuire, 2007). To summarize the seven categories one can say that Baldrige strives to increase the satisfaction of stakeholders, stakeholders being the customer, the people connected to the organization, and the society (Ehrlich, 2006).

Having leaders that are engaged in developing the organization and truly believe in and communicate a vision is a key element in Baldrige. By creating strategies to improve quality that are based on a long term vision the organization will have more efficient progress.

Baldrige emphasize the management of processes (Brown, 2006) (Leonard & McGuire, 2007) and thereby implying that a process approach is required. In improving process performance proper measures are needed and all decisions should be based on facts and understanding rather than on opinion (Cameron & Winn, 1998). Decentralization of decision-making to lower levels is also the key to faster decision-making and to a higher degree of employee participation (Cameron & Winn, 1998).

There are quality awards similar to Baldrige that also asses the performance of organizations based on the criteria for business excellence. One of the more established of these is The European Quality Award that is founded by the European Foundation of Quality Management (EFQM) (Bergman & Klefsjö, 2001).

5.5 Six Sigma

In literature, there are several definitions of Six Sigma. Park (2003) cites a definition of Six Sigma as "*a program aimed at the near-elimination of defects from every product, process and transaction*". Jones, Parast, & Adams (2010) on the other hand state that Six Sigma is *"recognized as a systematic and structured methodology that attempts to improve process capability through focusing on customer needs".*

What all studied literature has in common is an understanding that Six Sigma revolves around process improvement and the reduction of variation in process output, relying heavily on structured process management (Bergman & Klefsjö, 2001), (Goh, 2002), (Jones, Parast, & Adams, 2010), (Park, 2003), (Przekop, 2006).

The name Six Sigma itself is a straight forward clue to what the concept implies. Sigma (σ) is the Greek letter that has become a symbol and metric for what in statistical practices are called standard deviation (Park, 2003). This deviation is measured upon variation within a data set, a group of items, or output of a process. The name 'Six Sigma' is derived from the use of six standard deviations when measuring performance, thus implicating striving for fewer than 3.4 deviations from the standard out of one million units (Przekop, 2006). Applied within a manufacturing context, this means having a process yielding less than 3.4 defect items out of one million produced. Przekop (2006) identify this as playing a key role in the concept as a drive for perfection.

What makes Six Sigma unique, in comparison with all other improvement concepts studied within this research, is the rigorous training of employees (Goh, 2002), (Bergman & Klefsjö, 2001). This results in several levels of expertise in organizations work-force making a structured hierarchy (Bergman & Klefsjö, 2001).

Six Sigma is a data-driven concept (Jones, Parast, & Adams, 2010) and based on this notion, data and facts should be the basis of decisions and actions across an organization (Przekop, 2006) (Jones, Parast, & Adams, 2010) (Goh, 2002). An important feature of Six Sigma is the focus on measurability of each action (Bergman & Klefsjö, 2001), and with its result oriented approach the outcome of each Six Sigma project is usually expressed financially (Goh, 2002).

The management of improvements is guided by four principles. Firstly, during the *alignment* of activities, managers need to understand their performance gaps in order to identify improvement targets. Customer requirements also need to be linked with the business strategy and key processes and strategies need to be developed expressing goals, and appropriate measures that are aligned to these requirements. (Barney & McCarty, 2003)

The literature strongly accentuates customer focus (Przekop, 2006) (Goh, 2002) (Park, 2003) as a fundamental part of the concept. According to Goh (2002), customer focus is emphasized throughout Six Sigma in terms of critical to quality parameters (CTQ's) and that an improvement initiative only make sense if its outcome is directly related to the CTQ's. These parameters measure what is important to customers in term of value creation.

Secondly, all improvement efforts made within the Six Sigma concept is made on a project-by-project basis (Goh, 2002). In order to meet these goals, improvement leaders *mobilize* teams to execute projects in a structured and systematic manner using the so called DMAIC-model (Barney & McCarty, 2003) (Bergman & Klefsjö, 2001) (Goh, 2002). Park (2003) gives an explanation of the DMAIC-model. Teamwork and boundary-less cooperation across functions is according to Przekop (2006) a key within the concept.

Thirdly, managers need to *accelerate* the organization in terms of timely and appropriate education alongside projects, in order to bridge the gap from learning to doing (Barney & McCarty, 2003). And lastly, managers must *govern* all initiatives using scorecard metrics and CTQ's established during the alignment in order to prevent falling back from the new and improved state.

5.6 Theoretical framework

A theoretical framework was developed in order to answer research question two, reviewed as;

RQ 2: Are there components of fundamental importance for the success of concepts within a manufacturing context?

In order to identify core components from the previously described concepts, established frameworks and the specialized literature concerning each concept was further studied. Within these frameworks and this literature, components creating the essence of each concept have been distinguished by earlier researchers and authors. The emphasis within the study is to identify the key aspects from each concept and embody these in a concept only considering the fundamental prerequisites from the reviewed concepts. Therefore, the choice of using already established frameworks was made in order to put more emphasis on identifying the more fundamental components within these.

The framework contains core components from the reviewed improvement concepts. In order to extract components from each concept, 'component' needed a definition. There are many different ways of defining a component depending on the context upon which it is used. Within this study, the context used in order to define component is business improvement concepts.

A general definition of component is according to Cambridge online dictionary "a part which combines with other parts to form something bigger". This along with the definition of its context implies a definition of component as follows:

"A part which combined with other parts forms a concept of how businesses can improve their performance"

In Table 3, components from the frameworks and literature are presented. The components are grouped for each concept and are presented in no particular sequence. A source reference for each identified component is presented.

Important to notice is the fact that there might be differences in opinions of which components are core and which are not. There may also be parts of studied concepts that might be considered components by some, though neglected by the authors. What is presented is a compilation of components most commonly found and discussed in research and literature.

Looking at the components identified within the framework, there is no single one that strictly relates to manufacturing. This implies that an argument can be made that the components might be general and applicable for organizations outside a manufacturing context.

Table 3: Compilation of components identified as core components of the chosen improvement concepts.

Improvement initiative	Agile Manufacturing	ISO 9001	Lean Manufacturing	Malcolm Baldrige Criteria	Six Sigma
Core Components	•Intra- and inter organizational cooperation in order to enhance competitiveness •Organizing to master change and uncertainty (1)(2) • Recognize the importance of employees as a key asset for the firm (1)(2) • Continuous change (3) • Rapid response (3) • Quality improvement (3) • Social responsibility (3) • Total Customer Focus (1)(2)(3)	• Customer focus (4) • Involvement of people (4) • Continual improvement (4) • Management involvement (4) • Management commitment (4) • Process approach (4) • Process management based on facts (4) • Monitoring of performance measures (5) • Information channels (4) • System approach to management (4) • Continuous and instant improvement (4) • Factual approach to decision-making (4) • Objectives aligned with customer needs (4) • Resource management (4)	• Focus on elimination of waste (6) • Focus on continuous incremental improvements (6) • Focus on customers (6) • Long term philosophy • Continuous flow (7) • Pull systems (6)(7) • Levelled workload (7) • Culture of stopping to fix problems (7) • Standardized tasks (7) • Process approach (7) • Visual management system (6)(7) • Use reliable, tested technology (7) • Leaders who understand the work and live the philosophy (7) • People development (6) (7) • Challenge and help partners and suppliers (6) (7) • Solve problems by understanding (7) • Make decisions slowly by consensus, implement decisions rapidly (7) • Become a learning organization (7)	• Leadership (8) • Customer and market focus (8) •Human resources focus (8)(9) •Process management (8) • Visionary leadership (9) • Customer-driven excellence (9) • Organizational and personal learning (9) • Agility (9) • Focus on the future (9) • Managing for innovation (9) • Management by fact (9) (8) • Societal responsibility (9) • Focus on results and creating value (9)(8) • Systems perspective (9)	• Process approach (8) • Structured process management (8) • Process improvement (8) • Genuine focus on the customer (8) • Monitoring metrics linked to CTQ's (8) • Boundary-less collaboration(8) • Data-and-fact driven management (8) • Proactive management (8) • Drive for perfection (8) • Tolerance for failure (8) • Top-down solution (10) • Alignment of activities (10)(11) • Mobilized teams to attach high impact projects (10)(11) • Accelerate in order to improve business results (10)(11) • Govern efforts to ensure improvements are sustained (10)(11)

(1) (Gunasekaran, 1998)
(2) (Avella, Vázquez-Bustelo, & Fernández, 2007)
(3) (Sharp, Irani, & Desai, 1999)
(4) (Hoyle, 2009)
(5) (Bergman & Klefsjö, 2001)
(6) (Anand & Kodali, 2009)
(7) (Liker, 2004)
(8) (Przekop, 2006)
(9) (Baldrige)
(10) (Motorola University)
(11) (Basu, 2009)

6 Theory conceptualization

This chapter presents the theoretical body used in developing the reference model during the conceptualization. Initially, the very idea of a business reference model is presented, followed by theories describing self -assessment, the implementation of improvement concepts, and, lastly, management and managerial levels are discussed.

6.1 Business reference model

A reference model is a general conceptual model containing common "best practices" of a certain domain. The model should consist of re-usable practices that will function in similar domains. (Rosemann, 2003)

The objectives of a reference model are to streamline the design phase of an enterprise individual model by reusing already common successful solutions. This will increase the effectiveness of the individualization of a model when it does not need to be built from scratch. (Gerosa & Taisch, 2008)

A business reference model is therefore a reference model, concentrating on the functional and organizational aspects of the core business of an enterprise, service organization or government agency.

According to Fettke & Loos (2007) there is almost no dispute that a reference model is a conceptual model and that not all conceptual models are reference models. What distinguishes reference models are according to Fettke & Loos (2007);

- **Best practices** - That they provide best practices for conducting business
- **Universal applicability** - Not representing a particular enterprise
- **Reusability** - A conceptual framework understood as a blueprint that could be reused

In this study, a reference model is developed as part of a conceptualization of a business improvement concept. The authors aim to represent 'best practices' within the model based on fundamental components of other improvement concepts. In order for businesses to adopt the concept, criteria representing best practice has been developed in to enable evaluation based on self-assessment against the reference model. This will be discussed in further detail in paragraph 8.

6.2 Self-assessment

In the book *Peter Drucker's The Five Most Important Question Self-Assessment Tool* by Leader to Leader Institute (2010) it is stated that organizational self-assessment leads to performance excellence. The book presents five questions that are essential for any organization that is to be successful. By assessing the organizational performance from these questions and creating a plan to resolve areas where performance is not optimal a good foundation for future success is built. The five most important questions are (Leader to Leader Institute, 2010):

- What is our mission?
- Who is our customer?
- What does our customer value?
- What are our results?
- What is our plan?

European Foundation for Quality Management (EFQM) has created a self-assessment tool called the EFQM Excellence model. According to EFQM the basis of building a culture of excellence in an organization is honest and informed self-knowledge. The creation of a common understanding of the performance of your organization is the foundation needed to enable a unified corrective work where all involved understand the need for change (EFQM).

The reference model created within this study will form a basis for self-assessment of organizations that wishes to improve their performance in areas considered fundamental and therefore increase chance of success in today's market situation.

6.3 Implementing organizational changes

The success and failure of many common improvement concepts rely heavily on their implementation. Even though this is a well-known fact, not many concepts come with a general implementation plan, emphasizing the fundamental prerequisites (Moosa & Sajid, 2010).

Chakravorty (2009) discusses an implementations model for Six Sigma while Murman, et al. (2002) form an 'enterprise transformation roadmap' to build a lean enterprise. The objectives of these models of implementation are to assist organizations in effectively transforming from a mass-production mentality to a more resource efficient mentality with a higher degree of stakeholder involvement.

Even though Chakravorty (2009) discusses Sex Sigma implementation and Murman, et al. (2002) is more focused on Lean enterprise implementation there are many similarities regarding the approach they recommend to achieve a successful implementation. Both emphasize the importance of engaged leaders in the transformation initiative and illustrates this in the models with an initial segment concerning only strategic decisions.

Both Chakravorty (2009), Pande, Neuman, & Cavanagh (2000) and Murman, et al. (2002) recommend the use of an implementation leader or an implementation team to support the day-to-day activities in the implementation process. This person or unit will work as a support for the entire implementation phase from the leadership group to sponsors. They will help fill the gaps in the improvement organization, documenting the overall program progress, bring issues to the surface, and market the initiative internally. Chakravorty (2009) also emphasizes that the team should be created by specialists from different parts of the organization and also function to secure that leadership commitment is kept throughout the implementation and sustained in the future organization.

It is common that organizations use consultants to accelerate and ease the implementation but Chakravorty (2009) advises against the use of outsiders.

6.4 Management and organizational levels

Management studies are very popular in business science, and Drucker (2007) claims there are hundreds, if not thousands, of books on the topic. This literature focuses on the management of different functions of a business such as production, engineering, marketing, purchasing, information, and knowledge.

The term 'management' has several meanings according to Drucker (M2001), denoting both a function and the person who wields it, a social position and authority, as well as a discipline and field of study. Management is defined by Daft (2008) as "the attainment of organizational goals in an effective and efficient manner through planning, organizing, leading, and controlling organizational resources".

According to Grünig & Kühn (2009), there are three levels of processes that are needed within a business. Firstly there are operational processes, taking the hiring process as an example. There are also management processes, which according to Grünig & Kühn (2009) ensure the efficient and effective

organization of operational processes. Lastly, there is governance processes ensuring compliance with rules and guidelines.

Management is decision-making according to Grünig & Kühn (2009), and as defined by Waters (2002), there are three levels of decisions implying different importance, time scope, and focus as presented in Table 4.

Table 4: Features of different levels of decisions. Source (Waters, 2002)

Decision	**Strategic**	**Tactical**	**Operational**
Level of manager	Senior	Middle	Junior
Importance	High	Medium	Low
Resources used	Many	Some	Few
Timescale	Long	Medium	Short
Focus	Whole organization	Parts of the business	Individual activities
Risk	High	Medium	Low
Uncertainty	High	Medium	Low
Amount of detail	Very general	Moderate	Very detailed
Data available	Limited	Some	More
Structure	Unstructured	Some	Structured
Management skills	Conceptual	Human	Technical

This makes classifying management into three distinct organizational levels possible. The strategic level, concerned with governance processes and strategic decisions. The tactical level, making tactical decisions and running management processes. Lastly, there is the operational level, concerned with managing operational processes and making operational decisions.

7 Model categories

During the conceptualization phase of the study the components of the different improvement concepts were grouped into categories by the use of an Affinity Diagram. The grouping of the components are further described and presented in paragraph 8.2. The categories established are; customer focus, leadership, structure, decision-making, and control. Each of the five categories will in this paragraph be further described in detail.

7.1 Customer focus

The customer is the sole reason companies exist (Cochran, 2006) and in order for a company to meet customer demands, it is important to understand what the customer's actual needs are. There is often a difference in what a business perceive as their customers' wants, and what the customers feel they need, and what customers actually need. For this reason, it is vital that organizations have a focus on the customer.

Having a customer focus involves understanding the customer's activities, interests, and opinions around a particular value (Joby, 2003). Also significant is having an understanding of customer expectations and perceptions on this particular value in order to deliver products and services that meet these expectations.

There are a number of key processes that help organizations to ensure a customer focus. These are management systems, innovation, training, leadership and culture, customer perceptions, and complaint resolution. (Cochran, 2006)

7.1.1 Customer-focused organization

A customer-focused organization (CFO) is defined by Miller & Miller (2007) as an organization:

- Whose every action is shaped by a relentless commitment to meeting and exceeding its customers' expectations regarding product and service quality.
- Who constantly evaluates and improves internal processes to meet those expectations.
- Whose employees are aware of their role in maintaining a valued relationship with their customers.

7.1.2 Internal customers and cooperation

In his study on customer-driven manufacturing in 1997, Quentin R. Skarbec, Jr. identified five critical characteristics, of which cross-functionality and integration are the two most significant. Customer-driven manufacturing must be a uniform, unified approach to the customer and that internal cooperation clearly is as critical as external cooperation with the customer, says Skarbec, Jr.

Cross-functional and cross-departmental cooperation is according to Miller & Miller (2007) essential in order to deliver superior value to customers and in order to succeed, everyone needs to understand that their job is a primary part of creating customer value and not only a series of tasks.

An important part and one of the key characteristics of successful internal service partnerships are well-designed and efficient work processes and mutual agreement and commitment to actions. In order to build and strengthen internal partnerships, Miller & Miller (2007) introduce a six step tasks-list with 'identifying your internal service partners (people/departments) and clarify requirements as the two most fundamental an initial steps.

