Streamlining Internal Supply Chain

- Based on Mapping Processes

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Preface and acknowledgements

Understanding how the supply chain works and affects performance is essential knowledge for a company. Especially as a majority of companies operate in a contemporary and competitive environment. To attain that knowledge a company has to map its processes, to improve its performance it has to streamline operations, to sustainably manage that performance it has to adapt its performance management system by creating a clear and transparent connection between strategy and operations. Supply chain management is sometimes a forgotten part within a company but it has a key role in process orientation and high performance.

The study has been carried out at Saint-Gobain Sekurit Scandinavia (SGSS) in collaboration with Lund University, Faculty of Engineering, Department of Production Management. The study and master thesis is the final part of our Master of Science degree in Mechanical Engineering, Engineering Logistics and Production Management. Our interest in process orientation and supply chain management has successively grown throughout the education, and it was an obvious choice to immerse into these areas when it was time to do our graduate work and get the opportunity to apply our knowledge to real problems. To implement those ideas, philosophies, and theories into a world leading company has been both challenging and a great learning experience. Our hope is that this thesis will rub of some of our passion for supply chain management and process orientation and thus raise interest for these areas but also that the work will offer some practical help and guidance for anyone that's involved in supply chain management.

The time that we've spent at SGSS has been insightful; the people have all been helpful and courteous, managers have provided us extensive access to facilities and IT, which has enabled us to be productive. We are very grateful for the opportunity that was given to us and want to thank all the people at SGSS that have supported and helped us in different ways throughout the study, special thanks to our supervisor Martin Svensson that has been extremely accessible and willing to provide us both his own time and other resources. We are also especially grateful to our supervisor at Lund University, Bertil Nilsson who has provided valuable feedback and guidance throughout the study. Bertil is an extremely knowledgeable and experienced professional and lecturer that has helped to level up the quality of this thesis.

We finally hope that Saint-Gobain Sekurit Scandinavia will appreciate our Master Thesis and that it will provide useful guidance and feasible recommendations for the future.

Lund, June 2013, authors:

Jonas Sjöberg   Eldan Kajevic

" Why the West will Lose

We are going to win and the industrial West is going to lose; there is nothing much you can do about it, because the reasons for your failure are within yourselves.

Your firms are built on the Taylor model; even worse, so are your heads. With your bosses doing the thinking, while the workers wield the screwdrivers, you are convinced deep down that this is the right way to run a business.

For you, the essence of management is getting the ideas out of the heads of the bosses into the heads of labour.

We are beyond the Taylor model: business, we know, is now so complex and difficult, the survival of firms so hazardous in an environment increasingly unpredictable, competitive, and fraught with danger that their continued existence depends on the day-to-day mobilization of every ounce of intelligence.

For us, the core of management is precisely this art of mobilizing and pulling together the intellectual resources of all employees in the service of the firm. Because we have measured better than you the scope of the new technological and economic challenges, we know that the intelligence of a handful of technocrats, however brilliant and smart they may be, is no longer enough for a real chance of success.

Only by drawing on the combined brainpower of all its employees can a firm face up to the turbulence and constraints of today's environment.

This is why our large companies give their employees three to four times more training than yours; this is why they foster within the firm such intensive exchange and communication; this is why they seek constantly everybody's suggestions and why they demand from the educational system increasing number of graduates as well as bright and well-educated generalists, because these people are the lifeblood of industry.

Your socially minded bosses, often full of good intentions, believe their duty is to protect the people in their firms. We, on the other hand, are realists and consider it our duty to get our own people to defend their firms, which will pay them back a hundredfold for their dedication. By doing this, we end up being more ´social´ than you.[1]

"

[1] Hill and Hill (2012) - Matsushita, K, (1985) ´Why the West will lose: extracts from remarks made by Mr Konosu Matsushita of the Matsushita Electric Industrial Company (Japan) to a group of Western managers,´ Industrial Participation, Spring, P. 8.

Abstract

Title   Streamlining Internal Supply Chain, based on mapping processes

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Bertil Nilsson, Department of Production Management, Faculty of Engineering, Lund University

Context/ Background   Globalisation, increasing product complexity, volatile demand, and financial crisis all put strains on the supply, processing, and distribution of goods. That's why supply chain management has become the area to focus on to gain competitive advantages and reduce costs.

Saint-Gobain Sekurit Scandinavia (SGSS) is part of a large global French enterprise, Saint-Gobain that's a world leader in its markets. SGSS also operates globally in three markets and manufactures windshields for the automotive and transportation industries.

SGSS's overall a high performing company that over the years has conducted numerous improvement projects and is both ISO/TS 16949 and ISO 14001 certified. It currently has several employees that have world class manufacturing belts and are continuously managing projects to improve performance. SGSS currently uses a balanced score card type of measurement system and puts a lot of effort on maintaining and improving quality.

Problem   SGSS's supply chain processes are not currently defined which makes overview of the supply chain not optimal from management point of view and raises thoughts about the supply chain processes potential for improvements. Distribution of responsibilities is not fully clarified and creates a platform for conflicts and communication problems. That in turn increases the risk for delays of delivery to customers as a result. Other perceived problems are long lead-time, increasing complexity, and high WIP.

Purpose   Identify and recommend improvements and/ or how to eliminate bottlenecks in information flows within the internal supply chain, based on mapping processes. Improvements are supposed to address the operationalization of strategy and have the purpose to create a sustainable solution

Methodology   The study assumes systems approach to research and attempts to create a solution that's greater than single components of analysis. The study begins inductively with the process map, in the second phase it becomes deductive when analysing challenges, the measurement sys-

tem is a result of both methods iterating and cannot really be defined. The measurement system that is the final result of the study attempts to be normative and the study is therefore considered to be normative as well. Credibility has been important to this study for several reasons, partly because it attempts to be normative; triangulation has been used extensively to ensure credibility. It's overall a qualitative study even if some quantitative aspects exist. Data is an even mixture of primary and secondary nature. The collection of data is executed through interviews, observations, and archive analysis.

Findings   Recommendations are separated into three types: primary, secondary, and tertiary recommendations, depending on estimates of required time, dedication and size of investment.

SGSS should use the process map and measurement system to improve communication related issues and the measurement system to communicate the relation between operations and strategy so that employees better understand the purpose of their work.

Delays can be decreased by restricting forecast changes to the different safety stocks in the supply chain and by using the appended fault tree analysis to understand root causes to delays.

SGSS should give supply chain management more attention to take advantage of the on-going market trends and define their value proposition to better align operations.

Reorient to the process view in order to reduce hierarchy, i.e. delegate responsibility and authority by empowering process owners, involving employees into decisions, and creating systems that allow employees to get their ideas realized. This also means that SGSS should map the remaining core processes and integrate them with each other.

Companies in general and Saint-Gobain Sekurit in Eslöv should take the outside in perspective to strategy. To do that they should benchmark the frame of reference in the performance management system. This will better align strategy with reality.

Keywords   Supply Chain Management (SCM), Streamlining Business Operations, Process Mapping, Performance Management System, Process Based Business Development (PBBD)

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Abbreviations

BPM   Business Process Management

CSF   Critical Success Factors

EDI   Electronic Data Interchange

HR   Human Relations

KPI   Key Performance Indicator

OEE   Overall Equipment Effectiveness
OEM   Original Equipment Manufacturer
OPI   Operational Performance Indicator
OTD   Order To Delivery

PBBD   Process Based Business Development
PEMM   Process and Enterprise Maturity Model

ROI   Return On Investment

SC   Supply Chain
SCM   Supply Chain Management
SGG   Saint-Gobain Group
SGS   Saint-Gobain Sekurit
SGSI   Saint -Gobain Sekurit International
SGSS   Saint-Gobain Sekurit Scandinavia AB
SGSX   Saint-Gobain Sekurit [International sister company]
SKU   Stock Keeping Unit

WIP   Work In Process
WCM   World Class Manufacturing

1 Introduction

This chapter describes the circumstances under which the study is conducted. It explains what's happened prior to the study, what problems that need to be resolved and the purpose of the study. Delimitations, limitations, finally the construct of the thesis is described and how the different chapters interrelate to reach final conclusions and recommendations.
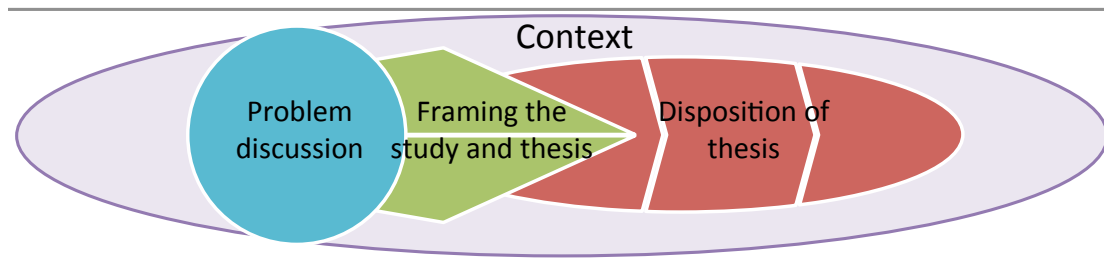
1.1 Context

The growing global economy has redefined the dynamics of competition for modern organizations. With product life cycles shortening and worldwide rivalries increasing, success depends on effective global supply chains management, being able to deliver the right product to the right market at the right time. The complexity involved is managing supply chains that span continents and dominate markets, demands strategies and systems that are agile, adaptable, and aligned[2].