7.2 Leadership

There are several different types of leadership and with the limited research scope of this study in mind, only transformational leadership will be discussed.

Based on a study made by Bennis and Nanus in 1985, four common strategies where used in transforming organizations. Firstly, transforming leaders had a clear vision of the future state of their organizations. Secondly, transforming leaders were social architects. Thirdly, they created trust, and lastly creative deployment through positive self-regard. (Northouse, 2010)

Kouzes and Posner (1987, 2002) have identified five fundamental practices for transformational leadership that are summarized into the list below (Northouse, 2010):

- Model the way by being clear about their own values and philosophy
- Inspire a shared vision
- Challenge the process by willingly changing the status qou and stepping into the unknown.
- Enable others to act, promoting collaboration and teamwork
- Encourage the heart by rewarding others for their accomplishments.

Based on the four strategies and the five practices mentioned above one can derive that having a clear vision and strategies to pave the way for transformation is critical. Becker, Kugeler, & Rosemann (2003) also state that when organizations change strategies, leaders should simultaneously consider the structure needed to support use of the new strategy since a proper match between strategy and structure can create a competitive advantage.

In management science, perceived target situations can be formulated into goals. Companies normally have multiple goals, and these goals together make up a goal system that is a necessary prerequisite for discovering decision problems. (Grünig & Kühn, 2009)

A complete goal description requires the following four key elements (Grünig & Kühn, 2009):

- A statement of goal content or goal variable
- A statement of the required degree of attainment of the goal
- A statement on the temporal validity of the goal
- A statement on the scope of applicability of the goal

7.3 Structure

According to Hitt, Ireland, & Hoskinsson (2009) research indicates that organizational structure and the controls that are a part of the structure affect a company's performance. They also state that the organizational structure define a company's formal reporting relationships, procedures, controls, authority and decision-making process. Hence, the structure specifies the work to be done and how to do it, given the firm's strategy or strategies.

Organizational structure is a critical component of effective strategy implementation processes and is concerned with processes used to complete organizational tasks (Hitt, Ireland, & Hoskinsson, 2009). According to Hitt, Ireland, & Hoskinsson (2009), a modification of a current strategy or adoption of a new strategy also requires a company to change to its organizational structure.

Nowadays, structure is commonly discussed using the term process-orientation that is a way for organization to organize activities and actions into a formal structure. The idea of process-orientation is nothing new and has been around since the 1980's. (Becker, Kugeler, & Rosemann, 2003)

According to Page (2010, p. 4), there are four simple questions to ask oneself in order to know if a business should examine and develop its businesses processes. These are;

1. Do your processes include a high level of customer interaction?
2. Does every step in your process add value for the customer?
3. Have you established customer focused metrics for the business process?
4. Are your employees evaluated on their contribution to the business process?

Noted is that Page defines customer as both internal and external stakeholders to the company.

The strengthening of a company as a whole and the reduction of existing interfaces, however, require a focus on the cross-functional business processes. Running individual functions for a long time period often lead to local optimization and perfection of functional areas causing the interrelationship of

operational functions to dry out and sometimes disappear. (Becker, Kugeler, & Rosemann, 2003)

When developing business processes, Page (2010) introduces a simple step-by-step routine to follow. The first two steps are considered fundamental and involve creating an inventory of processes and establishing a formal foundation by creating documentation where each process is defined. More information regarding this can be found in the book 'The power of business process improvement: 10 simple steps to increase effectiveness, efficiency, and adaptability'.

Oakland (Statistical Process Control, 2003, s. 5) defines a process as " the transformation of a set of inputs, which can include materials, actions, methods and operations, into desired outputs, in the form of products, information, services or – generally – result". He also states that a documented and agreed description of each process is necessary in order to prevent failure and that a definition of input and the desired output are required in order to measure and analyse process performance. A visualization of a process description is presented in Figure 4.

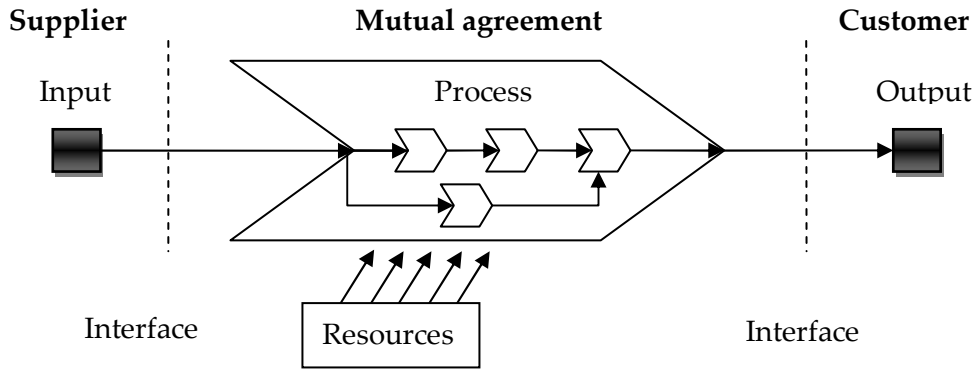

Figure 4: using resources, a process transform input into result on an internal/external customer request. The process interfaces determine the boundaries of a process. Source: (Bergman & Klefsjö, 2001, p. 417)

7.4 Decision-making

There are many different kinds of decisions to make and within a business context decisions can be grouped into five categories (Teale, Dispenza, Flynn, & Currie, 2003);

- Operational decisions, concern the day-to-day running of an organization

- Strategic decisions, are directly concerned with the overall direction of the organization, and are usually made by senior managers.
- Programmed decision, relies on predetermined procedures.
- Structured decisions, involve seemingly clear, unambiguous and a well defined context
- Unstructured decision, is the contrary to structured

According to Bhushan & Rai (2004), strategy is about fit. They also state that decision-making involves choice. The combination of these implies that strategic decision-making involves fitting the internal capabilities to the external environment by choosing the best among the possible courses of action.

Management is decision-making (Grünig & Kühn, 2009), and decisions can only be made when there is a decision problem to act upon. A decision problem has two characteristics (Grünig & Kühn, 2009):

- A discrepancy between the current situation and the target situation
- At least two options for action to achieve the target.

When looking at the two characteristics mentioned above, the goal setting activities discussed during the leadership paragraph 7.2 is further emphasized as critical.

In order for management to enable early recognition of problems, companies develop problem-finding systems that imply systematic monitoring of problem indicators that will be further explained below. These systems are defined by Kühn & Walliser (1978, p. 227 ff.) as cited in Grünig & Kühn (2009, p. 22) as;

- subsystems of the corporate information system,
- which gather, process and store information, and
- in order to discover decision problems and set problem-solution processes in motion

The central component of a problem-finding system is according to Grünig & Kühn (2009) its set of problem indicators. A problem indicator is a variable and when its value changes one can assume, that the change may indicate a problem. Problem indicators can according to them be grouped into four types;

- General goal indicators, such as return on equity
- Variables, which have an arithmetical relationship with a general goal

- Operational cause indicators, who are a construct of cause and effect relationship to a goal
- Strategic cause indicators, showing change in market position.

One of the main focuses of management science is according to Grünig & Kühn (2009) to support executives in dealing with decisions and that management as a science can contribute in one of two ways. Either by developing explanatory models used to predict future development and determine effects of possible 'states of nature', or by proposing decision-making procedures helping managers making decisions, i.e. choices between possible courses of action.

A decision-making procedure, interpreted as a type of decision support can be defined as a system of rules for obtaining and analysing information which can be applied to the resolution of a certain type of decision. More information on this topic can be found in the book "Successful Decision-making: A Systematic Approach to Complex Problems" written by Grünig & Kühn (2009)

7.5 Control

Control systems has according to Sitkin, Cardinal, & Bijlsma-Frankema (2010) been accepted as fundamental for organizations in aligning strive and goals with their capabilities, activities and performance.

In TQM-based control systems where process orientation is the norm, Sitkin, Cardinal, & Bijlsma-Frankema (2010) explain the differences of control depending on the level of understanding of the situation. A well understood situation could be controlled only by monitoring and standardization of operations to ensure a good outcome. In not as well understood situations where no stability or normal state is present, control will more or less be about monitoring the changes and assigning the appropriate response. Here exists a close relationship to the category decision-making when decision support is a good way to assign and sustain appropriate responses identified.

In order to have control, managers need a system and climate in which their subordinates can exercise control over their own processes (Oakland, Statistical Process Control, 2003). According to Cobb (2003), a "system thinking" approach is required in order to control an organizational structure that has a process approach. Cobb (2003, s. 49) further describes system thinking using a discussion from George and Weimershirchs book 'Total Quality Management'. They say that system thinking is a new management model that is nothing

more than *"a discipline for seeing your entire organization, the interrelationships among people and processes that determine success and the pattern of change that demand vigilance"*.

System thinking is not only important for top-level management, it needs to be rooted through the entire organization at all levels Cobb (2003, s. 51). This is important in order for managers to control the system to perform collectively and attain customer satisfaction. This also applies to middle-management and operators in order to make correct decisions that ultimately can have an impact on the entire systems overall performance.

A facility's productivity should also be measured according to its system, including all sub-systems and processes. According to Dettmer (1997, p. 8) productivity is not increased by increasing the performance of individual processes, but when the entire system increases its through-put the overall productivity is increased. Hence one cannot be faster that the slowest process.

A typical way of organizing manufacturing companies is a functional layout that often results in a vertical organization that limits its overall ability of operating efficiently (Oakland, 2003). Managers tend to focus on their single function, with top-down rewards and incentives connected to their narrow missions (Sitkin, Cardinal, & Bijlsma-Frankema, 2010). This inhibits the external customer perspective and creates barriers within the organization that limits the organizations total process of reaching customer satisfaction, and limits synergies between functions (Oakland, 2003).

According to Oakland (2003), businesses that focus on managing processes instead of functions, break these internal barriers and create an organization that works as a cross-functional team, having a horizontal view, in order to control the total process. This approach is different from a functional orientation, where processes cut through functions horizontally, as illustrated in Figure 5, instead of being contained within each function. More on process approach can be read in paragraph 7.3.

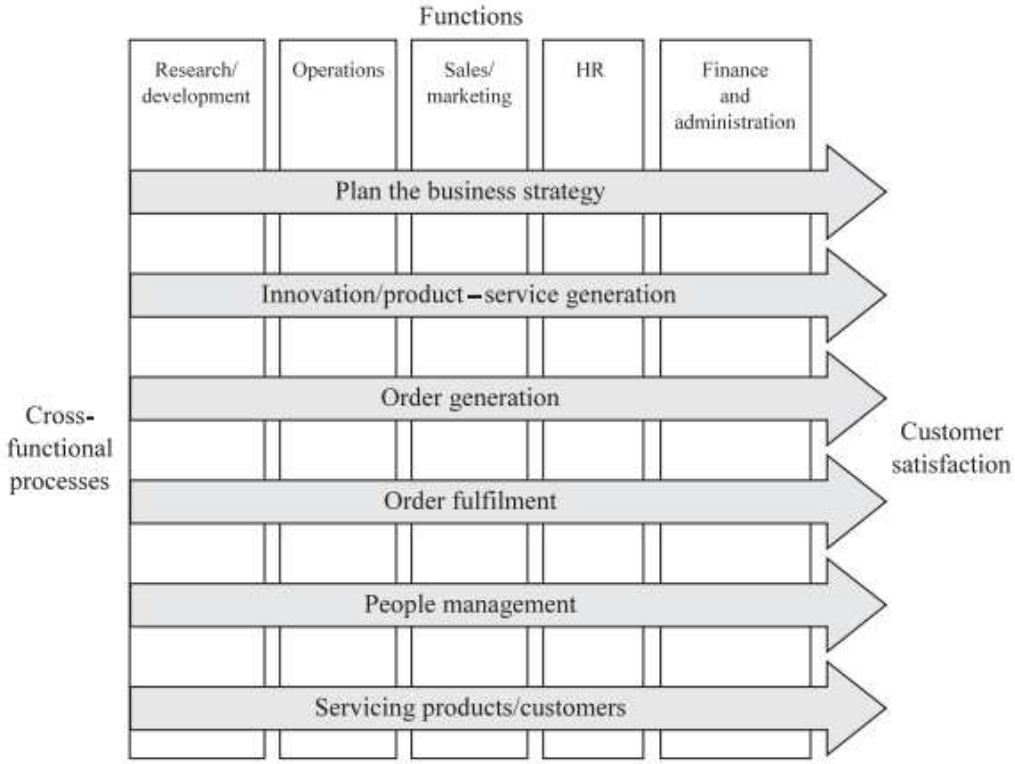

Figure 5: A typical cross-functional approach to manage core processes. (Oakland, 2003, p. 25)

Oakland (2003, s. 8) says that in order for an operator to control its process, he or she need 'tools' to control it. Operators using different methods and procedures in order to complete the same task are a significant source of variation on output according to Oakland (Statistical Process Control, 2003), and that standardized procedures designed together with technical experts have shown to reduce this variation.

This is important in order for managers and teams to control each process and ensure a higher degree of reliability of process performance measurements. These measurements are used in order to identify issues within the process as discussed in paragraph 7.3 and for factual decision-making discussed in paragraph 7.4.

Another important aspect of control is to ensure that changes and improvements within the organization are sustained. According to John (2004), there are three critical aspects of sustaining change successfully and that the success lies in focusing on all three when implementing major change:

- The operating system, commonly referred to as Lean production systems or such, is the way in which manufacturing companies deliver value to its customers. Important to note is that within a company, these operation systems exist throughout the entire organization, not only focusing on production.
- The management infrastructure is the means by which they manage. It usually contains systems, processes, and structures aiming to gather data upon which managers can make factual-decisions.
- The last aspects are capabilities, mind-set and behaviours. This aspect focuses a lot on organizational culture. John (2004) states that employees' mind-sets are *"shaped by the trust they have in their management, their past experience and the factors that motivate them in their role"*. He also claims that people's behaviour is driven by their mind-set.

John (2004) also notes that the three aspects discussed above also rely on external supporting resources such as information systems, education and training, and expertise of external specialists.

Connecting back to the previously discussed categories of leadership, structure, and decision-making, one can see that the categories gradually build a foundation for a companywide operation system and management infrastructure. The category discussed in this paragraph, control, breaks barriers between organizational functions in order to control the company as a whole. It also focuses on sustaining the changes required by the other categories by establishing guidelines for employees to follow, ensuring a new way of working and support for the management infrastructure my measurements of these guidelines in order to supervise that they are pursued.

IV. Conceptualization

This chapter is the body of the study. A business improvement model (CORE model) is constructed based on the theoretical framework developed in the previous chapter. The conceptualization process starts by identification of fundamental components that are later grouped into categories. Criteria are created as a foundation for using the model as a self-assessment tool. Lastly, the entire model is described by workflow and overview. Relevant theories for this chapter are presented in the previous chapter.

Outline

8 Business improvement model

The business improvement model is comprised of criteria grouped in categories with the purpose of functioning as basis for self-assessment and improvement.

The conceptualization of the model was made from core components presented in the theoretical framework in Table 3. In order to have a structured approach, a conceptualization process was developed as visualized in Figure 6. Firstly, the most fundamental components were identified. Secondly, these components were grouped into categories and, finally, criteria for each category were derived from their components.

These criteria act as a blueprint for best practices of each category as being an important part of a reference model (Peter Fettke, 2007). The authors have paid attention to the need for reusability and universal applicability when developing criteria, making sure that criteria are not specific for a particular business.

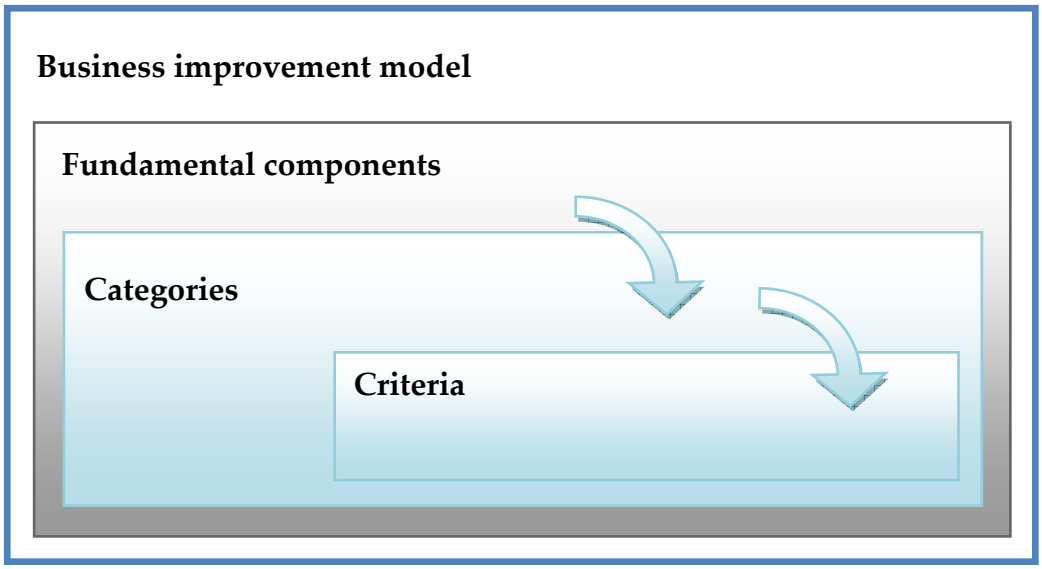

Figure 6: The Conceptualization process used in order to derive the model criteria from the fundamental components identified in the theoretical framework in Table 3.

8.1 Fundamental components

In this paragraph, fundamental components of business improvement are identified from the theoretical framework. These components make up the foundation of the model of which categories later are created. In order to proceed into conceptualization of the business improvement model the second research question of the study is reviewed as;

RQ 2: Are there core components of fundamental importance for the success of the concepts within a manufacturing context?

Based on this question, a discussion regarding all core components of each improvement concept are made and from this the fundamental components are identified. Cambridge Online Dictionary (2010) define fundamental as;

"*forming the base, from which everything else develops; more important than anything else*".

In the context of this study, this means the fundamental components of the improvement concepts create the prerequisites needed to enable successful use of the other components.

8.1.1 Agile manufacturing

Agile manufacturing is a concept that stems from other improvement concepts and requires an organization to already be world class and using lean methods. Hence, Agile manufacturing does not have as many specific

components but components from Lean production could also be considered valid for agile.

The components 'continuous change' and 'quality improvement' focus on improvement and development. This implies that these components relate to further development and since this study concerns creating a stable basis of such development, these components are not considered fundamental.

'Social responsibility' and the 'recognition of employees as key assets of the firm' are not considered fundamental because these do not form a foundation for any other component.

'Rapid response' is not fundamental since it is something that is reached and enabled after first reaching the three components that actually are considered fundamental. The fundamental components are intra- and inter organizational cooperation in order to enhance competitiveness, total customer focus and organizing to master change and uncertainty.

8.1.2 ISO 9001

From the core components identified, only three are dismissed as non-fundamental. These are 'involvement of people' since these mostly relate to improvement initiatives which lead us to the next dismissal. 'Continual improvement' is a component that depends on other components to be effective. Lastly, 'resource management' is identified as not being fundamental because it is not the basis of any other component, and changes in this component are only a result of improvement initiatives or regarding strategic initiatives.

The components identified as fundamental are customer focus, management involvement and commitment, process approach and management based on facts, monitoring of performance measures, information channels, system approach to management, factual approach to decision-making, and having objectives aligned with customer needs.

8.1.3 Lean

From all the components of Lean manufacturing, about half of them are not considered fundamental. The 'focus on continuous incremental improvements' and 'only use reliable tested technology' are not considered fundamental, since both relate to development. The fundamental prerequisites should create a steady state to develop from.

'Continuous flow', 'pull systems' and 'visual management system' are seen as ways to control the production system and create a good reliable production where overproduction and other wastes are minimized. These components need a solid foundation to function and can therefore not be considered fundamental.

'Become a learning organization' and 'people development' are important factors for an organization but are in this context not fundamental.

'Culture of stopping to fix problems' and 'focus of elimination of waste' could be considered fundamental because there are a lot of wastes to be eliminated in creating a stable organization, and changing it means a lot of problem fixing. In this study, the authors feel they focus more on further development and improvements from the normal and are therefore not considered fundamental.

The components considered to be fundamental are focus on customers, long term philosophy, levelled workload, standardized tasks, process approach, leaders who understand the work and live the philosophy, challenge and help partners and suppliers, solve problems by understanding and make decisions slowly by consensus, and implement decisions rapidly.

8.1.4 Malcolm Baldrige Criteria

From the Baldrige criteria there are about a third of the components that are not considered fundamental. 'Societal responsibility', 'organizational learning' and the 'human resource focus' are all components that do not by themselves create prerequisites for other components and are therefore not considered fundamental.

'Managing for innovation' is a component that focuses on creating a management climate that promotes innovation. Innovation is a great factor for development but cannot be seen as fundamental. The same goes for 'agility' that is a competitive priority, but to enable an organization to be agile there are other prerequisites needed and therefore the component is also not considered fundamental.

The fundamental principles of Malcolm Baldrige criteria are leadership, customer and market focus, process management, visionary leadership, customer-driven excellence, focus on the future, management by fact, focus on results and creating value, and systems perspective.

8.1.5 Six sigma

Looking at the core components identified in the theoretical framework, some are more fundamental than others. 'Process improvement' for one is not seen as a fundamental component since it regards improving processes.

'Proactive management' and 'data-and-fact driven management' is excluded from being fundamental because they demand prerequisites of data and facts that are enabled by other components

'Drive for perfection' and 'tolerance for failure' is important in order to improve, but since process improvement is not a fundamental component, neither is drive for perfection nor is tolerance for failure. Same as to 'boundary-less collaboration', which is a component related to the execution of improvement projects.

Regarding the components of alignment, mobilization, acceleration, and govern only alignment of activities and govern efforts to ensure improvements are sustained is considered fundamental since the other components rely on alignment to already have happened and that managers ensure that fundamental changes are sustained.

Fundamental components are the process approach, structured process management, establishment of metrics linked to CTQ's, genuine focus on the customer, top-down solution, alignment of activities, and govern efforts to ensure improvements are sustained.

8.1.6 Summary of fundamental components

An overview of the grouping of the components into fundamental and non-fundamental are shown in Table 5.

Table 5: Fundamental and non-fundamental components extracted from the theoretical framework.

	Agile Manufacturing	**ISO 9000**	**Lean Manufacturing**	**Malcolm Baldrige Criteria**	**Six Sigma**
Fundamental components	•Intra- and inter organizational cooperation in order to enhance competitiveness (1)(2) •Organizing to master change and uncertainty (1)(2) • Total Customer Focus (1)(2)(3)	• Customer focus (4) • Management involvement (4) • Management commitment (4) • Process approach (4) • Process management based on facts (4) • Monitoring of performance measures (5) • Information channels (4) • System approach to management (4) • Continuous and instant improvement (4) • Factual approach to decision-making (4) • Objectives aligned with customer needs (4)	• Focus on elimination of waste (6) • Focus on customers (6) • Long term philosophy (7) • Levelled workload (7) • Standardized tasks (7) • Process approach (7) • Leaders who understand the work and live the philosophy (7) • Challenge and help partners and suppliers (6)(7) • Solve problems by understanding (7) • Make decisions slowly by consensus, implement decisions rapidly (7)	• Leadership (8) • Customer and market focus (8) •Process management (8) • Visionary leadership (9) • Customer-driven excellence (9) • Focus on the future (9) • Management by fact (8)(9) • Focus on results and creating value (8)(9) • Systems perspective (9)	• Process approach (8) • Structured process management (8) • Genuine focus on the customer (8) • Monitoring metrics linked to CTQ's • Top-down solution (10) • Alignment of activities (10)(11) • Govern efforts to ensure improvements are sustained (10)(11)
Non-fundamental components	• Recognize the importance of employees as a key asset for the firm (1)(2) • Continuous change (3) • Rapid response (3) • Quality improvement (3) • Social responsibility (3)	• Involvement of people (4) • Continual improvement (4) • Resource management (4)	• Focus on continuous incremental improvements (6) • Use reliable, tested technology (7) • People development (6) (7) • Continuous flow (7) • Pull systems (6)(7) • Culture of stopping to fix problems (7) • Visual management system (6)(7) • Become a learning organization (7)	•Human resources focus (8) (9) • Organizational and personal learning (9) • Agility (9) • Managing for innovation (9) • Societal responsibility (9)	• Process improvement (8) • Proactive management (8) • Data-and-fact driven management (8) • Drive for perfection (8) • Tolerance for failure (8) • Boundary-less collaboration (8) • Mobilized teams to attach high impact projects (10)(11) • Accelerate in order to improve business results (10)(11)

(1) (Gunasekaran, 1998)
(2) (Avella, Vázquez-Bustelo, & Fernández, 2007)
(3) (Sharp, Irani, & Desai, 1999)
(4) (Hoyle, 2009)
(5) (Bergman & Klefsjö, 2001)
(6) (Anand & Kodali, 2009)
(7) (Liker, 2004)
(8) (Przekop, 2006)
(9) (Baldrige)
(10) (Motorola University)
(11) (Basu, 2009)

8.2 Categories

In order to proceed with conceptualization of the model, the third research question of the study is reviewed as;

RQ 3 How can a business improvement model, based on fundamental components, be designed within a manufacturing context?

To answer this question the components identified as fundamental in the previous paragraph (see Table 5) were separated from those considered non-fundamental. The components were further grouped using an Affinity Diagram. The components' connection to its original concept was discarded from this point since the model is meant to embody the fundamentals of all concepts, thus this connection was no longer necessary.

All components considered fundamental were included in the Affinity Diagram. As discussed in the problem background, the authors argued that the concepts may share some common fundamental components. In each group several components that could be considered equivalent were found, which further strengthened the authors' belief in the possibilities of a reduction of the number of components.

The components were grouped into categories. Components within each category define the context within that category. The categories, their components and the reason for affinity of some components in categories are further described in following paragraphs.

The affinity diagram with its categories and their components are presented as a whole in Table 11.

8.2.1 Customer focus

When looking at the 'customer focus' category, all components (see Table 6) are related to the fact that an organization needs to have a strong customer focus. 'Focus on results and creating value' is connected to the customer since value is defined as what the customer want and value. To define what is considered valuable for one's customers a deep customer focus is of great importance.

Table 6: Fundamental components within the 'customer focus' category.

• Customer and market focus	• Customer focus
• Customer-driven excellence	• Focus on customer
• Total Customer Focus	• Focus on results and creating value
• Genuine focus on the customer	

8.2.2 Leadership

The category named leadership has components mainly implicating the importance of strategic leadership, see Table 7. Establishing visions, goals and strategies in order to firstly align the organization with the customer's needs, and secondly keep a future focus and make sure that customer needs are fulfilled even in the future, are considered the main objectives for leaders within an organization.

Components in this category also consider leaders as role-models who serve as a driving force within the organization, therefore the affinities of 'top-down solution', 'management commitment' and 'Leaders who understand the work and live the philosophy'.

Table 7: Fundamental components within the leadership category.

• Top-down solution	• Leadership
• Objectives aligned with customer needs	• Visionary leadership
• Long term philosophy	• Focus on the future
• Leaders who understand the work and live the philosophy	• Alignment of activities
	• Management commitment

8.2.3 Structure

When grouping the components (see Table 8) there were several components from the concepts truly emphasizing on process approach and management by processes. The work with processes is a good way of creating structure within an organization, hence the category name structure.

The components of 'information channels' and 'organizing to master change and uncertainty' is also implying the importance of structure within an organization to enable rapid communication and responsiveness for change.

Table 8: Fundamental components within the structure category.

•Process management	• Process approach
•Intra- and inter organizational cooperation in order to enhance competitiveness	• Process management based on facts
	• Information channels
•Organizing to master change and uncertainty	• Process approach
• Process approach	• Structured process management

8.2.4 Decision-making

Another category created using the Affinity Diagram was decision-making, see Table 9. These Components category had a common emphasis on how a problem is to be solved and how to detect these problems.

Many of the components have a focus on metrics (data) and facts which is seen as a prerequisite for decision-making.

Table 9: Fundamental components within the decision-making category.

• Management by fact	• Solve problems by understanding
• Monitoring metrics linked to CTQ's	• Make decisions slowly by consensus, implement decisions rapidly
• Monitoring of performance measures	
• Factual approach to decision-making	

8.2.5 Control

The components grouped together in the category control all have in common that they strive to create stability and predictability within organizations or manufacturing facilities, see Table 10.

'Systems perspective' and 'system approach to management' is all about considering the organization as a whole where improvement efforts made should improve the overall performance.

'Levelled workload' and 'standardized tasks' are components focused on creating control in operations and tasks. Levelled workload is about level variations in demand to ease the workload. Standardized tasks create a "one way of working" that form a foundation for improvement. 'Govern efforts to ensure improvements are sustained' also imply standardization and the need for routines of how to sustain the set standards.

Table 10: Fundamental components within the control category.

• Systems perspective	• Management involvement
• Govern efforts to ensure improvements are sustained	• Levelled workload
	• Standardized tasks
• System approach to management	• Challenge and help partners and suppliers

Table 11: Categories and their fundamental components as identified in paragraph 8.2 using affinity diagram.

Category	Fundamental components	
Customer focus	• Customer and market focus • Customer-driven excellence • Total Customer Focus • Genuine focus on the customer	• Customer focus • Focus on customers • Focus on results and creating value • Focus on elimination of waste
Leadership	• Top-down solution • Objectives aligned with customer needs • Long term philosophy • Leaders who understand the work and live the philosophy • Leadership	• Visionary leadership • Focus on the future • Alignment of activities • Management commitment
Structure	•Process management •Intra- and inter organizational cooperation in order to enhance competitiveness •Organizing to master change and uncertainty • Process approach	• Process approach • Process management based on facts • Information channels • Process approach • Structured process management
Decision-making	• Management by fact • Recognize the importance of employees as a key asset for the firm • Monitoring metrics linked to CTQ's • Monitoring of performance measures	• Factual approach to decision-making • Solve problems by understanding • Make decisions slowly by consensus, implement decisions rapidly
Control	• Systems perspective • Govern efforts to ensure improvements are sustained • System approach to management • Management involvement	• Levelled workload • Standardized tasks • Challenge and help partners and suppliers

8.2.6 Order among categories

When the five categories were created, an in-depth literature study was conducted in order to create a more thorough understanding of the meaning of each of the five categories.

The literature review emphasizes that customer focus is the sole reason that a company exists and that the understanding of customer needs and demands is essential and should permeate every action made. In the model the category 'customer focus' will not be a standalone category but will instead, due to its essential nature, be a part of all of the other categories.

When reviewing literature regarding leadership, and especially leadership in the context of leading change, the main emphasis is on creating the guidelines and plans for the organization, such as establishing visions, goals and strategies of how to fulfil customer's requirements, today and in the future.

Strategies and vision determine the foundation of how an organization is planned to operate and develop in the future. Structure is according to literature, a critical component of implementing strategies and setting up processes to effectively complete organizational goals, and could therefore be seen as a consecutive category to leadership.

Recent literature about structure mostly considers process orientation which means the organization of activities and actions in a structured way across all functions. This structure implies that functions are assigned with processes and roles and authorities of these are defined.

As management is about making decisions and roles of management are defined when establishing a structure, the category decision-making must be seen as subsequent to structure.

The category control is the last category in the model, making sure changes and effects made from previous categories are sustained. Furthermore, the model will contain four categories in order as presented;

1. Leadership
2. Structure
3. Decision-making
4. Control

8.3 Criteria

In order for companies to use this research as a reference model, sub-categories, and criteria have been developed for each category. These criteria are collectively a representation of the implications within each category and stand as targets for self-assessment. The theories upon which sub-categories and criteria have been developed have been reviewed in paragraph 7.1 through 7.5.

8.3.1 Customer Focus

Customer focus and its extraordinary nature have been selected as a superior category. This implies having a customer-focused organization, where all actions are committed in exceeding its customer´s expectations (internal and external) as discussed in paragraph 7.1. This category has no criteria of its own but has been incorporated in criteria of other category in order to include customer focus the foundation of the organization.

8.3.2 Leadership

In order for any company to perform and to produce the right value for its customers, it is of vital importance that management identifies its customers' needs before focusing on any other improvements. This will minimize the risk and maximize the chance of successfully meeting the customers' expectations.

From the discussion on paragraph 7.2, transformational leadership involves paving the way for the organization and its followers. This implies creating a vision of the future state for the company as a whole. In order to create a common strive within the organization in reaching this vision, having goals are also vital.

If no goals are present, decisions and actions can be made that contradict the overall direction of the company. One should see the goals as guiding stars. Having a strategy is also of major importance in reaching goals, and the strategy is a statement of how the company intend on doing his.

Four sub-categories were identified as; customer-needs, vision, goals, and strategy and their criteria are presented in Table 12.

Table 12: Sub-categories and criteria for the leadership category.