To maintain competitiveness, it's essential to continuously increase the utilization of available resources. A starting point for higher utilization is keen understanding of the current resource utilization, which can be determined by mapping the flow of information and related activities. Mapping provides understanding of where in the supply chain value is added and where waste is generated. It's also a prerequisite for continuous improvement. To effectively manage the implementation of strategy across the supply chain and make the implementation sustainable, it's fundamental to make strategy integrated into the companies' infrastructure. To achieve this, strategy has to be implemented in the companies performance management system.

Saint-Gobain Sekurit (SGSS) in Eslöv, Sweden, is a business unit of the global French company Saint-Gobain that is the world leader in habitat and construction markets. The company designs, manufactures and distributes building materials worldwide.[3] Saint-Gobain Sekurit (SGSI) is within the division of innovative materials and manufactures glass for the automotive industry for three markets; original equipment manufacturing (OEM), aftermarket and transport.

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[2] Stanford executive education
[3] SGG intranet

The situation is currently even more aggravated by the financial and other[4] global crisis that have put a strain on the automobile industry. As automakers are large players in the industry, it naturally leads to the pressure that they recognize is transferred upstream and ends up lowering margins on their suppliers, such as SGSS.[5]

1.2 Problem discussion

SGSS's supply chain processes are currently not accurately defined which makes overview of the supply chain not optimal from management point of view and raises thoughts about the supply chain processes potential for improvements. A manager with a long history in the company and extensive knowledge has resigned and the manager's responsibilities have been spread out to other employees, which creates a secondary effect that the distribution of responsibilities is not fully clarified and therefore creates a platform for conflicts and communication problems. Which in turn creates a risk for delays of delivery to customers as a result. A "headache" for SGSS is an increasing need for flexibility while the supply chain currently is constructed for larger production volumes. SGSS's supply chain manager is looking for a sustainable solution that will increase performance.

Perceived problems further include long lead-times from order of raw material to dispatch of finished products to customers, inefficient production planning, high amounts of WIP in the supply chain, and delays caused by prototype production.

1.3 Framing the study and thesis

1.3.1 Purpose and deliverables

The purpose is to identifying and recommending improvements and/ or how to eliminate bottlenecks in information flows within the internal supply chain, based on mapping processes. Which bottlenecks that are addressed depends on the process character and is determined in line with the strategy for the supply chain. Improvements are supposed to address the operationalization of strategy and have the purpose to create a sustainable solution. In relation to this the authors want to take a look at context related challenges and integrate them into the solution. Deliverables are divided into five parts as follows:

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[4] Subprime mortgage crisis 2007, Global financial crisis 2008, European sovereign depth crisis 2010
[5] The Link

1. Develop a map of the internal supply chain process at the current state with a high level of details. In more conventional language it's also called, order to delivery (OTD) process.
2. Measure business performance.
3. Find opportunities for improvements and recommend solutions on both tactical and strategic levels.
4. Develop an appropriate performance management system in order to create a sustainable transformation.
5. Develop an action plan for the implementation of recommendation.

1.3.2 Study focus

The focus is on mapping the main internal supply chain process at SGSS, i.e. deliverable number 1. The number of processes that are included into the internal supply chain limit the depth of analysis in each process. In order to have an even clearer goal, the focus is on mapping the production planning process and other sub-processes connected to it, which for example could be purchasing and sales monitoring.

1.3.3 Delimitations

A supply chain involves an entire network of entities, from raw material suppliers to end customers. Although in this thesis it refers to the triadic entities, first tier supplier, SGSS, and first tier customer, see appendix B for definition.

The study only considers information flows and does neither map material nor financial flows. Further, the only flows that are mapped are within serial production. This delimitation can also be acknowledged to the fact that the study is limited to the internal supply chain where only serial production is handled according to SGSS documentation of core processes. See figure 1 for illustrations of these delimitations.
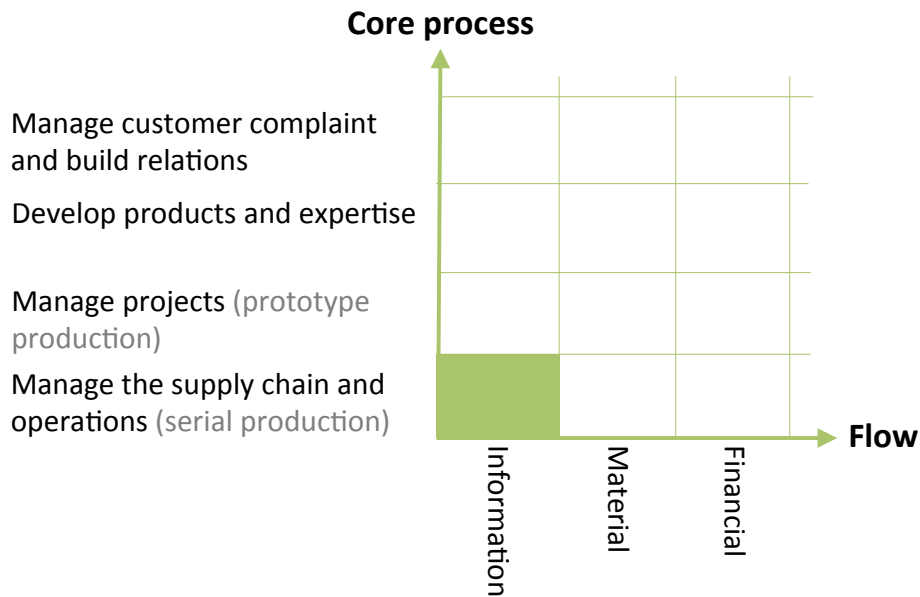
Figure 1, delimitation I for this study.

The study is limited within the scope of the prerequisites of a master thesis. The study is further limited to the internal SC, see figure 2, Internal Supply Chain in this study refers to the flows in SGSS, from that raw material arrives until products are dispatched from SGSS, i.e. this study has not considered supplier & customer negotiations, risks, strategies etc. It considers only the results of other processes that might affect the SC, without providing recommendations for those processes.
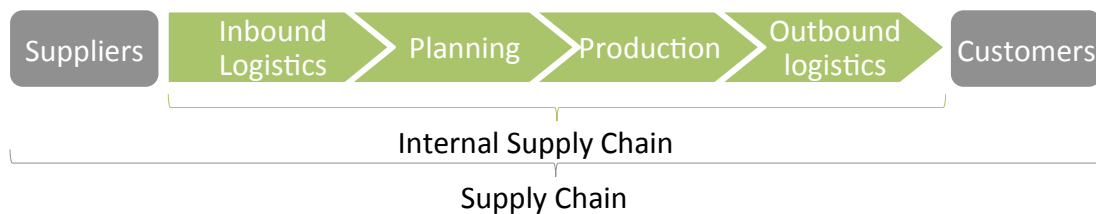
Figure 2, delimitation II for this study.

1.3.4 Target audience

This master thesis is aimed at senior students and professionals with engineering and business backgrounds as well as stakeholders within Saint-Gobain Sekurit. Its primary audience is although managers within the logistics department and other managers at SGSS in Eslöv.

The authors have aimed to create a document that can be used by the entire SGG. The point of this is to achieve a larger impact and spread the message that the process view and the supply chain are two areas that should be prioritized. This requires that the thesis is more normative[6] and strongly related to SGG current work.

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[6] See methodology chapter for explanation.

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1.3.5 Distribution of workload

A majority of work that's conducted during this study has been equally distributed between the two authors. Sections have usually been written by one author and then modified and further developed by the other author. Both authors have been present at all interviews, meetings, observations, and workshops. Recommendations are developed in consensus between the two authors and trough discussions.

1.4 Disposition of thesis

The disposition of the report is typically distributed in eight chapters and the content is strictly constrained to the chapter in which it's placed. Figure 3 illustrates how the different chapters interrelate in the form of a simplified process map, an explanation of the different illustrations can be found in appendix A. The different phases in the figure will be further discussed in chapter three, methodology. Appendix contains a number of important additions to the thesis that might be of use for the reader that seeks deeper knowledge and understanding or desires to verify some statement, although not crucial for basic understanding of the study.
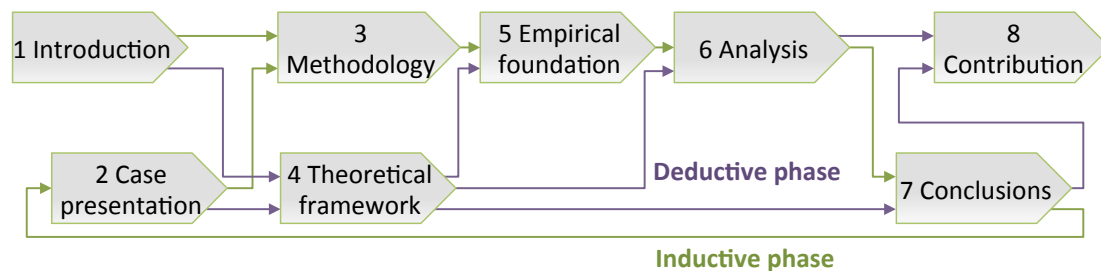
Figure 3, illustration of the disposition and logic of the thesis.