Sub-category	Criteria
Customer needs	• All customer are defined • All customer requirements are defined
Vision	• There is a vision statement • The vision statement is individualized • The vision is general • The vision reflects upper-level vision
Goals	• There are goals • The goals reflect all customers' needs • The goals are S.M.A.R.T • The goals are aligned with vision
Strategy	• There is a strategy • The strategy is aligned with vision and goals

8.3.3 Structure

Having created a foundation in the previous category, now management need to create a structure that supports this foundation as Rosemann (2003) states as important when companies change their strategies.

Based on the theoretical discussion in paragraph 7.3, having a process approach is vital in order to be a successful manufacturing company in today's market situation. Not only does it enable cross-functional activities, but also improvements in performance using tools such as statistical process control. Processes also make the structure for management and control of business activities, and create a clear picture of authority and responsibilities.

Creating customer-supplier relationships between process interfaces also create a contract like description of what is required of supplier processes in order to attain satisfaction in delivering value to its customer.

The four sub-categories identified are; identify, customer-supplier relationship, process ownership, and process requirements, and their criteria are presented in Table 13.

Table 13: Sub-categories and criteria for the structure category.

Sub-category	Criteria
Identify	• There is a process approach • All processes are identified
Customer-supplier relationship	• There is a customer-supplier relationship between process • The boundaries between processes are clearly identified
Process ownership	• A process owner is defined for each process • The role of process owner is defined on authority and responsibilities
Process requirements	• Top-down requirements are defined for each process • Each process have requirements set by customer processes

8.3.4 Decision-making

Decisions are only made when there is a decision problem to act on, these decision problems are usually identified using problem finding systems as a part of the management infrastructure as mentioned in paragraph 7.4. These systems are a construct of performance measurements that management monitor in order to identify change. The indicators are used, together with valid targets (goals) to monitor if performance moves toward the intended target or on the contrary, moves away from it. Based on this monitoring, management identifies decisions to be made.

To enable management to make decisions that all strive toward the overall aim of the company, decision-supports are used. These tools are developed together with upper tier managers in order to vertically align objectives throughout the entire organization, and to avoid sub-optimization.

In order for managers to make good decisions, they need to have valid facts to base their decisions upon and the system of indicators of lower tier levels of the organization can be used to gather information from processes that after processing are transformed into facts.

The two sub-categories identified for the decision-making category as; facts and decision support, and their criteria´s are presented in Table 14.
.

Table 14: Sub-categories and criteria for the decision-making category.

Sub-category	Criteria
Facts	• Performance objectives that are essential for reaching goals are identified • All performance objectives are monitored • Performance objectives are linked to process requirements
Decision support	• All managers have decision support helping to align decisions with goals and strategies • Monitored data are analysed in order to create facts for decision-making

8.3.5 Control

To break barriers in functional organizations, cross-functional cooperation is a vital component. This enables managers of different functions to collectively see the entire organization as a system that also need to be controlled as a whole.

Systemic thinking lies at the core of cooperation, and is not only applicable on strategic- or tactical level management. It is essential that this view of the system is rooted vertically throughout the entire organization down to the very operator. In many cases, it is here many discrepancies occur creating a system that can appear out of control. These discrepancies are not due to an operator or floor manager making a wrong decision, but due to the lack of a common way of working.

Standardized tasks, as in established procedures or routines are common tools used in order to eliminate discrepancies as mentioned above and are collectively called guidelines.

In order for managers to ensure proficiency and that these guidelines are sustained and followed, these guidelines also need to be a part of the management infrastructure and monitored.

The two sub-categories identified for the control category are; cooperation and standardized tasks, and their criteria are presented in Table 15.
.

Table 15: Sub-categories and criteria for the control category.

Sub-category	Criteria
Cooperation	• There are cross-functional cooperation in order to control the system as a whole
Standardized tasks	• Guidelines are defined for a one common way of working • The guidelines are communicated
Govern	• Govern efforts • The guidelines are monitored

The model criteria developed in this study are presented as a whole in appendix B.

9 CORE model

A model, in this text referred to as the CORE model, has been developed during the previous paragraph of this report. The model is presented in Figure 7 and is further described as follows. The model as a whole with all criteria for each sub category is presented in appendix B.

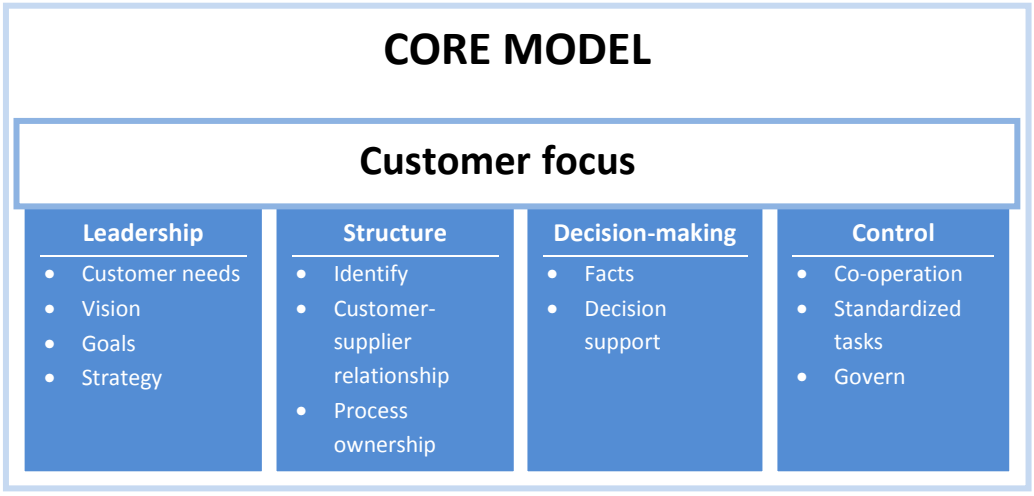

Figure 7: The CORE model developed in the conceptualization phase with each category and its sub categories.

As stated earlier, the model is meant to be used as a self-assessment tool in order for management to identify what areas of the company need improvement. Based on the interview templates (se appendix C) data are collected and later evaluated, having the criteria of the model as a target. The company is analysed in detail, criteria by criteria, from its very core, starting at a strategic level.

When comparing the assessment result with the defined target, values of the criteria, areas where the performance is not sufficient are identified. The results and the identified gaps from the assessment will then form the basis for creating an action plan of how to close the gaps to improve the performance.

9.1 CORE model workflow

In order to thoroughly examine the entire company, the model implies a process of using the model in three sequential steps at three different levels of the organization as illustrated in Figure 8.

Figure 8: Organizational workflow in using the CORE model.

Since each category of the model creates prerequisites for other categories, it is vital that necessary changes are implemented sequentially as they are identified throughout the process, having an ongoing implementation of structured change within the organization. This is important because circumstances continuously change as improvements are made, and in order to avoid sub optimization and redundant improvements at lower levels. This is illustrated in Figure 9.

The model is constructed in such a way that stability is supposed to be attained at each level. Starting by creating a foundation in the leadership category and establishing a structure aligned with vision and goals in order to support strategies in the structure category. Furthermore, a management infrastructure is developed during the decision-making and control category in order to attain stability in controlling the level and sustaining changes.

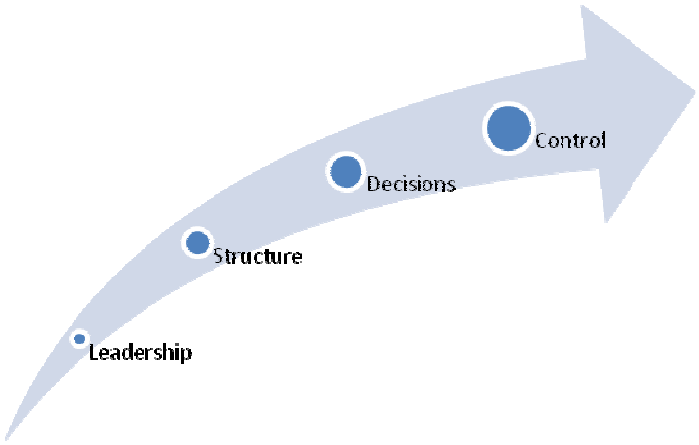

Figure 9: Structured order among categories that also represent in what order improvements are to be made.

In Figure 10, the workflow is visualized, showing how improvements gradually intend to increase organizational stability throughout each level.

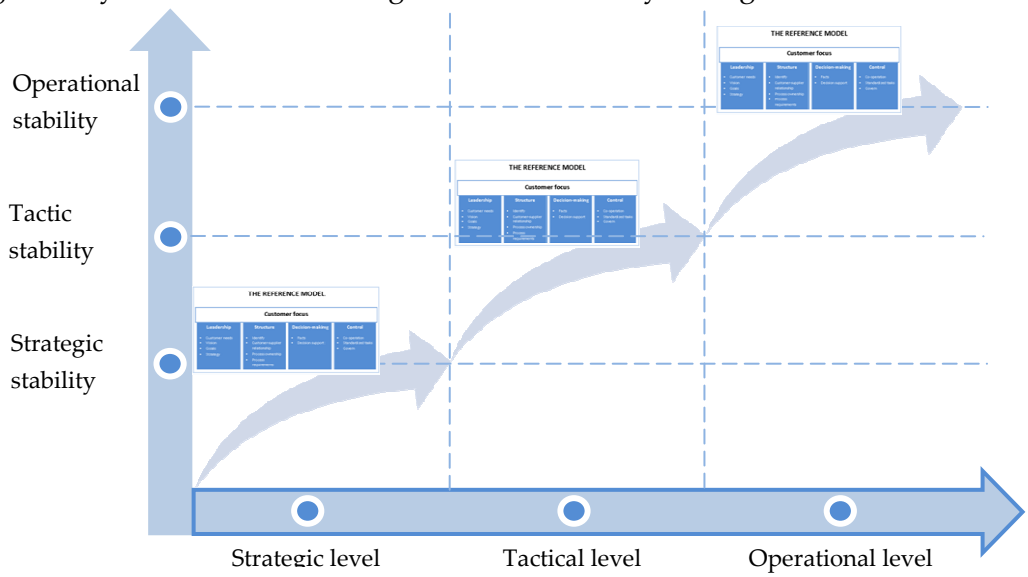

Figure 10: Illustration of the workflow of the CORE model.

Additionally, having a separate function managing the use of the model within the organization is recommended in order to have structure and overall control over what improvement initiatives are on-going. This function should report directly and work in close contact with the strategic management team enabling a coherent view on improvements, and alignment with the company's overall vision.

V. Case: Sandvik PU Sandviken

In this chapter, the CORE model is tested in a case-study on a cross-section of PU Sandviken. Initially, a case description is presented followed by a company presentation. Following this discussion, an analysis is presented based on the use of the model as an assessment tool. Finally, Results are discussed and solution suggestions presented.

Outline

10 Case description

This case study was conducted as a trial of the CORE model created in order to investigate its usability and answering RQ 4 reviewed as;

RQ 4: How would the model work at Sandvik Mining and Construction PU Sandviken?

The case study was conducted at PU Sandviken, a production unit within the Sandvik Mining and Construction supply chain. A company description and an introduction of PU Sandviken are presented in paragraph 11.

Due to the limited resources of the research, the entire workflow of the model could not be tested. Essential to ensure viability of the entire model is that the assessment according to the categories and criteria gives the desired output, hence the main purpose is to test the model and its performance in identifying gaps. Separate to the main purpose, the assessment will also consider the major gaps identified within PU Sandviken as agreed, resulting in an action plan for the company. This action plan is also seen as a desired output as being based on identified gaps based on the CORE model criteria´s. These gaps identify where PU Sandviken needs to increase its performance.

The assessment was carried out with the model as target-state. The assessment was conducted on a strategic, tactical, and operational level covering the entire company. A cross-section of PU Sandviken, as presented in Table 16, was the base for the study. Areas within the cross-section were chosen with regards on their dependence upon each other in order fulfilment.

Table 16: Cross-section used in the case study.

Level	Activity
Strategic	• Entire Strategic level
Tactical	• Extension equipment function. • Purchase and planning function (further referred to as PP).
Operational	• Production of integral drill steels and extension rods (S5), a production flow within the extension equipment function. • Heat treatment (also referred to as S9), a production flow within the extension equipment function. • Sourcing, an activity within the PP function.

When collecting data for analysis of the company, semi-structured interviews were carried out. Each section of the case study was organized around the four categories within the model.

Initially, the company is presented and the current state described in paragraph 11. Secondly, data from eleven semi-structured interviews are analysed in paragraph 12 using the gap method with the criteria of the model (see appendix B) as a reference. Lastly, the analysis and results are presented in paragraph 13 and 14.

The case study contained a lot of data, therefore, all results are not discussed within the thesis which focuses only on some major areas. All results are presented in tables attached in appendix D.

11 Company presentation

The Sandvik Group is a global engineering group in the areas tools for metal cutting, equipment and tools for the mining and construction industries, stainless materials, special alloys, metallic and ceramic resistance materials as well as process systems. Sandvik is active in 130 countries and had in 2009, 44 000 employees. (AB, Sandvik)

Sandvik Mining and Construction, further referred to as SMC, is a business segment within the Sandvik Group active in providing equipment, tools, services, and technical solutions for the mining and construction industry. (AB, Sandvik)

11.1 PU Sandviken

PU Sandviken is a production unit (PU) within the SMC supply chain that manufactures tools for surface and underground mining and construction drilling. The PU is located in Sandviken, Sweden, has about 400 employees and is also a global technology centre for top hammer and DTH products along with research and development (Sandvik Mining and Construction, 2010). Top hammer products, meaning that the hammer is located on the top of a drilling line and DTH, meaning that the DTH hammer is located down the hole, that in short gives the name, DTH.

11.1.1 Manufacturing

PU Sandviken basically employs two techniques when manufacturing extension rods. Both techniques are based on the same raw material, either round steel bars or hexagonal steel bars. In the first technique, ends of the rods are forged to prepare them for lathe machining of threaded ends. The second technique is modular, where threaded rod end components are manufactured and later friction welded onto either end the rods. The assembled rods are then transported for heat treatment, completion and packing. In cases where the entire rod do not need heat treatment the components are heat treated before welded onto the rods.

11.1.2 Production

The production in PU Sandviken consists of a series of separate flows interconnecting for heat treatment and completion. The heat treatment has limited capacity and also deals with products from contract manufacturing.

The production today is run with a pushing system. Buffer build-ups in production are common, especially within the flow and in front of the heat treatment operation. All orders at PU Sandviken are produced according to customer orders, though the largest part of production is delivered to a stock within a main distribution channel of SMC and the remaining part is delivered directly to the actual customer. Because of uncertainties in the supply of incoming materials, the production planning is based on available material from the supplier. This is mainly performed from experience and is not supported by tools and routines. This way of working with knowledge and key competences tied up in persons are common.

11.1.3 Leadership

PU Sandviken could be defined as having two customers, one being the global function within the SMC Supply Chain called DI and the end customer as the other. The PU deliver products according to the demand set by DI and are

based on both actual customer orders and forecasted stock replenishments. The contact with the actual customer is very low and the orders from DI are seen as channelling the actual customer demand to PU Sandviken. The orders sent to the PU are not prioritized according to the actual need of the customers. All orders are given an estimated time of delivery of ten weeks even if the customer needs it earlier or if it is produced to stock.

PU Sandviken has chosen to adopt the same vision statement as used by the overhead organization SMC Supply Chain. The vision is focused on being their customer's solution partner of choice and helping their customers to increase their productivity. This fall, the PU also just launched, what they call, their mission statement for 2013. Here, the strategic leaders communicate values, objectives, goals, and a production strategy for the upcoming three years.

The mission largely concerns reaching a desired normal state in production, where all employees within the company are active in developing the business and proactive actions are taken. The intent is to attain this by increasing the level of automation and by creating more capacity in core production processes thus enabling a more flexible production.

The strategy has a strong focus on production. They intend to focus a lot of recourses on core competences where they aim to create a machine capacity above normal. This applies especially to the heat treatment- and completion processes. In other production areas the strategy aims to outsource the manufacturing of some products when more capacity is needed and having in-house capacity that are either on or below normal.

Values communicated in the mission statement are focused on mind-sets such as everybody's involvement in improvement efforts, customer focus and producing high quality yield. The goals stated in the mission for 2013 are covering mainly the production functions of the organization. They involve delivery precision, quality yield, lead time, and availability in key machines, volume flexibility and also an EHS target of no work related injuries.

When looking at functions on a tactical level, there are individualized goals for producing functions that have broken down goals and individualized them into fitting them specifically.

Goal deployments for support functions are sparse, and these functions have difficulties relating to the PU goals since these are very production oriented.

Goals on the lower levels of the organization are not clearly defined and also, strategies on how to reach goals are not defined.

11.1.4 Structure

PU Sandviken is described as a matrix organization (as shown in Figure 11) with a functional layout containing two core functions, extension equipment and drill bits. Process development, human recourses, purchasing and planning (further referred to as PP), finance, engineering, and maintenance are support functions.

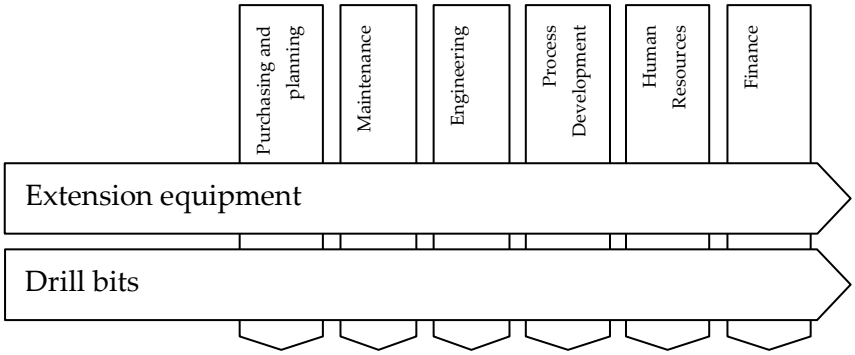

Figure 11: The matrix organization of PU Sandviken.

All functions are managed by the PU manager who is also responsible for overall performance of the production unit. On a strategic level, the functional managers together with the PU manager form the strategic management team. This group gathers in order to collaborate on strategic and tactical issues as well as goals and result follow-ups for the production unit as a whole. The structure on a strategic level is not well defined in processes, but they do engage in activities concerned with long term management of the company.

On a tactical level, there are no processes defined for the organization but there are some cross-functional activities. The cross-section described in this study has a focus on the cooperation between the extension equipment function and the PP function. PP is responsible for supplying production with material. The two material suppliers for S5 are Materials Technology (SMT) and Ovako. Within this study, only material supply from SMT has been considered.

The PU also has an operational management team that meet in order to follow-up goals, results, and issues concerning this level. On an operational level, process orientation is more common. Here processes are represented as the production equipment and the surrounding activities that are carried out. Processes are defined within a specific function or a specific flow, while

processes between tactical functions are rarely found. Requirements on functions are clearly defined for the two production functions but are sparsely defined for the supporting processes.

The extension equipment function is organized by several interconnected flows. The facility has two main flows, S5 producing extension equipment, and S1 producing shank adapters. There are also a flow called H1 producing integral drill steels and tapered rods. Both S5 and S1 interconnect by the heat treatment section called S9. Here, several external flows also connect as presented in Figure 12. A flow of drill bits from the drill bits function and a flow of rotary drilling tools from a PU located in Köping, Sweden. From S9, some products return to each flow for further processing and the rest continue to the flow called H3 for rust protective treatment and completion.

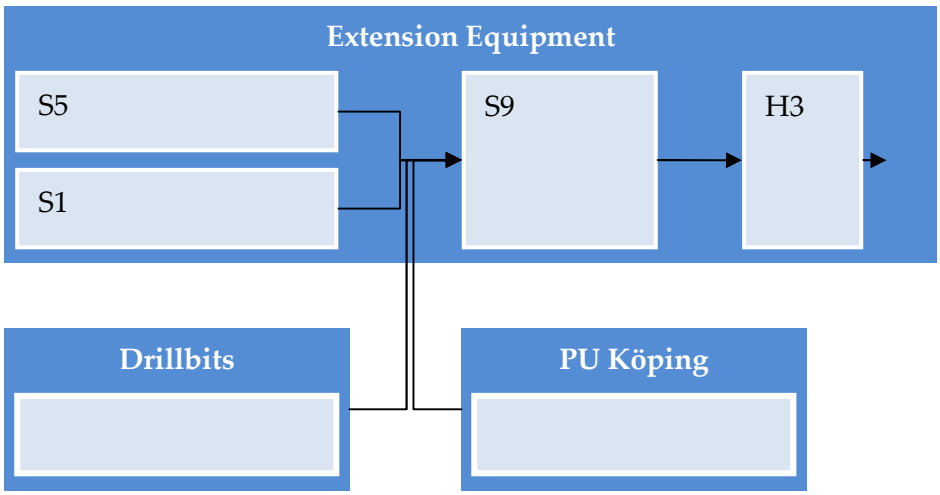

Figure 12: Production flows of PU Sandviken identified within the cross-section.

The managers of each starting flow in extension equipment (S1, and S5) have responsibility for their products from order start until completion. This means that they have responsibilities over the products throughout the final stages of production though the products are controlled by production managers of these operations. Managers of S1 and S5 have no direct authority or control over the products in following production phases though remain responsible for delivery precision of the products within the function.

The PP function contains the sourcing activity which is responsible for releasing material orders to the supplier in order for the production to receive material. The activity is not defined as a process and the activity change over time as environmental conditions change such as production status, machine down-time, and materials supply.

11.1.5 Decision-making

The PU is collecting a lot of data, especially when it comes to production metrics. Data is collected from entire production flows as well as processes inside the flows. Some data are compiled into diagrams and lists used to monitor performance of separate flows during day to day and weekly meetings, and for functions on strategic and operational meetings. Not a lot of production data is analysed in detail in order to create facts and managers relies on simple column charts with target levels as performance objectives.

Noted is that performance reviews are commonly made flow-by-flow and function-by-function and not for the entire order fulfilment process. Sub/ optimization is in fact a reality since each flow controls their performance in order to reach its own objectives, not considering other flows and sections.

When making decisions, there are some priorities to consider. One established decision support is the guidelines concerning environment, health and safety (EHS). The overall prioritization guidelines of the company in order as presented are: EHS, quality, flexibility, introduction of new products, and reduction of variation.

Performance indicators for production flows are in addition to the above mentioned priorities the main decision support. If target levels are not reached, managers know what need to be improved. For the extension equipment function, these objectives are yield, delivery precision, OEE (overall equipment effectiveness), production time, volume, waiting time, and accidents/mishaps.

On a strategic level, managers have decision support when making strategic decisions, these decisions are made in a group environment where all managers can give their opinions. Decisions are made in consensus, but if the group cannot agree, the PU manager has the final say.

The heat treatment section has established a decision support. Their schedule for choosing what products are to be loaded into furnaces is easy to use and understand. The schedule will be discussed in further detail in the following paragraph. They also have developed a portfolio of training material and checklists used to make sure that the workforce attained the required knowledge level needed within heat treatment.

11.1.6 Control

Within the PU, there is an old but functioning enterprise resource planning (ERP) system that is the base for production control and management. It is

used on a tactical level and operational level to manage production orders throughout the PU and is the interaction interface between the PP function and the production functions.

Based on the current order stock within the ERP system and the agreed upon production volume from the production functions, material orders are sent to the supplier SMT. The order is made using the ERP system and when an order is sent to SMT, a production order is sent to S1 and S5 respectively creating a production sequence at the beginning of the each flow. This production sequence is the basis for order-start.

There are several factors controlling PP's input of material. Firstly, they use production forecasts in planning mid- and long-term demand. These forecasts have a large impact on short-term scheduling since they are also used by SMT as base for production planning resulting in shortages or overstock if forecasts substantially differ from actual demand.

Secondly, they use the order stock from DI as a base for short-term scheduling. Thirdly, the available storage space at the beginning of S5 is also a factor. Furthermore, the production status of flows and functions also play a major part in decisions made by PP concerning material order to SMT. When placing orders, PP use SMT's actual stock levels as baseline.

The production is divided into flows that are more or less self-managed by different roles. Production control is therefore segmented on an operational level, with different managers controlling their flow separately to reach their own performance indicators. Furthermore, the sourcing activity is also self-managed and a part of a different business functions. Day-to-day feedback from production flows to the sourcing activity come from the planner actually walking down to the production facility or by manual monitoring orders in ERP-system.

The PP function controls the material input to S1 and S5. Orders are started based on 'first-in-first-out' from the production backlog, pushing products toward S9. As mentioned, S9 has developed a production schedule in order to maximize utilization of its furnaces. This schedule pays no attention to the current production sequence from S1 and S5, nor do S1 or S5 take regard to the schedule used in S9.

Between S5 and S9, there is a supermarket replenishment solution with purpose of controlling order-start in S5 in order to produce "the right

products". The PP function does not include this replenishment solution in their sourcing activity. This solution is today not active and more or less used as a controlling buffer for heat treatment to see what products are in place.

After S9, there is at the moment overcapacity or capacity that could be increased by increasing the workforce. There is no scheduling in these last activities where the production is run based on first-in-first-out.

12 Analysis

Within this case study, the information from PU was analysed using the CORE model criteria as a tool. Overall score are presented in Radar Charts, showing individual scores on categories for each studied area. The analysis is also based on each area's individual scores on criteria where the authors have chosen to discuss major deficiencies identified. The entire results table from the assessment presented in a result summary shown in appendix D.

Discussions within the analysis is based on assessment scores and discussed with relation to the current state described in paragraph 11. In this case study the authors' current state description acts as the knowledge base which otherwise would be kept by the company.

In order to help in analysing test score, a grade system was developed as presented in Table 17. Grades are divided with a 30 % interval except the 'excellent' score which only have a 10 % interval. This is due to the fact that an excellent score according to the authors should measure when a category is fulfilled.

Table 17: Grades used when analysing test scores of the assessment.

Grade	Score interval
Poor	0% - 29 %
Moderate	30% - 59%
Good	60% - 89%
Excellent	90% - 100%

The score interval is used on overall percentage score of each assessed area within the organization. For each section, results are also presented in tables with abbreviations in the table headers that are explained in Table 18.

Table 18: Abbreviations used in tables presenting assessment scores.

Studied area	Abbreviation
Strategic level	Str.
Extension rods	Ext. R
Purchase and planning	PP
The S5 production flow	S5
Heat treatment	HT
Sourcing activity	Src.

12.1 Leadership

When analysing the outcome from the self-assessment of PU Sandviken the first category covered by the CORE model is leadership. The individual scores from the assessment of each criterion are presented in Table 19 below where '1' represents a fulfilled criteria and a '0' represents a not fulfilled criteria.

Table 19: Results from assessment of criteria in the leadership category.

1.1. Customer needs	**Str.**	**Ext. R**	**PP**	**S5**	**HT**	**Src.**
1.1.1. All customer are defined	1	1	1	1	1	1
1.1.2. All customer requirements are defined	1	1	0	0	0	0
1.2. Vision						
1.2.1. There is a vision statement	1	1	0	1	1	0
1.2.2. The vision statement is individualized	1	1	0	1	1	0
1.2.3. The vision is general	1	1	0	1	1	0
1.2.4. The vision reflects upper-level vision	1	1	0	1	1	0
1.3. Goals						
1.3.1. There are goals	1	1	1	1	1	0
1.3.2. The goals reflect all customers' needs	0	0	0	1	0	0
1.3.3. The goals are S.M.A.R.T	1	1	0	1	1	0
1.3.4. The goals are aligned with vision	0	0	0	0	1	0
1.4. Strategy						
1.4.1. There is a strategy	1	1	0	1	0	0
1.4.2. The strategy is aligned with vision and goals	0	1	0	0	0	0
%:	75%	83%	18%	82%	73%	9%

At a strategic level, the external customers and their requirements are defined. Product requirements are defined on the needs of the final customer but delivery precision metrics concern DI requirements alone. DI who place orders to PU Sandviken, set planned delivery time of ten weeks not considering actual customer demand. This creates a gap in thoroughly understanding the final customer needs especially with regards to the actual demand in timing, volume and urgency.

Looking at criteria 1.1.2, the assessment show that the customer focus is not as well established throughout the studied areas considering internal customers. Customers are known but their requirements are not well defined. The reason

for this is related to the category structure and will be further discussed in the structure paragraph below.

The sub category concerning goals in the assessment show that there are goals set for the PU, though the goals do not reflect all customer needs and are not aligned with the vision. This could also be seen in goals defined in the mission statement, as they are not relevant in reaching the stated objectives or fulfilling the strategy that is defined. This implies that goals are not aligned with the company's strategy, as well as objectives. More precisely, there is a gap between what management aims to accomplish and what management demands in order to attain their mission objectives.

As a result of the strong production focus in the mission statement, the strategy and some objectives are problematic to adapt to other functions. As an example, the PP function does not directly respond to the stated objectives due to the fact that the strategy only focuses on resource management in production functions. It implies the allocation of spare capacity in core processes of heat treatment and product finalization. Furthermore, the goals stated are mainly focused on areas within the organization that the PP function is unable to affect. This results in goals that are not appropriate for them, and they therefore lack targets to strive for.

The scores from each studied area are presented in Figure 13.

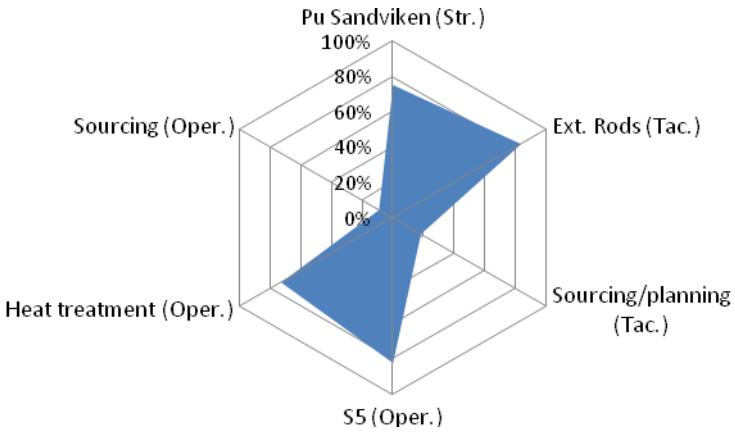

Figure 13: Analysis score for the leadership category presented in a Radar Diagram.

As illustrated in Figure 13, one can see that all areas directly related to actual production have received good scores, while areas not having a direct

connection have a poor score. This implies that there are substantial gaps between function and activities related to production and those who are not.

12.2 Structure

The internal structure reveals some important deficiencies, mainly on the strategic level which is responsible for creating a structure on a tactical level and defining the inter-dependence between functions. Results for each criterion are presented in Table 20 where '1' represents a fulfilled criteria and a '0' represents a not fulfilled criteria.

Table 20: Results from assessment of criteria in the structure category

2.1. Identify	**Str**	**Ext.R**	**PP**	**S5**	**HT**	**Src.**
2.1.1. There is a process approach	0	1	0	1	0	0
2.1.2. All processes are identified	0	1	1	1	0	0
2.2. Customer-supplier relationship						
2.2.1. There is a customer-supplier relationship between process	0	0	0	1	0	1
2.2.2. The boundaries between processes are clearly identified	0	0	0	0	0	0
2.3. Process ownership						
2.3.1. A process owner is defined for each process	0	1	1	1	0	1
2.3.2. The role of process owner is defined on authority and responsibilities	0	0	0	1	0	0
2.4. Process requirements						
2.4.1. Top-down requirements are defined for each process	0	1	0	1	1	0
2.4.2. Each process have requirements set by customer processes	0	0	0	1	0	0
%:	0%	50%	25%	88%	13%	25%

Summarizing the results from the table, PU Sandviken performs poorly considering a strategic level structure. As presented earlier, the organization is illustrated as a matrix organization, see Figure 11, where production is the core functions and the rest supporting functions. Their inter dependencies is not defined and customer-supplier relationships is not established. Functions do not interact as a system to optimize the whole production creating a cross-functional product realization process. The poor result here could be seen as a cause for poor results on other levels, as structure is set top-down in an organization.

The main production processes are identified but these processes lack cross-functionality. They only cover order start to order finish, not order in to order out. Before the production processes, the PP function have authority, but is not

an incorporated part of the entire production system of product realization, making control of material input, and material flow throughout the process more difficult.

Looking at the criteria concerning boundaries between processes and the defining of roles of process owners almost none of the areas did fulfil the criteria. One can see that both processes and process ownership are not defined as the model suggests. As an example, consider Figure 14 below, illustrating the structure surrounding heat treatment. When looking at the flow of S5, the manager has authority and responsibility over products started throughout the entire production, even though heat treatment has its own manager. This creates a discrepancy in authority since process boundaries and requirements are not clearly defined.