1.4.1 Chapter: Introduction

This chapter describes the circumstance under which the study is conducted. It explains what's happened prior to the study, what problems that need to be resolved and the purpose of the study. Delimitations, limitations and the method of execution are described, and finally the construct of the thesis is described and how the different chapters interrelate to reach final conclusions and recommendations.

1.4.2 Chapter: Case presentation

This chapter presents the parenting company Saint-Gobain, different business areas and activities, and in that way aims to provide an understanding of the corporation and the culture that drives its operations.

1.4.3 Chapter: Methodology

This chapter explains the science behind the study, it brings to light what's important to consider when conducting a study of this kind. The chapter also describes how credibility is achieved and how different approaches to research can affect the end result. At the end of the chapter the authors leave comments on the literature that's used and how credibility has been achieved despite some challenges.

1.4.4 Chapter: Theoretical framework

This chapter contains the theory that's found most relevant for the study. It contains theory that's used in empirics (execution), analysis and conclusions. The theory that's brought up concerns process orientation, supply chain management, mapping, and performance management. If you find a word or terminology that's unfamiliar or seems to be used in another way then you are used to, look up the definition of the most frequently used terms in appendix B.

1.4.5 Chapter: Empirical foundation and findings

Empirics contains the actual data that's used in analysis and conclusion, it's both a result of methodology and the theoretical framework. It is not supposed to contain analysis, nor evaluation from the authors and its supposed to contain all the data (excluding what's found in the appendix) that's mentioned in the subsequent chapters. It's structured in four sub-chapter where the first collects information about SGSS as a whole, second about supply chain related information, third collects information about operations, and the last sub-chapter gathers the challenges in SGSS that are related to the supply chain.

1.4.6 Chapter: Analysis

This chapter will initially analyse the process map and challenges that SGSS faces. The next step will be to analyse SGSS strategy and translate it into concrete measures in measurement strategy with the measurement system as a result. It will then go on to develop targets and priorities for the different OPI's.

1.4.7 Chapter: Conclusions

"The west will lose", is an excellent summary of the challenges that corporations are facing in this modern age. The heritage from the industrial age, with Taylor, glorification of hierarchy, and divisions of labour is embedded in everything that we do and it's a premise for everything that we do. The world has changed, we have to adapt to the change in our minds, culture, and how we view the organisation of labour. This chapter concludes how process based business development together with a performance management system helps to meet this new age at SGSS.

1.4.8 Chapter: Discussion & contribution

This chapter discusses the performance management system in order to explain its place in the organisation and how it can contribute real value. It also explains why the authors consider the system to be an addition to existing literature on performance management systems.

2 Case presentation

This chapter presents the parenting company Saint-Gobain, different business areas and activities, and in that way aims to provide an understanding of the corporation and the culture that drives its operations.

2.1 Saint-Gobain Group

Saint-Gobain Group (SGG) is a French group that was founded 1665 in Paris by Louis XIV where the headquarters is located today. SGG was first internationally established in Germany 1857 and has after 1889 grown globally and is today present all around the world, see figure 4.

Saint-Gobain in 1904
Saint-Gobain in 1980
Saint-Gobain in 2012
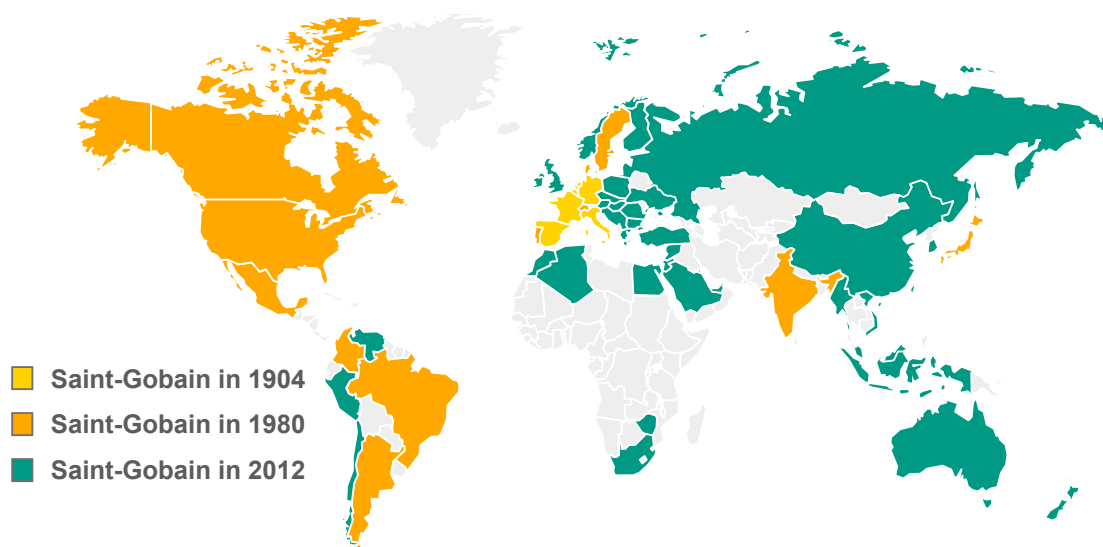
Figure 4, illustration by SGG; historical presence.[7]

SGG is one of the worlds' top hundred leading industrial corporations consisting of more than 1200 companies and operates in 64 countries worldwide where SGG is a world leader in all its business areas. SGG employs approximately 200 000 people and has a turnover of 360 billion SEK.

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[7] Presentation SGG (2011)

SGG has 50 different activities divided into four main areas (see figure 5 and appendix E):
- Innovative materials (23%). Flat glass and high-performance materials.
- Construction Products (25%). E.g. insulation, plaster and siding.
- Building distribution (43%). E.g. Building materials, tile and plumbing.
- Packaging verallia (9%). Bottles and jars.

Innovative Materials   Construction Products
Building Distribution   Packaging Verallia
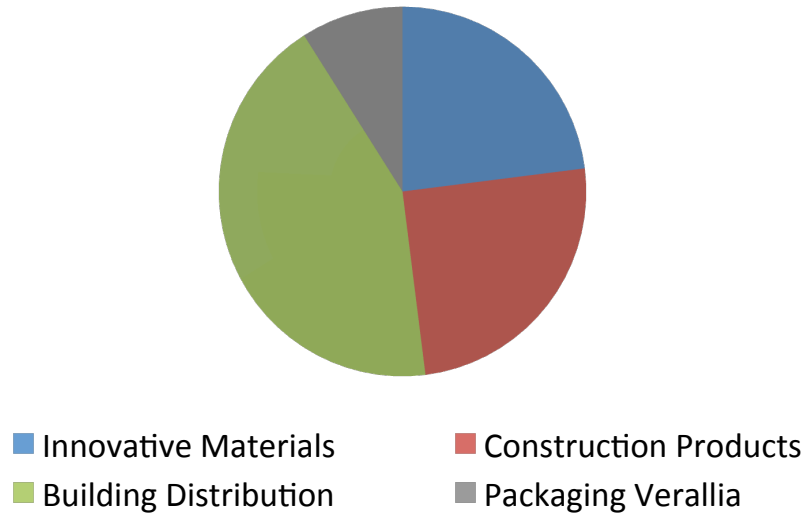
Figure 5, consolidated net sales for SGG year 2010.

2.2 Saint-Gobain Sekurit

Saint-Gobain Sekurit is a subsidiary of SGG and a part of the business area innovative materials (Flat glass). SGSI has been in the glass business since 1699 and is today recognized as the technology leader in automotive glass and operates in 22 countries with 12 100 employees and has a turnover of approximately 16 billion SEK.

SGSI is one of the leading glass manufacturers in the world, and provides highly value-added products and services in three markets:
- Automotive glass originally installed by carmakers (OEM).
- Automotive glass replacement (aftermarket).
- Glass for transport vehicles (buses, lorries, aeronautics).

Figure 6, illustration by Saint-Gobain Sekurit; manufacturing facilities.[8]

Cars all over the world are equipped with SGSI's products. Every second European car is equipped with SGSI glazing and the company has therefore the largest market share in Europe and the second largest globally with significant, and growing presence in Asia and America.

2.3 Saint-Gobain Sekurit Scandinavia

Saint-Gobain Sekurit Scandinavia (SGSS) is a part of SGSI and was founded 1974 when SGSI acquired the Swedish company Trempex after a couple of years of co-operation. Trempex was established 1951 in Malmö where they produced windshields for the automotive industry. The company then moved its production to Eslöv 1961 and changed its name from Trempex to SGSS in 2000.

SGSSs facilities, see figure 7, are overall modern and highly automated.

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[8] Presentation SG Innovative Materials (2012)

Figure 7, Saint-Gobain Sekurit Scandinavia, production facility.[9]

SGSS in Eslöv is the primary unit for supply of windshields for the Nordic countries and manufactures both tempered and laminated side windshields besides from:

- Printed/un printed.
- Soldering connectors/buttons.
- Gluing of holders.
- Aqua control coating.

SGSS provides some value adding activates, such as pre-assembly of: frames & pins, gluing of rain sensors/brake light brackets, camera holders and priming.

SGSS currently consists of 150 employees and has a turnover of 550 million SEK. Their customers amongst others are Volvo, Volkswagen, Jaguar, Landrover, Scania, and PSA.

Note: This study does not differentiate between side, front and back windows with respect to SGSS that uses different names for the different types. So from now on whenever windshield is used it can mean any one of the three types.

2.4 Business concept

SGSS business concept is to be a leader in quality within glass system supplies to the automotive industry and to actively participate in the development of the automotive industry in order to manufacture and supply products that meet the needs of markets.

Operations focus on value-added activities in order to effectively meet SGSS vision, policies, goals and customer expectations. This is considered highly important for SGSS and the company currently offers laminated side windows (SGS Global Protect) and Water Repellent Coating (SGS Aquacontrol) as their main

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[9] SGSS intranet.

value-adding activities. The organization strives to continuously improve and develop processes, management tools & routines.

2.5 Market

SGSS's markets are primarily in Sweden, Germany and France, but they have customers all over the globe. Their OEM-customers are manufacturers of passenger cars, trucks, and commercial vehicles. SGSS also delivers spare parts related to OEM production. SGSI as a whole delivers parts to the aerospace industry, military, and armoured vehicles besides from those three main markets.

3 Methodology

This chapter explains the science behind the study, it brings to light what's important to consider when conducting a study of this kind. The chapter also describes how credibility is achieved and how different approaches to research can affect the end result. At the end of the chapter the authors leave comments on the literature that's used and how credibility has been achieved despite some challenges.

Methodology: "a set or system of methods, principles, and rules for regulating a given discipline, as in the arts or sciences" – dictionary.com

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3.1 Different approaches

3.1.1 Scientific approach

Depending on an author's basic view and knowledge in an area, the author may have different goals with a study. These goals can be classified into three different perspectives, namely the analytical approach, actors approach, and systems approach.[10]

The analytical approach seeks to explain the truth as objectively and completely as possible. The subjective assessment is not taken into account and knowledge is considered to be independent from the author. The author strives to find "cause-effect"-relations, and reality is seen as a static structure that can be divided into parts and the parts can be analysed separately. The sum of the parts is then supposed to represent the entirety. [11]

Actors approach puts emphasis on the fact that reality is a social construction that's affected by and that affects people. The description of reality is therefore dependent on the authors experience and behaviour,[12] meaning that both a subjective assessment is included and the authors' personal knowledge are factors that affect the result.

Systems approach also tries to explain reality objectively as the analytical approach, but believes that the whole is different from, and often more than the sum of its parts. The approach emphasizes synergies between different parts and relations between different parts are as important as the parts themselves. The author seeks to find connec-

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[10] Björklund, M & Paulsson, U. (2003)

[11] Ibid.

[12] Ibid.

tions and relations between different parts of a system in order to understand the underlying factors that cause different behaviours/ phenomena.[13]

The process map that's developed in this study represents the sum of all perspectives in the supply chain. The scientific perspective therefore mostly resembles the analytical approach. Recommendations on the other hand are developed with a systems approach as they originated from a holistic view, meaning that all parts were considered, with the purpose to improve the whole system, meaning that the goal was to find synergies that would make the entirety better then the sum of all part.

3.1.2 Induction, abduction and deduction

Authors work between different levels of abstraction during a study where general theories and/ or concrete empirical data is the endpoint.[14] The choice of research method involves how the relation between theory and empiricism is perceived. There are usually two methods that are mentioned, i.e. induction and abduction[15], but there's also a third method that's of interest for this study, that's deduction.

Induction has a starting point in reality (empirics), seeking to identify patterns that can be described trough models and theories. The chosen topic is studied without existing theory, so the resulting theory is then based on empirical data.[16] General and theoretical conclusions are drawn based on data, where it's often stressed that the data collection must be completely unbiased[17] and credibility of the data becomes the most significant factor.

Abduction is a method that draws conclusions about what has caused or preceded an observation. The method can't be used systematically as it requires extensive experience within the studied field.[18] The level of abstraction ("theoretical conclusions") therefore differs during abduction-based research.[19]

Deduction is the opposite of induction and therefore begins with theories in order to make predictions about empirical data. The theory is then verified with the empirical data that's collected, this in turn enables the researcher to make further predictions about the phenomena that's studied. The strength of this method is that it enables the researcher to breakdown a phenomena based on existing theory;[20] deduction has therefore a stronger and more independent position compared to induction[21] as it allows researchers to address smaller problems instead of the entirety.

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[13] Björklund, M & Paulsson, U. (2003)

[14] Ibid.

[15] Wallen, G (1996)

[16] Björklund, M & Paulsson, U.(2003)

[17] Wallen, G (1996)

[18] Ibid.

[19] Björklund, M & Paulsson, U.(2003)

[20] Ibid.

[21] Wallen, G (1996)
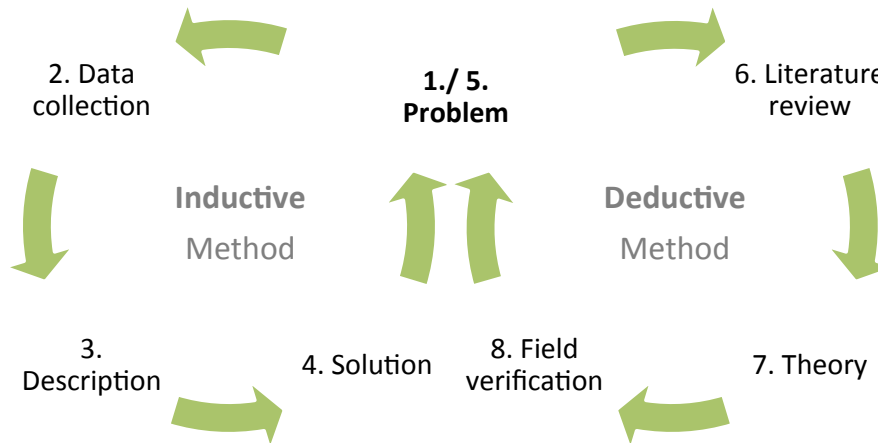
Figure 8, scientific method, deductive vs. inductive.[22]

The method that's applied in this study mostly resembles the one that illustrated in figure 8. The study began inductively and was built up on a base of data collection in order to describe reality trough the process map. The study then proceeded to the second phase where a thorough theory study acted as the base for a formal theory, the deductive part of the study, which was followed up with archive analysis and PEMM questionnaire. Towards the end of the study the method switched between inductive and deductive more than once for verification purposes, data collection was continually checked with theory and vice versa. Both theory and data was collected throughout most parts of the study. The performance management system is although considered to be developed deductively mainly as a result of the literature review.

3.1.3 Purpose and strategy of research

The size of existing knowledge in the research area is of importance when determining what strategy that will be applied for the study. There are a number of different purposes, although only four of them are explained here to create a basic understanding.[23]

Purpose of a study can be:[24]

- Exploratory; the main purpose of the study is to in depth understand how something works or is performed. This also means that the current knowledge in the area is limited.
- Descriptive; the main purpose of a study is to find out and describe how something works or is performed which is suitable when there is a basic knowledge in an area.
- Explanatory; the study seeks to find out cause & effect relations and descriptions of how something works or is performed. There is already extensive knowledge in the area and so the researcher wants to both explore and describe the phenomena.

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[22] Based on Jan Olhager

[23] Björklund, M. Paulsson, U. (2003)

[24] Höst, M. Regnell, B. Runeson, P. (2006)

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- Normative; the study has the purpose to develop a theory that acts as a guide for what's normal. The purpose is best suited when knowledge is extensive and the researcher has a good understanding in the area.

The purpose of this study has partly been to describe or explain reality. The process map acts as a descriptive part of the study, streamlining on the other hand is more explanatory as it, for instance aims to find root causes for delays but it's also a part that connects existing theory to the collected data and tries to solve problems in that way. There is also a third part of the study that aims to create a normative approach for developing performance management systems. Section 3.5.3 discuses the credibility of sources and mentions that there is limited literature in this certain area, which can make this normative description questionable but this study nevertheless, argues that the performance management system is a normative part. Existing literature is extensive in the way that there are numerous different sources that mention or discuss performance management systems from different perspectives, but no single source gives a complete description and they all provide delimited solutions, which is the issue that's discussed in section 3.5.3.

If the study as a whole is to be defined as one of the three, it's normative. The process map is more of a means to achieve the goal than the goal itself, the streamlining part is also more of a means to achieve the goal as it's used to find the challenges that have to be tackled by the measurement system. The streamlining part provides solutions to the challenges but it's the measurement system that's used to ensure that they are carried out.

3.2 Aspects of data and its attributes

3.2.1 Credibility of research

A study can be authentic in three areas, that's: conclusions are well founded, it truly addresses the phenomena that the author wants to study, or the results are general. These three categories are usually called, *reliability*, *validity* and *representative*. Reliability is the trustworthiness in the data collection and analysis of data in regard to random variations. Validity refers to the likelihood of "what's being measured is what was supposed to be measured", in other words it's a measure of systematic problems, see figure 9. Finally representative refers to the results of the study and if the results are general.[25] National encyclopaedia defines the three as:
- Reliability: "yielding the same or compatible results in different clinical experiments or statistical trials".
- Validity: "the extent to which a measurement instrument measures what it is supposed to measure".
- Representative: "makes a suitable and typical example (of something) that in a worthy way can represent (a person or phenomena)".