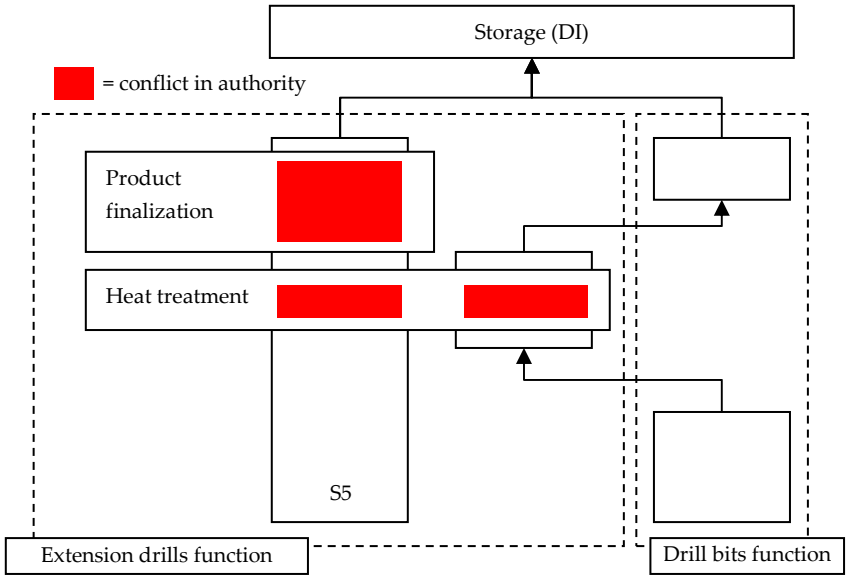

Figure 14: Structure surrounding heat treatment.

These undefined inter-connections create an insecure environment where each function is more or less operating on its own and striving to develop themselves. The assessment shows that S5 have a good structure within their flow. Here almost all criteria are fulfilled but when looking at other operational areas not performing as good. This shows that the system could perform better when working together.

With undefined processes and interconnections, roles are also hard to define on authority and responsibilities. This creates an ambiguity in the organization where no one clearly know who is responsible for which area. Resulting in that either everyone does a bit of everything or no one does anything, thinking it is

someone else's responsibility. This ambiguity and lack of communication channels also lead to redundant work such as the occurrence of improvement project working individually without having contact with simultaneous projects or including everyone affected by the project. This will lead to a large amount of sub optimization and waste of resources.

A good example of this is the schedule used in heat treatment. It is a good way to control the heat treatment but it does not consider other production flows. Only focusing on optimizing its own utilization and not being an integrated solution for the entire system, the use will in the end lead to a production that is not uniform in its control. More on the systems perspective and what consequences this lacking structure has is discussed in the paragraph control.

The CORE model strongly emphasizes a process approach and managing activities through processes. Today, this is something that is not present at a strategic and tactical level of the organization and therefore explaining the low score from the assessment, which also could be seen in Figure 15.

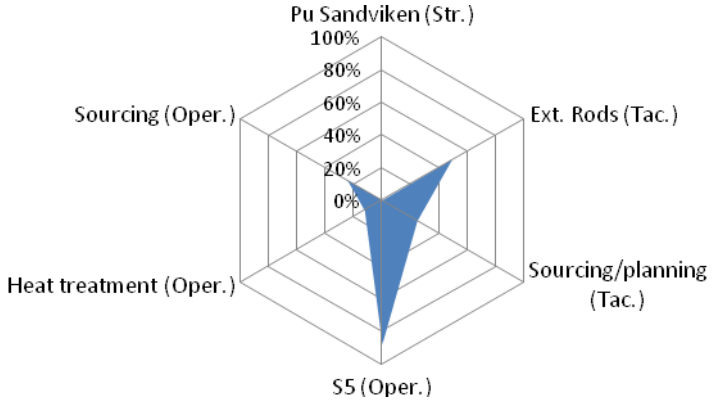

Figure 15: Analysis score for the structure category presented in a radar-diagram.

A big structural problem is according to the research that there is no unified structure of the organization as a whole. Tactical processes are not identified or well defined as shown by the overall score for the strategic level.

12.3 Decision-making

When analysing the category of decision-making one can see that PU Sandviken measure performance and have a wide spectrum of metrics concerning the performance of the production functions. The complete results from assessment of individual criterion for each area are presented in Table 21

below where '1' represents a fulfilled criteria and a '0' represents a not fulfilled criteria.

Table 21: Results from assessment of criteria in the decision-making category

3.1. Facts	**Str**	**Ext.R**	**PP**	**S5**	**HT**	**Src.**
3.1.1. Performance objectives that are essential for reaching goals are identified	1	1	1	1	1	0
3.1.2. All performance objectives are monitored	1	1	0	1	1	0
3.1.3. Performance objectives are linked to process requirements	0	1	0	1	1	0
3.2. Decision support						
3.2.1. All managers have decision support helping to align decisions with goals and strategies	1	0	0	0	1	0
3.2.2. Monitored data are analysed in order to create facts for decision-making	0	0	0	0	1	0
%:	60%	67%	20%	75%	100%	0%

PU Sandviken has a great amount of metrics which also are shown in the criteria concerning identification of performance objectives essential for reaching goals. Though having a large amount of metrics, the metrics are not good to use as facts for decision-making within the support functions. This since they only concern performance indicators related to production. Referencing back to the leadership paragraph, goals and strategies stated in the mission is only concerning the main production processes and their performance. A function such as PP has no relation to these and has not individualized them to fit their own activities. Without goals and strategies there is nothing to aim for, therefore decisions cannot be defined as good.

An example of what the lack of cooperation and metrics lead to is in controlling the replenishment of raw materials. Material orders are placed only based on order stock and available material from supplier, not truly considering the current production situation.

Decision-support within the PU is difficult to identify. At a strategic level the decision support is made out of the management team. On other levels of the organization, with the heat treatment as an exception, decision-support is hard to find. During assessment, indications of decision support has been shown, but few concrete examples that are sufficient and generally accepted where given resulting in the generally low result in that sub-category.

Though having this amount of metrics, there is a lack of analysis to create facts for decision-making. Metrics of production performance according to stated levels are monitored in charts and diagrams but the monitoring rarely lead to

proactive measures being taken. If levels are not reached, reactive decisions are made.

Heat treatment performs excellent within this category. This is mainly because the nature of the operations performed here and the overall focus on EHS. Mistakes can have great consequences.

Overall, the score for this category is good to excellent considering production related functions and has some deficiencies considering the non-production related, as also shown in Figure 16.

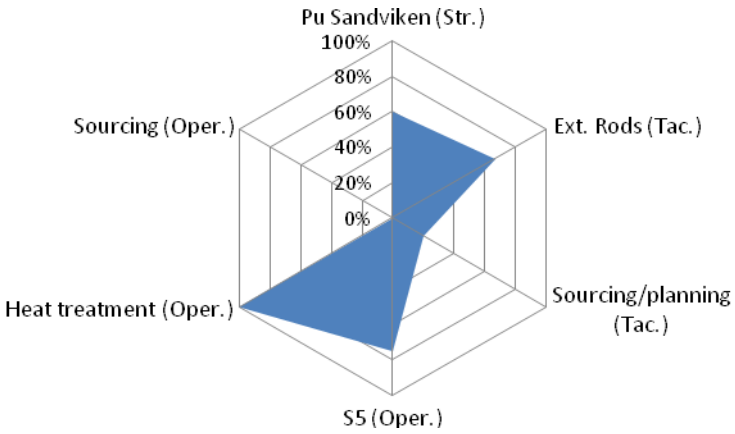

Figure 16: Analysis score for the decision-making category presented in a radar-diagram.

12.4 Control

The assessment of control shows that there are large differences regarding the overall scores for each area. Complete results from the assessment of each individual criterion within the category are presented in Table 22 where '1' represents a fulfilled criteria and a '0' represents a not fulfilled criteria.

Table 22: Results from assessment of criteria in the control category

4.1. Cooperation	**Str**	**Ext.R**	**PP**	**S5**	**HT**	**Src.**
4.1.1. There are cross-functional cooperation in order to control the system as a whole	1	0	0	0	1	0
4.2. Standardized tasks						
4.2.1. Guidelines are defined for a one common way of working	1	0	0	0	1	1
4.2.2. The guidelines are communicated	1	0	0	0	1	0
4.3. Govern efforts						
4.3.1. The guidelines are monitored	0	0	0	0	1	0
%:	75%	0%	20%	0%	100%	20%

An example of issues as a result from low cooperation is the production control of extension equipment. Here orders are released for production in S5, as a part of the extension equipment function, from the PP function according to the sequence of orders received from DI. Despite this, orders for heat treatment are collected according to the schedule they have established. These two controlling parameters is not aligned, meaning that, if a certain production sequence is released for production from PP this will not directly affect the sequence within the heat treatment as they strictly follow their schedule. This way of working counteracts the idea of takt-time production where the takt-time and sequence is set from the bottle neck process or by a single controlling parameter such as demand.

These issues in cooperation could also be seen as a result from the overall low structure, discussed in the structure category. Without a clear structure where cross-functional activities and its responsibilities are defined the cross-functional, cooperation will also remain low. The schedule used in heat treatment is a good way for them to control their part of production in a structured and organized way, but as analysed in the paragraph structure, one needs a structure where the main focus is to increase the throughput by collaboration in control.

In analysing the cooperation between functions, issues arises that could be described as time thieves. Workers in different functions feel that in order to help fellow function in their pursuit of performance improvements, their own time is wasted for no return or payoff. This can be exemplified in the cooperation between heat treatment and the drill bits function. Here, heat treatment need drill bits to be stored in special heat treatable carriers and drill bits are packaged on wooden pallets by production robots within the drill bits function. The problem lies in the allocation of responsibility for transferring these drill bits from the wooden pallet to the heat treatable carrier. Heat treatment feels that the drill bits function might as well conduct this activity in order to save recourses. But people in the drill bits function still feel that this is not a value adding activity for them, as they get no obvious return.

Based on the current state analysis there is no communicated strategy or approach to how the production system should be controlled as a unity. Today the two production function and the supplier function operate on their own without cooperation to create the most stable and predictable production. This lack of systems thinking and the several controlling parameters create a production that is pushing. Materials are forced on to the next production

process in the sequence toward the heat treatment process where the material is pulled according to the schedule they established.

When looking at the work routines and standardized ways of working, the heat treatment process is a good example of how standardization and documentation could be designed. Here, there are routines established for employee competence, work rotation and routines of how to monitor these parameters. This is type of standardization is not as well established in other functions. These routines make the heat treatment process the most stable and reliable process in the production.

In Figure 17 one can see that the control on a strategic level and within heat treatment there are good respectively excellent control, while all other areas perform poorly.

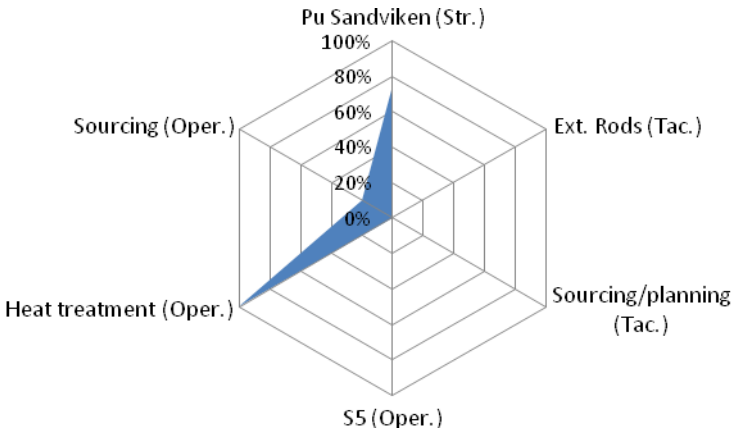

Figure 17: Analysis score for the control category presented in a Radar Diagram.

Today, the cooperation on a strategic level is performed by the strategic management team. The management team is constituted by the tactical leaders, thus creating a good foundation for cross-functional cooperation on a tactical level, though this cooperation is not well established.

13 Analysis findings

Summarizing the results from the analysis, the score for each section of the organization is reviewed as a whole in Figure 18.

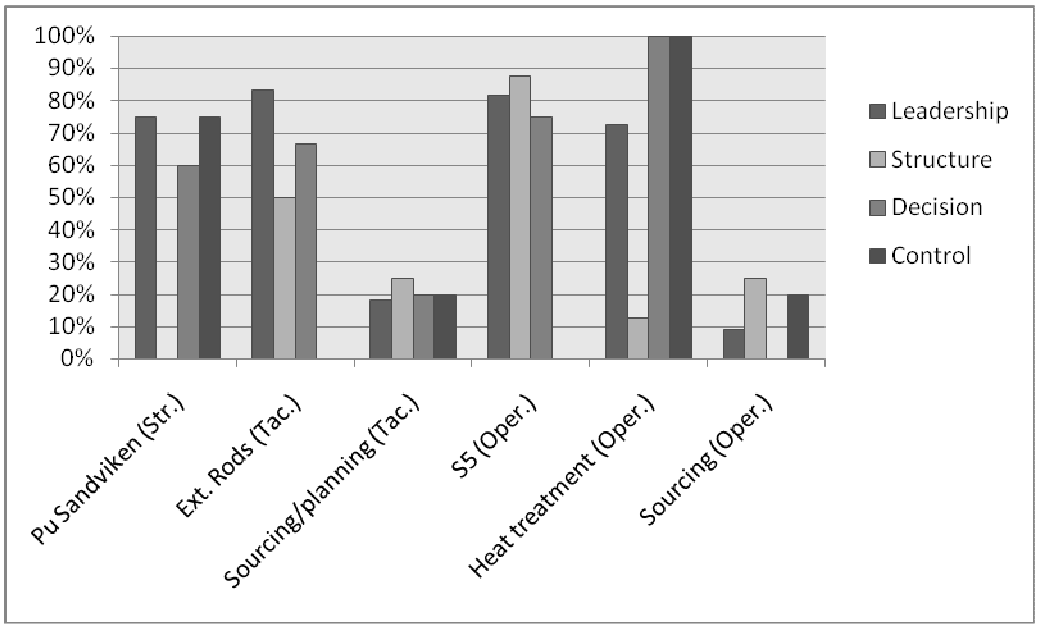

Figure 18: Overall results from the PU Sandviken assessment.

The analysis shows that goals and strategy for the PU are strictly production oriented. This is difficult for support functions within the organization to adopt, and therefore goal and strategy deployment is also difficult for these functions. Goals and strategies are not aligned with each other. The analysis also shows a lack in the customer-supplier relationship between functions and between activities.

The deficiencies in the structure category are considered to be the cause of many gaps in other categories. There is a lack of cross functionality throughout the organization, especially when considering functions on a tactical level, were no cross functional activities are set between PP and extension equipment. This issue is shown in score within the category structure on a strategic level where a poor score was reached.

In terms of production and the problems identified at the operational level, most deficiencies directly relate to the ambiguity within the structure on a tactical level. For support function PP and its Sourcing activity a poor score

was reached in all categories within the model. This is an issue that could be seen as a result from both the lack of goals, objectives, and strategies set from a precedent level. Also the lack of structure is important to notice where their relation to other function is not well established.

Concerning decision-making, the analysis shows that there is a low level of analysis on the data collected from within the organization. A lack of metrics related to the PP function and sourcing activity is also an identified issue. This is mainly due to the lack of goals and objectives concerning these areas. Noticed is also concerning control in heat treatment who scored excellent in this category, this is mainly because of the potential danger a lacking control could cause.

Mentioned in the analysis is also that there are some obvious deficiencies in production management, therefore a significant overall control that ties the production activities together is lacking. This is something that could be seen as a response to the unclear structure of the tactical level, if cross functional activities are not established there is also a difficulty in controlling connected activities as a system.

The long time execution of functions with low cooperation has led to local optimization and development of individual functional areas. This cause even lower interrelationship between functions.

14 Results and recommendations

The analysis assessment shows discrepancies in several areas within PU Sandviken. In order to give a recommendation for continued work to the company two suggestions was put together:

- Firstly, a suggestion that the company should start an improvement project using the CORE model with the proper workflow as it is intended. This, in order to fully ensure that the company attains all the fundamental components before moving forward and improving their business using other concept and tools.
- Secondly, an action plan was developed containing all major issues identified. This suggestion was developed for the company to use, if they feel that the model is immature since it has only been tested in one earlier business case.

14.1 Action plan

As part of the second suggestion handed to the company, an action plan was developed. This plan was developed using the results of the assessment and is described in detail below and summarized as a tasks list in appendix E.

14.1.1 Neutralize mission statement

The first thing the company needs to do is, according to the model, to revise their mission statement. Goals need to be aligned with, and represent the defined objectives. The goals should be more neutral, taking less regard to production, making it possible for other functions as PP and Sourcing to relate to these goals. The strategy should also be neutralized, reflecting a common strategy in which the company intends to reach their vision, objectives, and goals.