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[25] Höst, M. Regnell, B. Runeson, P. (2006)
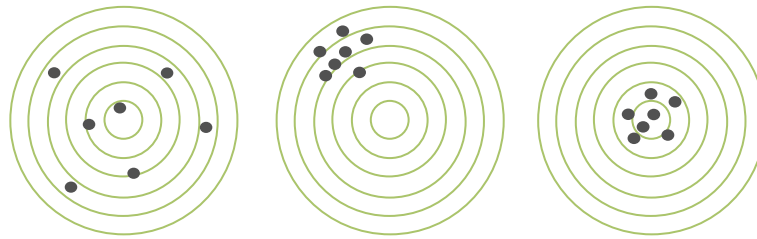
Figure 9, illustration of reliability and validity.

The illustration to the left in figure 9 shows both low validity and reliability, illustration in the middle has only low validity and the one to the right has both high validity and high reliability.[26]

To increase or guarantee credibility triangulation is applied. There are four types of triangulation that all in one way or another help to increase credibility[27]:
- Method triangulation, use different methods to examine the same phenomena.
- Data triangulation, use several data sources.
- Evaluation triangulation, different people evaluate the same data.
- Theoretical triangulation, use different theories on the same data.

Reliability was attained in this study by performing several interviews and using primary data sources but also by preparing thoroughly and making sure that the interviewees understood what the study aimed to do and that the interviewees used the same terminology, had enough time to explain etc. Validity was important in this study as it aims to be normative and was realized trough triangulation. Hence, all four approaches to triangulation were used, i.e. method, data, evaluation and theory. The study argues that by triangulating theory and evaluation, and applying an inductive/ deductive method to research it has achieved a result that also should be widely representative. Credibility is hence achieved and considered to be high.

3.2.2 Qualitative and quantitative

Quantitative analysis refers to analysis of quantitative data, that is data that can be represented in terms of "number of units" and other numerical values. Qualitative data is perceptual evaluations of a situation, for instance: high quality, heavy machine, or good service.

Quantitative methods are mainly used with two purposes. Firstly to explore a situation in order to gain understanding and secondly to show connections with a hypothesis that has been chosen beforehand.[28] This study has although not conducted any extensive quantitative analysis, mean and standard deviation of PEMM is discussed but that's all.

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[26] Björklund, M. Paulsson, U. (2003)

[27] Jan Olhager

[28] Höst, M. Regnell, B. Runeson, P. (2006)

Analysis of qualitative data is different in character than analysis of quantitative data as it consists of words and descriptions and it's therefore hard to calculate mean and variance on that type of information. However, the existence of terms, concepts and descriptions are important in qualitative analysis, in some cases even the frequency. Qualitative analysis methods are divided into four principally different categories, where the first three qualify for scientific research: [29]

- Quasi-static methods are based on counting the occurrence of words or groups of words in texts. Thus, it's possible to compare the importance of different terms and concepts to different people.
- Template-based methods are based on a list of keywords and the analysis seeks to find patterns in their occurrence in a dataset. The list of keywords is compiled from theory and terminology from the studied area. Here the focus is who says what instead of how many that say what.
- Edited methods aim, just like the template-based, to create categories of terms but the difference is that edited methods start to search for keywords in the dataset. In other words, the author's personal interpretation of the content and patterns is highly important.

The edited method was determined to be most appropriate for interviews as it was important to capture how SGSS works and communicates instead of trying to force terminology on to the organisation. The terminology and descriptions were then verified with other employees to ensure that they were correctly understood. The template-based method was used for observations and archive analysis, as it appeared most suitable for a deductive study that aims to be normative.

3.2.3 Primary vs. secondary data

When examining the origin of data sources in order to determine credibility, it's just as important to examine the relationship between different sources, in order to create a MECE (Mutually Exclusive, Collectively Exhaustive) set of sources. It's generally considered that the closer a data source is linked to the studied situation the more important is the source[30].

Primary data can be described as data that's collected for use in the current study, for example interviews and surveys,[31] primary data is also generally closer to the selected source[32] and is therefore also more important. This also means that misinterpretations are less likely to happen which in turn raises the credibility of the study. Secondary data is usually collected for other purposes than the current study, for example: literature studies and archive analysis,[33] meaning that the study loses some credibility, but that is managed with triangulation. The authors' presence at SGSS resulted in that observations were characterized by primary data.

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[29] Höst, M. Regnell, B. Runeson, P. (2006)

[30] Holme (1997)

[31] Björklund, M & Paulsson, U. (2003)

[32] Holme (1997)

[33] Björklund, M & Paulsson, U. (2003)

3.3 Instruments to collect data

The four most relevant overall-approaches for conducting graduate work within applied sciences are: surveys, experiments, action research and case studies. Surveys are summaries and descriptions of the current state of the studied situation and often aim to describe broad questions, experiments aim to compare two or more alternatives, and action research is a carefully monitored and documented study of an on-going solution to a problem. A case study is an in-depth study of one or more cases that attempt to influence the studied object as little as possible. [34] This study is a case study because it tries to create a solution to a problem without neither implementing the solution nor experimenting with it, although it conducts a survey but that is only a tool for the larger purpose. Typical methods for collecting data in a case study are: interviews, observations and archive research[35].

As this is a case study some data is collected trough observations and observations are not documented in the same thorough manner as for example interviews. References therefore don't contain reference to specific observations; as a result of this it also does not name individuals in relation to specific interviews. The reason is integrity, as results of the fact that observations are not documented but they are used to both verify data from interviews and are verified in interviews. Some data that's presented as originating from certain interviews might therefore have been presented after verification and the context of the data changed, hence the need to disconnect interviewees from interviews. The interviews are although documented in the study and can be verified if needed.

3.3.1 Interviews

If the nature of interviews is of qualitative nature and don't focus on being representative, then the selection of the population is focused on capturing the variation that exists in the whole population. The selection is then done trough stratification, i.e. a number of categories (process steps) are defined from the population and the selected interviewed subjects are picked from every category. This study has in a sense aimed to capture the variation of a population but without sacrificing being representative by interviewing almost a third of the supply chain department. Interviews were structured into four phases according to the guidelines by Höst, M. et al. (2006):
1. Context
2. Opening questions
3. Key Issues
4. Summary

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[34] Höst, M. Regnell, B. Runeson, P. (2006)
[35] Ibid.

Interviews can also have three different approaches according to table 1.

	Semi-free	Semi-structured	Structured
Goals	Individual experiences of a phenomena quality	Individual experiences of quantities and qualities	The interview seeks knowledge about relations between concepts, if related
Structure	Interview guide, open within chosen subjects	Mix between firm questions with restricted answers and open questions	Firm questions with restricted answers
Purpose	Explorative	Descriptive/ explanatory	Descriptive/ explanatory

Table 1, interview structure.[36]

Interviews can be described as different types of hearings that may be carried out through personal contact or by phone, a dialogue guided via e-mail or text messages might also be categorized as an interview. Interviews may also be conducted with a single person or in the form of group interviews.[37] This study has initially carried out semi-free interviews with management to explore, which were followed up by semi-structured interviews with employees in operations both to validate results and to deeper understanding. Data has also been collected via e-mail and some interviews/ workshops were also conduced in groups.

3.3.2 Observations

Observations involve the use of senses or technological means to collect data in different situations. The researcher can have different degrees of interaction with the studied situation, from being an active participant in the situation to a mere observer. The people that are observed can also have varying degrees of awareness about being observed. Four outcomes are obtained when the two dimensions are combined in a two-dimensional figure, see table 2.[38]

	Awareness, high	Awareness, low
Interaction, high	Observer tries to get integrated into the group and collects data with notes	Observer keeps a low profile but leads the discussion and collects data trough notes
Interaction, low	Data is collected trough recordings and the interviewees are asked to "think loudly"	Data is collected with total anonymity with camera or recordings

Table 2, observation, interaction vs. awareness.

Interaction and the employees' awareness have been high in a majority of all observations throughout the study. Meaning that the authors have been integrated into SGSS

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[36] Björklund, M. & Paulsson, U. (2003)

[37] Ibid.

[38] Höst, M. Regnell, B. Runeson, P. (2006)

everyday activities, and had a high degree of participation in everyday work. This has allowed the study to get a realistic inside perspective on challenges, strengths and opportunities. Integration has been an important factor too much of the data that's collected as it's allowed the authors to continuously verify certain data or ask specific questions.

3.3.3 Archive analysis

Archive analysis involves going through documentation that's produced for other purposes then that of the current study. For example, final reports from past projects or studies of a companies' development over a period of time. It's important to take into account the original purpose of documents when analysing archives; marketing documents for example, are produced for a different audience than for example, internal documents and can therefore position the information so it results into different outcomes.

Data that's collected from archives is divided into four types[39]:
- Processed material, material that's acquired and processed in a scientific context.
- Available statistics, data that's collected and processed, but where no conclusions have been determined.
- Registry data (database) is data that is available in a raw format, i.e. data that's unprocessed.
- Archive data, data that is not systematic, such as records, correspondence and project documentation.

The study had extensive access to SGSSs & SGGs intranet, which has been convenient and allowed the study to find credible data. The data that's collected is of primarily two types, available statistics and archive data. The origin of the data is not considered to be a concern hence the study has had access to large parts of the intranet and been allowed to review and compare different documents. Meaning that triangulation has been used continuously to verify the credibility of the data that's presented in empirics.

3.4 Practical approach

3.4.1 Mapping approaches

The purpose of mapping in general is explained in the chapter four, theoretical framework, although the aim of practical mapping is to obtain information that will form the basis for the creation of the process map. One goal is to achieve a uniform appearance and an unmistakable graphical illustration, and there are four different approaches to achieving that. The different approaches differ in the amount of people that are involved and the time spent on the project, which will affect the maps objectivity as well as peoples commitment to the project.

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[39] Höst, M. Regnell, B. Runeson, P. (2006)

The process can be mapped according to the following approaches:[40]

- Process walk – Those who are responsible for the project walk through the process physically. During the walk they interview employees who are performing the different activities.
- Virtual process walk – Gather a larger number of representatives from all parts of the process where everyone gets to describe their part in the process.
- Mapping team – A few representatives from the entire process are together responsible for the entire mapping of the process.
- Process design – Is used when no formal process exists, for example in a project organization where individuals create own paths and ways of working, The mapping therefore requires a dialog and a lot of compromises in order to agree upon a common version of the process.

The mapping procedure in this study is based on process walking where the authors had the overall responsibility for the procedure. The entire mapping procedure was conducted according to the following steps:

1. Initial mapping procedure is executed according to steps "a" to "h" (see next list level), which involved nine individual and group interviews. Every interview followed the following mapping procedure, that's based on Ljungberg and Larsson (2012).
   a. Define the process purpose and its starting and ending points.
   b. Define the different hierarchical levels of the map and select the level that is being mapped.
   c. Brainstorm the process all eventual activities and put them on post it notes. Focus on what is done and not how.
   d. Arrange the activities in the correct order.
   e. Put together and add activities.
   f. Define object in and out of every activity. Make sure that every activity is connected to another trough an object.
   g. Ensure that all activities are on the same hierarchical level and that they have appropriate names.
   h. Iterate steps "d" to "g" until a satisfying map is obtained.
   i. After every interview the actual map was updated in Microsoft Visio within one day to ensure that poor memory wouldn't be a source for errors.
   j. Almost every mapping interview was recorded and the recordings were written down to paper, which allowed comparison of views over time.
2. The interviews were followed up with a validation that was carried out by placing the actual map in a public area where everyone involved could evaluate the map and give feedback in his or her own pace. Some people got the map sent to them electronically for practical reasons. This step did not provide much feedback.
3. Mapping step three was two sequential meetings (workshops) where four key individuals participated and during which the map and processes were discussed.

In-between all these steps observations were made in an informal manner, during lunch breaks or just talks in the hallway. The processes were also compared with ex-

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[40] Ljungberg and Larsson (2012)

isting ISO certification maps but that didn't prove to be very useful for this purpose. The two maps aren't contradictory but they were created in different contexts so the content wasn't comparable.

3.4.2 Opportunities and development of a performance management system

A systems approach was adopted for finding opportunities and was carried out inductively. The initial search was wide and included everything from challenges to customers, to the current situation was analysed. Where after interdependencies were analysed, such as challenges that affect two different outcomes, so that opportunities that affect the system the most would be prioritized. The result was compared with existing theory and knowledge to determine the most appropriate solutions, i.e. opportunities.

Analysis that was carried out to find opportunities:
- Employees were during interviews asked what challenges that affect SGSS and its supply chain, which was followed up with:
  - Fault tree analysis
  - Plan Do Check Act (PDCA) analysis
  - Lead-time analysis
- Context analysis
- Business performance analysis (i.e. PEMM analysis)
- Analysis of corporate philosophies and existing documents, such as existing measurement systems etc.

The measurement system was developed deductively but as a result of the inductive first phase where opportunities were identified. Those opportunities and challenges acted as the basis for a literature review. The literature was compared with the current challenges in order to analyse if the existing solutions in literature could solve SGSS current challenges. This resulted in to a theory and was verified in the field by developing a performance management system for SGSS that should solve their existing challenges and exploit opportunities.

The opportunities and solutions that were a result of the inductive phase also acted as input into the action plan.

3.5 More on credibility

3.5.1 Overall

In every interview the interviewees were asked what problems that he or she found most urgent to solve for the supply chain to prosper. The answers were in general varying and reflected everything from organisational problems to hierarchy and capacity constraints. Employees with different positions and hierarchal levels were chosen in order to achieve a reliable representation of the current situation. The data is therefore considered representative, although as explained in empirics, the process maturity part of the PEMM should optimally have been answered by more people to

be truly representative. But evaluation-triangulation strengthens the results and credibility is still achieved. That concern is neither a problem for the map or other parts of the study.

3.5.2 Limitations

The study is conducted for the department of Logistics & IT and it's a case study with a purpose that primarily aims to help the department increase its performance trough the different deliverables, focus and purpose that are discussed earlier. This study although has a base in process mapping and the process view. The original mission or purpose of process based business development (PBBD) contrary to the purpose of this study is to map cross-functional processes in order to increase business performance as a whole. The different purposes are contrasted to each other and don't allow simultaneous fulfilment. The study has attempted to broaden its perspective as much as possible in order to fulfil both purposes, although the interests of the department and the deliverables of the study have limited the full potential of PBBD. The effects have been noticed on both the mapping part and PEMM[41] analysis.

This limitation might affect the credibility of the performance management system, which is supposed to be a system that's based on the process view. The limitation might also affect the recommendations in the way that they are suboptimal as a result of the identification of challenges being focused on the department and not the system as a whole. The relation between the identification of challenges and mapping is that challenges where identified during the mapping procedure. The study has as mentioned attempted to broaden its perspective to consider the other departments interests and argues that it thereby has managed to retain credibility.

3.5.3 Theory

The deductive part of the study required extensive theoretical research and that the credibility of the theoretical framework is reviewed thoroughly. Triangulation has been used to verify theories and make sure that the presented guidelines are a representation of a wider scope of scientists and companies. The literature that's used is mostly highly credible and has led to practical use & recognition.

The literature that's used in this study is considered to have high credibility, both in terms of the providers of the literature and authors. This study has used several articles that are provided by management-consultant companies and the purpose of those articles can be questioned but the study has tried to remain objective and critical when applying the content of those articles in the thesis. The information that's ultimately used in the thesis is despite the origin (management-consultant companies) considered credible and of high relevance.

A large majority of the literature on supply chain management has the perspective of triadic or dyadic supply chains and discuss effectiveness issues whilst this study is based on the (monadic) supply chain function in a company with the purpose of helping the company increase its efficiency (streamlining). The supply chain perspective, even if the solution is locally focused, forces the study to look outside the borders of

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[41] See theory chapter for explanation, sections 4.2.2 and 4.3.1.

the company and consider literature with wider views on SCM and challenges then what's originally intended by the purpose and deliverables of the study. Current literature provides only limited guidance on the development of performance management systems and rarely does it connect strategy to operations even if it mostly mentions that it's important. Best practices for certain industries are hard to find and complete guides are only to wish for.

3.5.4 Solution to missing theory

The solution from the study's point of view has been to incorporate several views and opinions from different sources into one that's presented trough out the thesis and summarized in conclusions. This study is combining literature on global SCM philosophies, corporate strategy, and the operationalization of these into methods and models that are applicable to a modern business situation based on process orientation.

Some of the typical search strings and words that have been used when searching for literature are:
- Operationalizing strategy
- Strategy in operations
- Performance management
- Performance management in operations
- Measurement system
- Process based business development
- Process orientation
- Operational excellence
- Balanced score card
- Streamline operations
- Supply chain management
- Key performance indicators
- Best practice
- World class

These search strings have frequently been used in different combinations, and in combination with authors that are prominent in certain areas like for instance, Dag Näslund and performance management or measurement system.

A majority of all searches have been done in LUBsearch at www.lub.lu.se, which is Lund Universities search motor for literature. Although Google has also frequently been used to check up on certain information and validate both sources and content. Contrary to popular perception Google has also provided several credible sources with highly relevant content; for example, "Future supply chain 2016" from the Global Commerce Initiative and Capgemini that describes the challenges of future supply chains and what's important to keep in mind. That study is also one of few examples that provides best practices and key performance indicators (KPI) that are relevant to use in SCM. That study is also a good example of literature that's provided by a management-consultant company where the content still is considered objective and credible.

Literature has been reviewed with respect to questions:
- Is the material reviewed?
- Is the guarantor credible?
- Is the result produced in a context being relevant to this study?
- Have the results been confirmed or led to recognition and thereby referenced in other credible contexts?

Not all literature has been reviewed as thoroughly. For example articles by Michael Hammer have barely been reviewed, since he is a famous writer with years of experience in process orientation, by some considered almost a guru in the area. It's therefore not considered a necessity to review the credibility of his texts. On the contrary, Robert J. Trent has undergone a complete review. He's prior to this study unknown to both authors, but the content of his article has been useful in the study and has almost led to a smaller breakthrough in the writing process, and therefore been important to validate his credibility. Literature that's not reached up to these criteria has been excluded from the study, for example a study performed by Aberdeen group in 2006 on several hundred (310) companies that resulted in 15 best practices for performance management. Unfortunately, the results were produced in a context that was partly irrelevant for this study and could not be applied.