The concept of focusing on core processes is a good idea, also for other functions. The authors suggest that the strategy should be similar to the illustration of Figure 19. A neutralization of the strategy will increase its usability within all functions. It will be easier to relate to and create function specific activities aligned to it.

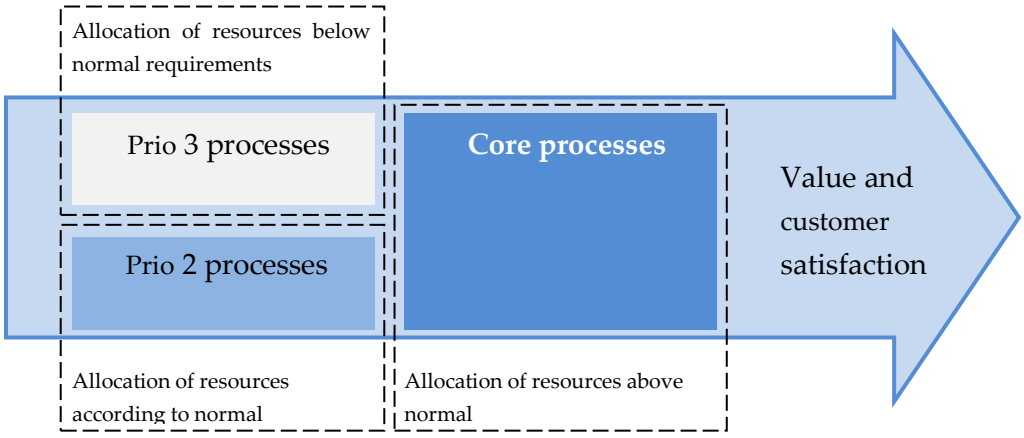

Figure 19: Illustration of a neutralized strategy.

14.1.2 Process approach

The use of the model shows that the company needs to establish a new structure, especially over the tactical level which is defined on the strategic level. This should be established in order to enhance a systems view and also create a foundation for a structured approach to control and monitoring of the business. The reviewed improvement concepts, and therefore also the CORE model places emphasis on process orientation as a tool or approach to achieve a better structure.

From the cross-section examined within this study, the most important structural gap identified was the lack of a unified and cross-functional production control process to control the production system as a whole, from order-in to order-out. The process approach at the operational level needs to be supplemented with links to support functions to facilitate communication and cooperation. A greater clarity can only be achieved by clearly defining customer-supplier relationship among them so expectations are agreed upon.

The authors suggest that the company should establish a process approach on a strategic level. The main focus should be on cross-functionality between the PP and producing functions and the establishment of cross-functionality in main processes as suggested in Figure 20 below. Also recommended is for the company to further asses all needs for tactical processes throughout the entire organization and develop the process structure using cross-functional teams focusing on process feedback and management interface.

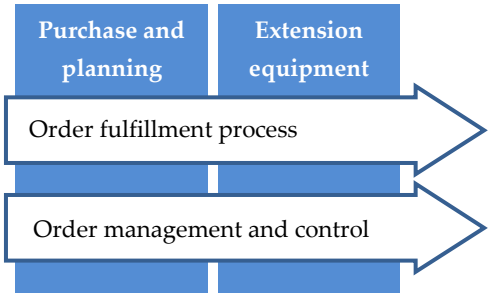

Figure 20: Suggestions for two new tactical processes.

Furthermore, boundaries and roles should be defined throughout the organization, clarifying authority and responsibilities. Customer-supplier relationships should also be established between activities by defining their requirements. This in order to establish contract-like agreements clarifying what is expected from supplier activities.

14.1.3 Tools and support for decision-making

Metrics should be established at a tactical level based on goals and objectives of each function. The establishment of decision support in order to unify management of, and control over, the tactical processes mentioned above is also strongly recommended.

The company should also create a general decision support tool as a part of the management infrastructure. Preferably a checklist defined for each

management role concerned with helping to align decision with goals and strategies.

14.1.4 Systemized control

By establishing a production control activity which is responsible for planning, routing and scheduling, a common control is established. The production control should be planning from where the complexity within the production is located, in this case the heat treatment. By controlling production as an entire system considering all factors and from these create a common way of producing.

By planning from a later stage within the production and using this together with production scheduling a flow that could be considered pulling is created. This also implies having a production that is more predictable. From the scheduling one could then predict when machines would not be operating and therefore create good possibilities for either proactive maintenance, improvement activities or the operation of other more vital machines.

Also suggested is that the company should create cross-functional routines for management and control of production, ensuring a standardized way of management. A management infrastructure should be established on a tactical level based on performance metrics of operational level activities. This is according to the authors important in order to control the system as a whole and not only individual functions.

The last task is to establish standardized routines for order-release and order-start. This enables a structured flow throughout production, in turn enabling scheduling and information of when processes are supposed to stand still allowing pro-active actions.

VI. Results

Within this chapter the research results and their meaning is presented. This involves a brief description of how the CORE model has been created and how it differentiates from other concepts, thus creating something new.

A model for business improvement has been created within the framework of this study. The model in itself is built upon a set of categories and criteria, the idea is for the model to be used as a self-assessment tool where the workflow explains in which manner the assessment should be carried out.

The model is created with a basis of fundamental components from successful business improvement concepts. These components together create what can be considered the basis of all improvement concepts. This basis is what the model created within this study aims to establish when used in organizations. The model consists of a set of criteria to which an organization is evaluated. The complete CORE model could be seen in appendix B. An illustration of the model created is presented in Figure 21 below.

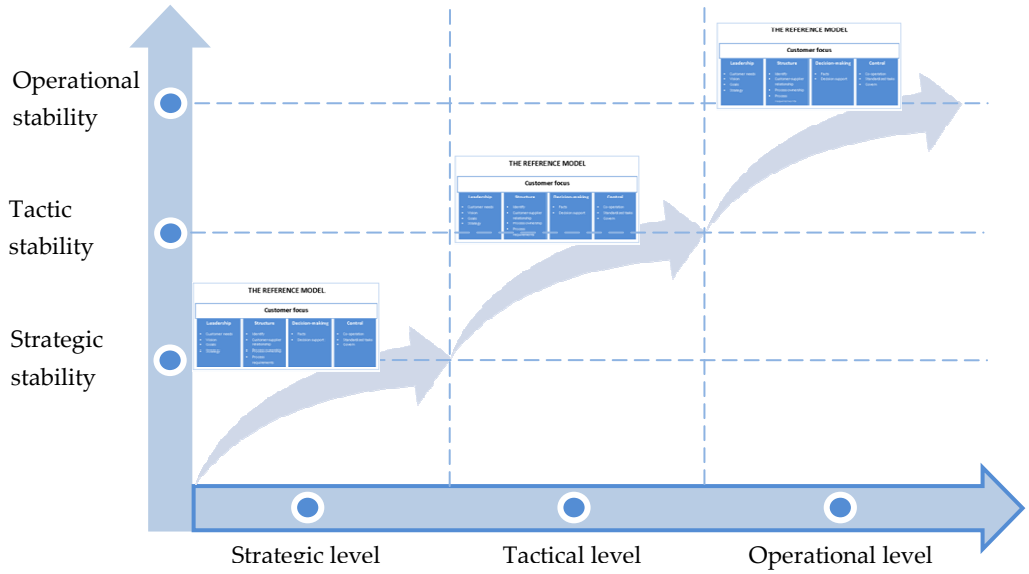

Figure 21: Illustration of how to use the model.

The model has within this study not been thoroughly tested as a whole due to the limited timeframe. But the function of the criteria, as the most essential part of the model, has been tested through a case study at PU Sandviken. The main purpose was to test its performance in identifying gaps within the

organization. The testing was successful. During the assessment, shortcomings within the organization that were considered fundamental were identified.

Since the model created stems from other business improvement concepts, several similarities could be seen. But what truly differentiates the model created within this study from already established concepts is the focus on fundamental prerequisites. These are, in many cases of business improvement attempts, not emphasized as much. This model strictly concerns these prerequisites. A set of criteria has been created that, if fulfilled, defines if these prerequisites are established.

Based on the learning experience of this study, the authors claim that this model brings something new into management improvement, as it identifies fundamental issues in an organization in a structured, yet simple fashion.

VII. Conclusions & Discussion

The research questions are reviewed and answered one by one in this chapter. Following this is a discussion of all finding of the research that was conducted. Lastly, suggestions for further research are presented.

15 Conclusions

In order to describe the research findings in a structured way, all research questions are reviewed followed by a brief description of how they are answered within the study.

RQ 1: What business improvement concepts have proven successful in supporting businesses adapting to a new market situation?

In the initial part of the chapter III, a discussion concerning the meaning of business improvement concepts and examples of successful improvement concepts are presented. Further the authors decide upon which concepts the study will be built and a further description of these follow. This is considered as answering the first research question.

RQ 2: Are there components of fundamental importance for the success of concepts within a manufacturing context?

From the concepts reviewed in order to answer research question one, core components already used in established frameworks are identified. These components are presented in the theoretical framework that could be seen as forming the basis for the concept created within the study. As mentioned earlier, the core components within the theoretical framework have no strict manufacturing context. An argument was made that the components forming the basis of the CORE model could be seen as general and therefore also the model itself.

According to this study, there are core components of greater fundamental importance. This is due to the fact that some core components are pre-requisites for other core components, and therefore are considered fundamental by the definition used and reviewed as;

"*forming the base, from which everything else develops; more important than anything else*".

The fundamental and non-fundamental components of each concept are presented in Table 5 on page 48 of this thesis. This is considered as answering the second research question.

RQ 3: How can a business improvement model, based on fundamental components, be designed within a manufacturing context?

Based on the fundamental components identified in answering research question two, a business improvement model was designed. The components were conceptualized into categories and criteria that form the foundation of the model. The fundamental components were grouped into categories and from each group, sub-categories and criteria were established that could be seen to represent if a company has established the fundamental prerequisites or not.

As an addition to the set of categories and criteria, a workflow for the model was designed in order to create a structured approach in using the CORE model as a whole as discussed in section 9 and illustrated in Figure 10.

To further test the categories and the criteria, as being an essential part of the model and in answering RQ 4 reviewed below, a trial was carried out at a cross-section at PU Sandviken.

RQ 4: How would the model work at Sandvik Mining and Construction PU Sandviken?

The result from the trial was seen as successful and therefore research question three is considered answered.

16 Discussion

In creating the model, an extensive literature study on improvement concepts was conducted. During the conceptualization phase the literature study was deepened in areas that were considered fundamental.

When considering fundamental components from the reviewed concepts one can argue that no matter what concept a business choose to adopt the prerequisites and fundamental components needed are the same. Latter, the differences between the concepts are more or less based on their approach for improvement. One can therefore consider the concept created within this study as an initial step used before choosing which improvement concept to adopt.

The CORE model is meant to be used in three loops each concerning different levels of the organization. Assessments of subsequent levels are not supposed to be made until corrective action has been made for identified improvement areas. If done properly necessary changes at a strategic level is carried out before advancing to a tactical level and therefore the conditions for assessment have been altered for this level. During the test run, due to a limited timeframe, the assessment was carried out where all levels where assessed and analysed at once.

In the test run of the model at PU Sandviken, the assessment of the company was made by the authors. This means that a greater understanding of the model and how it is meant to be used is present compared to what would be if done by company representatives. For a company to on its own conduct a self-assessment with the model as a tool, a further developed description of how to use it might be necessary.

The model is strictly evaluating performance upon if the criteria are met or not. Sometimes it can be marginal cases on whether it is met, in most cases it has been considered to not fully meet the criteria. These deliberations has been considered in the overall evaluation and analysis but is not reported clearly in the results from the assessment and the result will therefore tend to show a more negative result. The authors also note that using a percentage scale in analysing the test score yield misguiding results when comparing result. This is due to differences in the amount of questions of each category. With the knowledge of this, the result are analysed more carefully.

Important to note is that the model do not consider having a mission statement. This is due to the fact that a company mission statement is set for an entire organization. Having a mission statement within the model implies having a mission statement for all organizational levels which is not the purpose of a mission statement. Due to this fact, having a mission statement was discarded.

The sub category about decision support for managers has during the test run at PU Sandviken proven to be somewhat hard to evaluate during the assessment. A decision support could, depending on the area in which it is supposed to operate, be designed in many ways. It could be either collaboration upon decision making, checklists to follow, or even computer based software that compiles data to ease the decision making process. Due to

this the authors have had difficulties to define whenever the criterion is fulfilled or not.

Important to notice is the fact that only the performance of assessment with the model as a reference was tested, and not the entire model developed. From the results of the test, the authors draw the conclusion that the model is applicable for further testing, preferably using the workflow as intended. The performance and validity of the model is further strengthened not only because it successfully identified areas where improvement is needed. Also, as presenting the findings of the study for the management team, these issues where accepted.

Regarding validity of the developed model, the authors argue that components used are valid, in their existence in the studied business improvement concepts that are proven successful. The authors are also aware that their relative order might bring different results and suggest this as a topic for further research.

Important for the validity of the research is also that the model measures what is intended, and that changes made throughout the use of the model are taking a company in the right direction. This has not been tested, but the authors argue that the components themselves and their characteristics and origins may be sufficient.

With regards to reliability of this research, the authors argue that the study may yield different results when conducted by others having a different background. A more comprehensive description of the authors' thoughts regarding values and attitudes could give a more reliable result in similar research.

17 Further research

The CORE model created within this study is still only tested in a trial run at PU Sandviken with good results as an outcome. This result shows that the model was successful in identifying areas where fundamental components was missing and from this an action plan to correct these issues was created.

To further validate the model, an extended trial should be carried out where the action plan is followed by either PU Sandviken or another company that used the model and created an action plan from this. Doing this will enable validation that the corrective measures suggested from the model actually will create the desired output of stability and control.

For further research, full scale testing of the CORE model where assessment and corrective measures are taken for improvement areas on each level before advancing to the next would be in place. This would give the model a true evaluation where strengths and weaknesses could be identified for further development.

An option to develop the model in further research is to examine whether it is possible to use a performance scale for evaluation the degree of fulfilment of criteria. This will perhaps reduce the effect of deliberation and present a more true value. By assessing according to a scale it will also be easier to identify progression within each category between assessments done.

Another thing to further evaluate could be if the different loops of the workflow need to be as strictly completed before advancing to next level as presented within this study. There might be a possibility that together with the evaluation of criteria according to a scale, advancement could be done if an overall score of a specific level has reached a desired level. This development, if possible, could lead to a faster advancement and prevent the possibility that the progression is hindered by the fact that a single criterion is not met.

At last, research that evaluate if the CORE model would fit in other types of business aside the manufacturing context would be of great interest.

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Appendices

2010-09-30

CURRENT STATE ANALYSIS

What stops us from delivering the right product with right quality in time?

– Current state analysis of PU Sandviken–

Vad hindrar oss att leverera rätt produkt med rätt kvalitet i rätt tid?

– Nulägesanalys av PU Sandviken–

Analysis presented in Swedish

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1 Abstract

A current state analysis was conducted during the first two weeks of the research. Data collection was made using unstructured interviews and observations. Findings from interviews and observations were later grouped and analysed using affinity diagram (see paragraph 2) based on the question: "**What stops us from delivering the right product with right quality in time?".** Furthermore, an interrelationship diagraph (see figure 2) was created from the identified groups used as basis of further analysis.

When analysing the affinity diagram, an unclear organization and lack in communication and interaction is identified as causal problems for complexity and lack in joint planning and control of production flows.

The analysis of the interrelationship diagraph shows that several problems identified are based in a unclear organization. Many problems are related to the complexity of production planning, which is either a cause or effect of other problems.

2 Sammanfattning

En nulägesanalys genomfördes under de första två veckorna av arbetet. Datainsamling genomfördes med hjälp av ostrukturerade intervjuer och observationer. Resultat av data grupperades och analyserades senare med hjälp av släktskapsdiagram (se sektion 4) baserat på frågeställningen: "**Vad hindrar oss att leverera rätt produkt med rätt kvalitet i rätt tid?"**. Vidare användes relationsdiagram baserat på grupperna identifierade i släktskapsdiagrammet för vidare analys av kopplingarna mellan olika problemområden.

Utöver materialbrist och traditionellt Lean-förknippade spill har verkstaden otydlig organisation med bristande kommunikation och samverkan som medför att de komplicerade flödena inte samplaneras för att uppnå effektivare produktion.

Många problem som identifierats grundar sig i en otydlig organisation. Många problemgruppen är relaterade till komplexiteten av en svårplanerad produktion, som antingen är orsak eller verkan till många andra problem.