4 Theoretical framework

This chapter contains the theory that was found most relevant for the study. It contains theory that's used in empirics (execution), analysis and conclusions. The theory that's brought up concerns process orientation, supply chain management, mapping, and performance management. If you find a word or terminology that's unfamiliar or seems to be used in another way then you are used to, look up the definition of the most frequently used terms in appendix B.
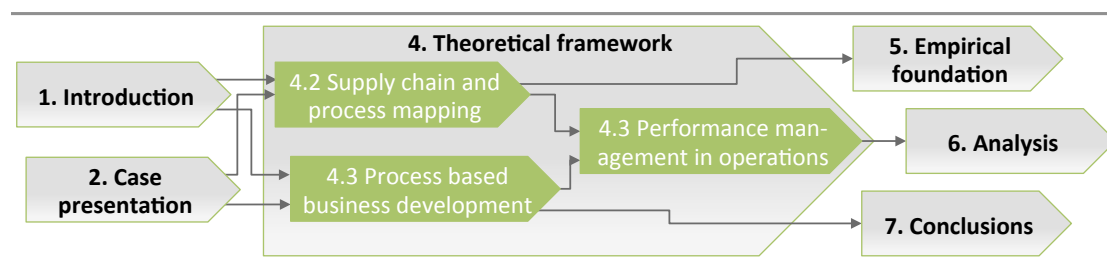
4.1 Background

4.1.1 Why Map?

Different improvement methods are often approached in a functional way, for example Activity Based Costing (ABC) by finance, Just In Time (JIT) by production, Total Quality Management (TQM) by quality, employee empowerment by HR etc. A problem with this functional approach to improvement methods is that it can lead to unhealthy fragmentation. [42] Successful supply chain management requires cross-functional integration within the firm and across the network of firms that are included in the supply chain. At the end of the day, supply chain management is about relationship management, a supply chain is managed either link-by-link or relation-by-relation, and the organisation that manages these relationships best will win.[43] The underlying reason for creating a map is to help create a holistic perspective to problem solving and improvements in order to avoid sub optimization and fragmentation and ultimately to improve performance and profitability.

A supply chain map is useful for several reasons. A well executed map can enhance the strategic planning process, illustrate distribution of key information, facilitate supply chain redesign or modification, clarify channel dynamics, provide a common perspective, enhance communications, enable monitoring of supply chain strategy, and provide a basis for supply chain analysis. Many people tend to think and learn in pictures and feel that "a picture is worth more than a thousand words". Thus, a map can be quite helpful in understanding a firm's supply chain, for evaluating the current supply chain, and for contemplating realignment of a supply chain.[44]

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[42] Näslund (1999)

[43] Lambert, M.D. (2008)

[44] Cooper, C.M. Gardner, T.J. (2003)

4.1.2 Historical recap

Measurement systems have changed over time, even if they change slowly and incrementally, which is natural as the measurement system is such a vital part of an organization. The measurement system could in many ways be resembled to the steering wheel in car, it basically has the same function in a corporation as the steering wheel has in a car and it changes over time; it's more adaptable, easier to handle, and it's even more ergonomic, but the basic shape and function is still the same.

- 1995: Traditional measurements were primarily financial, they had a short-term focus, they tracked end results – not the actual performance of processes in the organisation, and they were not, in general, there to support continuous improvement efforts or organisational strategy.[45]

1992 - on going: The balanced score card was introduced by Kaplan and Norton (1992) as a solution to the old fashioned measurement systems, widening the scope of measures and creating a clearer connection between strategy and what's measured.

Next step: Measurement systems based on process orientation. Philosophies about process orientation, its benefits and the process organisation has existed for a while now and many organisations claim that they are process oriented. But few organisations actually are[46] and even fewer organisations have process owners, who according to this studies' conception is a prerequisite for a truly process oriented measurement system.
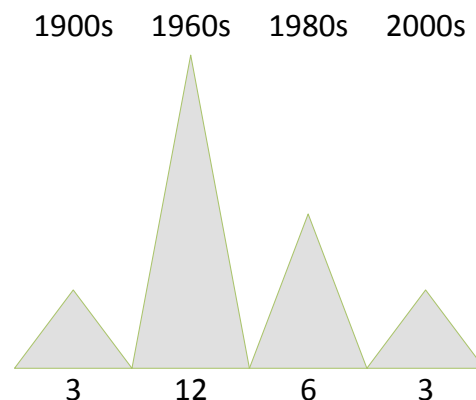
Figure 10, number of hierarchical levels in organisations over time.[47]

When operators become focused on "making" or "assembling" products and are not involved in the planning or evaluating aspects of the job it leads to a number of problems. If customers and employees instead are allowed to directly discuss orders etc. it better supports todays line activities and markets. The number of hierarchical levels therefore decreased in organisations since the 1960s as a result of these changes, see figure 10.

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[45] Näslund (1996)
[46] Ljungberg and Larsson (2012)
[47] Hill and Hill (2007)

Infrastructure that's designed for high-volume, stable-markets can afford to have higher costs, whereas businesses today face low-volume, unstable markets with increasing competition and overcapacity. To compete effectively, firms must develop infrastructure that reflects current market needs and can adapt to future changes.[48]

Functional thinking may still prevent the break down of strategic goals into operational goals, which are leading the entire organization in the same direction.[49] The philosophy behind this reasoning is that functional thinking and hierarchy are closely connected; the more times a strategy has to be broken down from one hierarchical level to the next the harder it becomes. By changing the overall orientation in the company to processes, hierarchy will decrease, strategy and operations will become better aligned, and the company will become more customer focused.

4.2 Supply chain and process mapping

"A map is a spatial representation of the environment. By representation, we mean something that stands for the environment that it portrays, and is both a likeness and simplified model."[50]

4.2.1 Mapping in general

It's important to keep in mind that the process map is created with the purpose of being used, and it's therefore of highest importance to make the map user friendly. User friendliness of the map can be defined in the form of a number of requirements and thereby the requirements on the actual mapping:

➢ The process map acts as a guideline and is supposed to be understood by all employees and staff that the map affects. This requires that the map has a fairly constrained level of complexity. In order to maintain a map that's easily understood with a clear overview simultaneously as it explains details thoroughly requires that the map is complemented with process specifications. Containing detailed information about the process, its purpose, objects in, objects out, customers, information and resource requirements as well as measurement points.[51]

➢ It's important to name the process so it doesn't get interpreted as a function;[52] hence the process is cross-functional. The name should symbolize why something is done or how value is added according to the purpose in order to move focus from the functional orientation to the actual process.

➢ The process has to enable flexibility and sustainability, and it's therefore important to name the process so the name doesn't constrain possible improvements in the future, while explaining the purpose of the process, i.e. keep in mind the customer need and not the way that it's satisfied.

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[48] Hill and Hill (2007)

[49] Näslund (1999)

[50] Cooper, C.M. Gardner, T.J. (2003)

[51] Ljungberg, A. Larsson, E. (2012)

[52] Ibid.

➢ The purpose of mapping processes and process management is to manage the white space[53] in-between functions. The white space could also be described as the interfaces in-between processes, i.e. objects in and out of processes. It's therefore important to name the objects with descriptive names that define the interface and thereby reduces the risk of misunderstanding.

4.2.2 Supply chain mapping vs. Process mapping

There are three distinguishing differences between SC mapping and process mapping, according to Cooper and Gardner (2003). The first difference is the focus of the mapping procedure, also noted as orientation. The second difference is the level of detail presented in the map, and thirdly the purpose. The purpose of SC mapping is often in order to create a SC conforming with the overal strategy while process mapping often is a result of the recognition of a problem area or an attempt to improve the operating efficiency, see figure 11. Although the likeness between SCM and PBBD is that the SC function is the only cross-functional function in most business and it aims to coordinate activities across the company in order to achieve excellence, just like PBBD.

	SC Mapping	Process Mapping
Orientation	External	Internal (typically)
Level of Detail	Low to moderate	High
Purpose	Strategic	Tactical

Figure 11, SC vs. Process mapping.[54]

This case study is focusing on process mapping within the scope of SC activities and therefore has a high level of details as well as a tactical purpose. (Note that the purpose of the study and the purpose of the map are two different perspectives).

4.2.3 Essential process definition

By describing the activities in processes, it becomes easier to understand how the various parts of the organisation interrelate to create value for its customers. Processes thus become the natural way to describe and realize the business idea by describing its purpose and products as well as how it's achieved. The definition of the term "process" is thereby central for an organization, because the definition determines the view of all work in the organization.[55]

It is essential to define the term "process" in this study, as it will be the basis for communication between the study and company. During this study the process definition by Ljungberg and Larsson (2012) is used, "A process is a repetitively used network of orderly linked activities that use information and resources in order to create value that satisfies a given customer need".

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[53] Rummler, G.A, Brache, A.P. (1991)
[54] Cooper, C.M. Gardner, T.J. (2003)
[55] Ljungberg and Larsson (2012)

Customers can be internal and external, and they are vital for the existence of processes. The process starts with the identification of a customer need and ends with the need being satisfied. The identification of the need triggers a number of activities that aim to satisfy the need. Processes require information and resources in order to create an output; a process alone is meaningless without those components. It's not until information's and resources are added that value can be created and thereby a process is established. Ljungberg and Larsson (2012).

4.3 Process based business development

The strategic perspective is important to take into consideration in the development of performance management systems. Process mapping and the development of performance management systems are projects with long-term consequences on business performance and therefore strongly affect corporate strategy.