3 Släktskapsanalys

17.1 Frågeställning

Vad hindrar oss att leverera rätt produkt med rätt kvalitet i rätt tid?

17.2 Identifierade problem

Här har vi grupperat de identifierade problemområdena och beskrivit dem kortfattat med någon mening. Var underliggande identifierat problem från analysen finns redovisad under var grupp i punktform.

17.2.1 Otydlig organisation

Organisationen för verkstaden är otydlig och både roll- och ansvarsfördelningen är diffus. Ingen vet fullt ut vem som ansvarar för vad och problem kan lätt skjutas ifrån sig.

- Otydlig rollfördelning
- Otydliga mål
- Otydlig ansvarsfördelning
- Brist på rutiner
- Det är ok att inte klara deadlines

17.2.2 Bristande kommunikation/samverkan

Kommunikationen mellan de olika avdelningarna som möts i samma flöde är bristande. Avdelningarna planerar för sig istället för att samverka för att uppnå bästa möjliga planering.

- Bristande samverkan mellan planerare
- Kommunikationssvårigheter mellan andra planerare
- Bristande helhetssyn
- Kommunikationssvårigheter med SMT

17.2.3 Spill i produktionen

Traditionellt Leanspill i produktionen

- Tryckande flöde
- Kassationer
- Fokus på fel saker
- Ugnar i värmebehandlingen fylls inte
- Mellanlager
- Brist på kunskapsåterföring

17.2.4 Felplanerade flöden

Flöden planeras utan gemensam strategi för att passera värmebehandlingen på effektivaste sätt. Vart flöde för sig.

- Ingen samplanering
- Vart flöde för sig
- Otydlig strategi för planering av flöden
- Ingen har koll på helheten
- Flera flöden för samma ugn
- Flöden styrs efter egen kapacitet
- Låg processöversikt vid planering
- Flera produktionsplanerare mot samma ugn som inte samverkar

17.2.5 Lego tillverkningen stör planering av egen produktion

Legotillverkningen stör planering av egen produktion då framförhållningen av dessa är kort och volymer varierar mycket

- Kort framförhållning på lego
- Lego är svårplanerat

17.2.6 Produktionsstörningar

Gamla maskiner och bristande förebyggande underhåll leder till långa stopp.

- Otydlig strategi för åtgärd av problem
- Osäkra maskiner
- Maskiner går sönder
- Låg processkännedom
- Undermåligt förebyggande underhåll
- Driftstörningar

17.2.7 Produkter innan värmebehandling som inte kan samköras

Kortsiktig planering av egna flöden leder till olycklig mix framför värmebehandling. Kortsiktig planering med fokus på fel saker.

- Man kör för att köra
- För många kan ändra körplan
- Fokus på materialtillförsel
- Man väntar in produkter i pipeline
- Osmart körordning
- Planering styrs efter kapacitet

17.2.8 Svårplanerad värmebehandling

Stor mix och i artikel och volym som ankommer från separata flöden. Olika artiklar körs med olika programnummer vilket ytterligare försvårar samkörning och fyllnadsgraden sjunker.

- Ingen produktklassificering/gruppering
- Saknar planering efter produktgrupper
- Kapacitetsbrist i anlöpningssteget
- Stor produktflora

17.2.9 Problem med materialtillförsel

Missade prognoser och produktionssvårigheter hos leverantör leder till osäkra leveranser.

- Lång leveranstid för inmaterial
- Ordermix inte anpassad efter värmebehandling
- Missade prognoser
- Kvalitetsbrist på inmaterial
- Brist på rätt material
- Osäkra leveranser av inmaterial

17.2.10 Svårjusterad produktion

På grund av långa led och processtider har produktionen svårt att snabbt svara mot förändringar.

- Lång anpassningstid av produktion
- Lång ledtid i produktion
- Långa processtider i värmebehandling

17.2.11 Ensamvargar

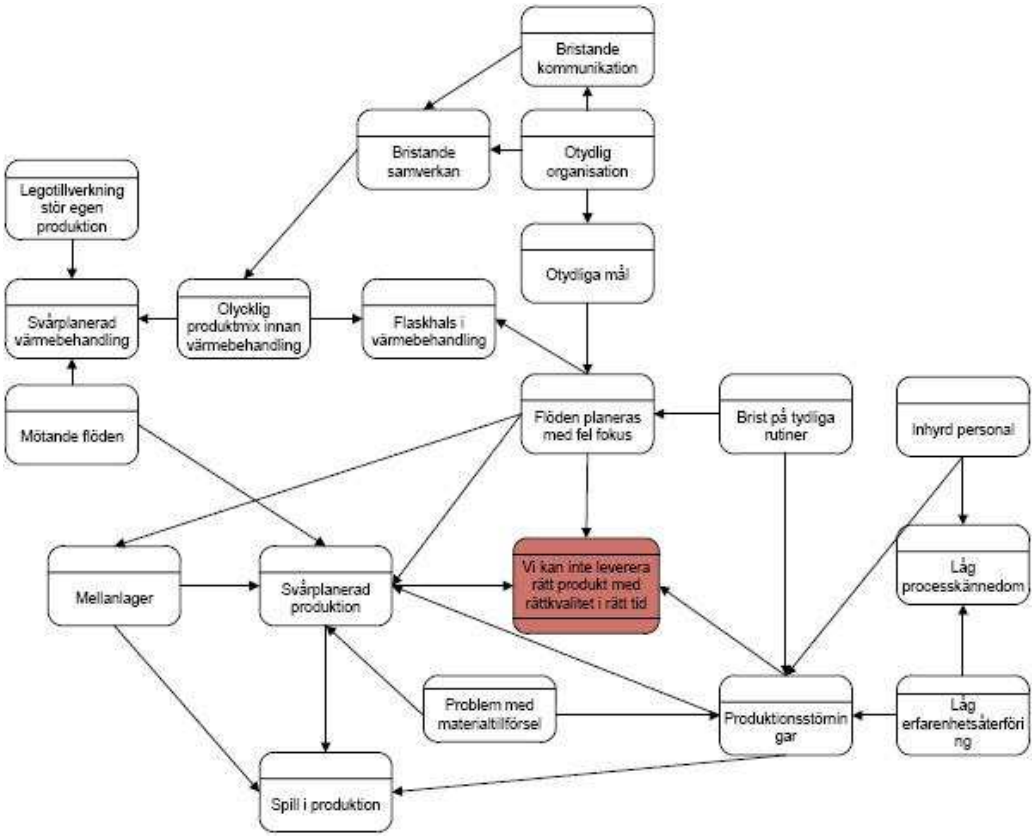
- Brist på kvalitetsparametrar
- Planeringskompetens låst till en person
- Lätta att visa på bra siffror
- Hög personalomsättning
- Backlogg i produktionen
- Kapacitetsbrist i kulbombning

17.3 Problemförklarande slutsats

Utöver materialbrist och traditionellt Lean-förknippade spill har verkstaden otydlig organisation med bristande kommunikation och samverkan som medför att de komplicerade flödena inte samplaneras för att uppnå effektivare produktion.

4 Relations diagram

Baserat på grupperna identifierade i tidigare avsnitt genomfördes en relations analys med hjälp av relationsdiagram som presenteras i Figur 1.



Figur 1: Relationsdiagram som visar relationer mellan grupper identifierade i släktskapsanalysen.

17.3.1 Analys

I första överblick av Figur 1 kan vi se att det finns många pilar till och från 'svårplanerad produktion'. Detta är ett tydligt tecken på att många problem som identifierats har förhållande till denna grupp, antingen som orsak eller något som orsakas av denna och ger upphov till ett komplext problem. Vi kan även se hur många grupper grundar sig från gruppen 'otydlig organisation'.

17.4 Problemförklarande slutsats

Många problem som identifierats grundar sig i en otydlig organisation. Många problemgrupper är relaterade till komplexiteten av en svårplanerad produktion, som antingen är orsak eller verkan till många andra problem.

Appendix B – Reference model

Reference model	
	Answer yes or no on each criteria
1. Leadership	
1.1. Customer needs	
1.1.1. All customer are defined	
1.1.2. All customer requirements are defined	
1.2. Vision	
1.2.1. There is a vision statement	
1.2.2. The vision statement is individualized	
1.2.3. The vision is general	
1.2.4. The vision reflects upper-level vision	
1.3. Goals	
1.3.1. There are goals	
1.3.2. The goals reflect all customers needs	
1.3.3. The goals are S.M.A.R.T	
1.3.4. The goals are aligned with vision	
1.4. Strategy	
1.4.1. There is a strategy	
1.4.2. The strategy is aligned with vision and goals	
2. Structure	
2.1. Identify	
2.1.1. There is a process approach	
2.1.2. All processes are identified	
2.2. Customer-supplier relationship	
2.2.1. There is a customer-supplier relationship between process	
2.2.2. The boundaries between processes are clearly identified	
2.3. Process ownership	
2.3.1. A process owner is defined for each process	
2.3.2. The role of process owner is defined on authority and responsibilities	
2.4. Process requirements	
2.4.1. Top-down recuirements are defined for each process	
2.4.2. Each process have requirements set by customer processes	
3. Decisions	
3.1. Facts	
3.1.1. Performance objectives that are essential for reaching goals are identified	
3.1.2. All performance objectives are monitored	
3.1.3. Performance objectives are linked to process requirements	
3.2. Decision support	
3.2.1. All managers have decision support helping to align decisions with goals and strategies	
3.2.2. Monitord data are analysed in order to create facts for decisionmaking	
4. Control	
4.1. Cooperation	
4.1.1. There are cross-functional cooperation in order to control the system as a whole	
4.2. Standardized tasks	
4.2.1. Guidelines are defined for a one common way of working	
4.2.2. The guidelines are communicated	
4.3. Govern efforts	
4.3.1. The guidelines are monitored	

Appendix C - Interview template

In this template, the results are collected based on interviews/observations within the organization. The data collection method should be aligned with the concept approach starting on a strategic level of the organization, continuing on a tactical level and ending up on an operational level.

Leadership

Customer needs

Current state	Answer (Yes/No)
1. All customers are defined	
2. ALL customer requirements are defined	

Vision

Current state	Answer (Yes/No)
1. There is a vision statement	
2. The vision is individualized	
3. The vision fit all departments of the company	
4. The vision reflects upper-level vision	

Goals

Current state	Answer (Yes/No)
1. There are goals	
2. The goals reflect ALL customers' needs	
3. The goals are SMART	
4. The goals are aligned with vision	

Strategy

Current state	Answer (Yes/No)

1. There is a strategy	
2. The strategy is aligned with vision and goals	

Structure

Identify

Current state	Answer (Yes/No)
1. There is a process approach	
2. All processes are identified	

Customer - supplier relationship

Current state	Answer (Yes/No)
1. There is a customer-supplier relationships between process	
2. The boundaries are clearly defined between processes	

Ownership

Current state	Answer (Yes/No)
1. A process owner is defined for each process	
2. The role of process owner is defined on authority and responsibilities	

Process description

Current state	Answer
1. Top-down requirements is defined for each process	
2. Each process have documented requirements set by the customer-process	

Decisions

Facts

Current state	Answer (Yes/No)
1. Performance objectives that are essential for reaching goals are identified	
2. All performance objectives are monitored	
3. Performance objectives are linked to process requirements	

Decision support

Current state	Answer (Yes/No)
1. All managers have decision support helping to align decisions with goals and strategies	
2. Monitored data are analysed in order to create facts for decision making	

Control

Cooperation

Current state	Answer (Yes/No)
1. There are cross functional cooperation in order to control the system as a whole.	

Standardized tasks

Current state	Answer (Yes/No)
1. Guidelines are defined for one common way of working	
2. The guidelines are communicated	

Govern efforts to sustain

Current state	Answer (Yes/No)
1. The guidelines are monitored	

Appendix D – Results summary

Results summary

Results Assessment PU Sandviken 2010-12-09	S	T		O			Tot.
S=strategic, T=tactical, O=operational (1=yes, 0=no)	Pu Sandviken	Ext. Rods	Sourcing/planning	SS	Värmebehandling	Sourcing	Total
1. Leadership							
1.1. Customer needs							
1.1.1. All customer are defined	1	1	1	1	1	1	100%
1.1.2. All customer requirements are defined	1	1	0	0	0	0	33%
1.2. Vision							
1.2.1. There is a vision statement	1	1	0	1/-	1	0	60%
1.2.2. The vision statement is individualized	1	1	0	1	1	0	67%
1.2.3. The vision is general	1	1	0	-	1	0	60%
1.2.4. The vision reflects upper-level vision	1	1	0	-	1	0	60%
1.3. Goals							
1.3.1. There are goals	1	1	1	1	1	0	83%
1.3.2. The goals reflect all customers needs	0	0	0	1	0	0	17%
1.3.3. The goals are S.M.A.R.T	1	1	0	1	1	0	67%
1.3.4. The goals are aligned with vision	0	0	0	0	1	0	17%
1.4. Strategy							
1.4.1. There is a strategy	1	1	0	1/-	0	0	40%
1.4.2. The strategy is aligned with vision and goals	0	1	0	-	0	0	20%
Summa 0:	3	2	9	1	3	10	
Summa 1:	9	10	2	5	8	1	
%:	75%	83%	18%	83%	73%	9%	
2. Structure							
2.1. Identify							
2.1.1. There is a process approach	0	1	0	1	0	0	33%
2.1.2. All processes are identified	0	1	1	1	0	0	50%
2.2. Customer-supplier relationship							
2.2.1. There is a customer-supplier relationship between process	0	0	0	1	0	1	33%
2.2.2. The boundaries between processes are clearly identified	0	0	0	0	0	0	0%
2.3. Process ownership							
2.3.1. A process owner is defined for each process	0	1	1	1	0	1	67%
2.3.2. The role of process owner is defined on authority and responsibilities	0	0	0	1	0	0	17%
2.4. Process requirements							
2.4.1. Top-down recuirements are defined for each process	0	1	0	1	1	0	50%
2.4.2. Each process have requirements set by customer processes	0	0	0	1	0	0	17%
Summa 0:	8	4	6	1	7	6	
Summa 1:	0	4	2	7	1	2	
%:	0%	50%	25%	88%	13%	25%	
3. Decisions							
3.1. Facts							
3.1.1. Performance objectives that are essential for reaching goals are identified	1	1	1	1	1	0	83%
3.1.2. All performance objectives are monitored	1	1	0	1	1	0	67%
3.1.3. Performance objectives are linked to process requirements	0	1	0	1	1	0	50%
3.2. Decision support							
3.2.1. All managers have decision support helping to align decisions with goals and strategies	1	-	0	-	1	0	50%
3.2.2. Monitord data are analyzed in order to create facts for decisionmaking	-	-	0	-	1	0	33%
Summa 0:	1	0	4	0	0	5	
Summa 1:	3	4	1	6	7	0	
%:	75%	100%	20%	100%	100%	0%	
4. Control							
4.1. Co-operation							
4.1.1. There are cross-functional cooperation in order to control the system as a whole	1	0/-	0	0	1	0	40%
4.2. Standardized tasks							
4.2.1. Guidelines are defined for a one common way of working	1	0	0	0	1	1	50%
4.2.2. The guidelines are communicated	1	0	0	0	1	0	33%
4.3. Govern efforts							
4.3.1. The guidelines are monitored	0	0	0	0	1	0	17%
Summa 0:	1	3	4	4	0	4	
Summa 1:	4	1	1	1	6	1	
%:	80%	25%	20%	20%	100%	20%	
Total							
Total summa 0:	13	9	23	6	10	25	
Total summa 1:	16	19	6	19	22	4	
Total %:	55%	68%	21%	76%	69%	14%	

Appendix E – Action plan

Action plan for PU Sandviken

Table 23: Suggestions for improvements of the major issues identified.

Major suggestions	**Task-list**
Neutralize mission-statement	Neutralize goals so they relate to all functions Align goals with objectives Establish goals and objectives for support functions Neutralize overall strategy
Process approach	Create cross-functional processes on a tactical level Define organizational structure with boundaries and roles Establish customer-supplier relationships between processes
Tools and support for decision-making	Establish performance metrics for support functions based on their goals and objectives Establish one controlling document for production control Establish decision support in order to unify management of, and control over, the tactical processes Create a general decision support tool that helps managers align decisions with goals and strategies (e.g. checklist) that will be a part of the management infrastructure
Systemized control	Create cross-functional routines for managing and control of production ensuring a standardized way of management Create a management infrastructure on a tactical level based on performance metrics of operational level activities. Create standardized routines for order-release and order-start enabling a scheduling of when processes should stand still.