4.3.1 Process and enterprise maturity model (PEMM)

The PEMM model is a comprehensive tool helping planning and execution of process based business development. It provides a systematic approach for measuring the process orientation in an organisation. The model consists of two types of characteristics: process enablers, which pertain to individual processes, and enterprise capabilities, which apply to entire organizations. These characteristics further consist of five process enablers and four enterprise capabilities. They also have four levels of maturity where every level has a separate scoring and maturity.[56]

Process enablers and enterprise capabilities are defined by Hammer (2007) as the following:

Process enablers	Enterprise capabilities
Design – The comprehensiveness of the specification of how the process is to be executed.	*Leadership* – Senior executives who support the creation of processes.
Performers – The people who execute, particularly in terms of their skills and knowledge.	*Culture* – The values of customer focus, teamwork, personal accountability, and a willingness to change.
Owner – A senior executive who has responsibility for the process and its results.	*Expertise* – Skills in, and methodology for process redesign.
Infrastructure – Information and management systems supporting the process.	*Governance* – Mechanisms for management complex projects and change initiatives.
Metrics – The measures the company uses to track the processes performance.	

The results of a PEMM audit might have a discouraging effect on managers in the beginning of process orientation initiatives, but as the old saying goes " what gets measured, gets done" and Hammer (2007) further attests the tools importance by saying that "one units pioneering experience can energize the entire organization".

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[56] Hammer (2007)

4.3.2 ISO recommendations on business management

ISO certification is often a requirement in business situations[57] and especially in the automotive industry. The recommendations and guidelines in ISO are therefore of high importance for any company, and especially this study as it concerns business management. The following text is mostly made up out of excerpts from ISO 9001:2008 and 9004:2009, but contains some reflections.

Processes are specific to an organization and vary depending on the type, size and level of maturity of the organization. The activities within each process should be determined and adapted to the size and distinctive features of the organization.[58]

The organization should ensure proactive management of all processes, including outsourced processes, to ensure that they are effective and efficient, in order to achieve its objectives. By adopting a "process approach" that includes establishing processes, interdependencies, constraints and shared resources the company can facilitate this.[59]

The organization should determine and plan its processes and define the functions that are necessary for providing products that can continue to meet the needs and expectations of customers and other interested parties, on an on-going basis. Processes should be planned and controlled to be in accordance with the organization's strategy and should address management activities, provision of resources, product realization, monitoring, measurement and reviewing activities.[60]

For each process, the organization should appoint a process manager (often referred to as the "process owner") with defined responsibilities and authorities to establish, maintain, control and improve the process and its interaction with other processes. The process manager could be a person or a team, depending on the nature of the process and the organization's culture. The organization should ensure that the responsibilities, authorities and roles of process managers are recognized throughout the organization.[61] By creating a process owner that's responsible for the entire process and has the authority to make changes; measures such as reliability become more natural, as it's a measure of the entire process and not individual departments. Measuring e.g. reliability, which is enabled with the process orientation, is a way of acknowledging the efforts of people that realise these values to customers which in fact is greatly important to the company and it's a way of moving focus to the needs of customers, instead of measuring qualities that are constraints of the hierarchical structure and not actual customer needs.

4.3.3 Sustainable competitive advantage, the Triple – A supply chain

Lee (2004) says, "The best supply chains are not just fast and cost-effective. They are also agile and adaptable, and ensuring that all their companies' interests stay aligned."

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[57] Ljungberg and Larsson (20012)
[58] ISO 9004:2009
[59] Ibid.
[60] Ibid.
[61] Ibid.

Lee then goes on to state the following, "To achieve sustainable competitive advantage, your supply chain needs all three of these qualities", aiming at agility, adaptability, and alignment.

The objective of agility is for management to respond to short-term changes in demand or supply quickly, in terms of the SC being able to handle external disruptions smoothly. Adaptability aims at enabling the SC to adjust its design in order to meet structural shifts in markets, it also means that the SC is able to modify the network to strategy, products, and technologies. The objective of alignment is to create incentives for better performance across the supply chain; one part in alignment is to design measurements "correctly" to create beneficial incentives for the company as a whole, and thereby increase profitability.[62]

Methods to achieve the three qualities:[63]

Agility	Adaptability	Alignment
Continuously provide supply chain partners with data on changes in supply and demand so they can respond promptly.	Track economic changes, especially in developing countries.	Provide all partners with equal access to forecasts, sales data, and plans.
Collaborate with suppliers and customers to redesign processes, components, and products in ways that give you advantage over rivals.	Use intermediaries to find reliable vendors in unfamiliar parts of the world.	Clarify partners' roles and responsibilities to avoid conflict.
Finish products only when you have accurate information on customer preferences.	Create flexibility by ensuring that different products use the same components and production processes.	Redefine partnership terms to share risks, costs, and rewards for improving supply chain performance.
Keep a small inventory of inexpensive, non-bulky product components to prevent manufacturing delays.	Create different supply chains for different product lines, to optimize capabilities for each. For example, with highly customized, low-volume products, use vendors close to your main markets. For standard, high-volume products, commission contract manufacturers in low-cost countries.	Align incentives so that players maximize overall chain performance while also maximizing their returns from the partnership.

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[62] Lee (2004)

[63] Ibid.

4.3.4 Different analysis methods

Fault tree: the analysis is an excellent tool for both qualitative and quantitative analysis. The fault tree is a logical event chart that illustrates the connection between an undesired event, i.e. a fault, in the system and prior events that cause this event, i.e. root causes. The construction of a fault tree begins by specifying the undesired event and thereafter with logically correct reasoning define relations to underlying faults or events, see appendix K for illustration. The analysis helps a company focus action on root causes and avoid wasting resources on symptoms that won't go way.[64]

Plan Do Check Act (PDCA) -cycle: Continuous improvements are usually required in today's business, and lack of this generally results in capability as well as performance limitations. PDCA-cycle is a popular and widely used quality-model and describes the basic approach for continuous improvements. The success with the model lies in getting it into an organizations daily thinking, i.e. the organisations culture. The organisation that successfully manages to implement this culture will establish structured and transparent management[65] which is desirable as it creates trust and understanding in the organisation. The optimal process setup is illustrated in figure 12 Illustration 3.

Processes degrade at a rate of approximately 5–10% per year if no improvement efforts are undertaken, these numbers might be fairly extreme but it literally means no improvement efforts. On the other hand, if a company adopts a continuous improvement approach and manages to implement it into everyday work processes will improve 5-15% per year. To clarify, the difference is 10-25% per year in process performance.[66]

Figure 12, PDCA-analysis.[67]

Illustration: 1 in figure 12 shows a reactive process, 2 shows a proactive process and 3 shows a proactive process with feedback and improvement.

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[64] Bergman and Klefsjö (2008)

[65] Ljungberg, A. Larsson, E. (2012)

[66] Harrington (2012)

[67] Ljungberg and Larsson (2012)

Process is[68] =

Plan if the processes trough preparation and planning creates a structure for the main process's main work, i.e. the executing (Do) processes.

Do if the process exists as a consequence of the main process purpose, i.e. it's value adding.

Check if the process reflects and questions the executing processes and thereby creates a platform for improvement.

Act if the process based on "Check" aims to improve the main process for better performance or to prevent earlier faults.

Some of the infrastructural issues in operations planning and control are that business split out planning, doing and evaluating aspects of the job. Line staff, in "doing" roles, has a lack of responsibility, empowerment and motivation and thus capacity becomes inflexible. This is overcome by setting up improvement teams and restructuring roles and responsibilities to recombine planning, doing and evaluating aspects of the job.[69] Planning, doing and evaluating jobs are generally on different hierarchical levels in a corporation, by combining the jobs; the organisation will inherently become more streamlined and flat.

4.4 Performance management in operations

"Performance management is the process that translates the overall strategic objectives of an organisation into clear objectives for each individual employee" Amos, et al. (2004)

"You can't manage what you can't measure. That's as true for SCM as it is for other parts of business´ operations," Morris A. Cohen, Wharton professor.[70]

It's not only important to measure in order to enable management, it's just as important to measure the right phenomenon. Measuring the wrong phenomenon may misalign incentives in the supply chain[71] and even generate counterproductive behaviour.[72] It's therefore important to have a thorough and systematic procedure when developing measures and measurement systems to mitigate these potentially negative effects. The big picture, figure 13 provides an overview of the different components and procedures that go into the creation of a performance measurement system and performance management system. Similar to change efforts with improvement methods, not having an cross-functional integrated approach may lead to sub-optimization

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[68] Ljungberg and Larsson (2012)
[69] Hill and Hill (2009)
[70] Boston Consulting Group
[71] Narayanan and Raman (2004)
[72] Ljungberg, A. Larsson, E. (2012)

and the measurement system will not reach the intended effect on operations.[73] The performance management system is therefore based and applied on a process view to ensure streamlined process improvements.

The major difference between the current way of measuring and the next step is how you measure your performance, that is to measure cross-functional performance. A process owner that has authority and responsibility for the entire process is the key to the process based measurement system. A process owner by definition (se section 4.3.2) will have a holistic perspective and he or she will be a natural bridge between measures of effectiveness and efficiency & general and indirect measures, se section 4.4.1. In other words, traditional measurement systems focus on measuring the objects (output or input), while the new measurement system enables measurements all over the process map.
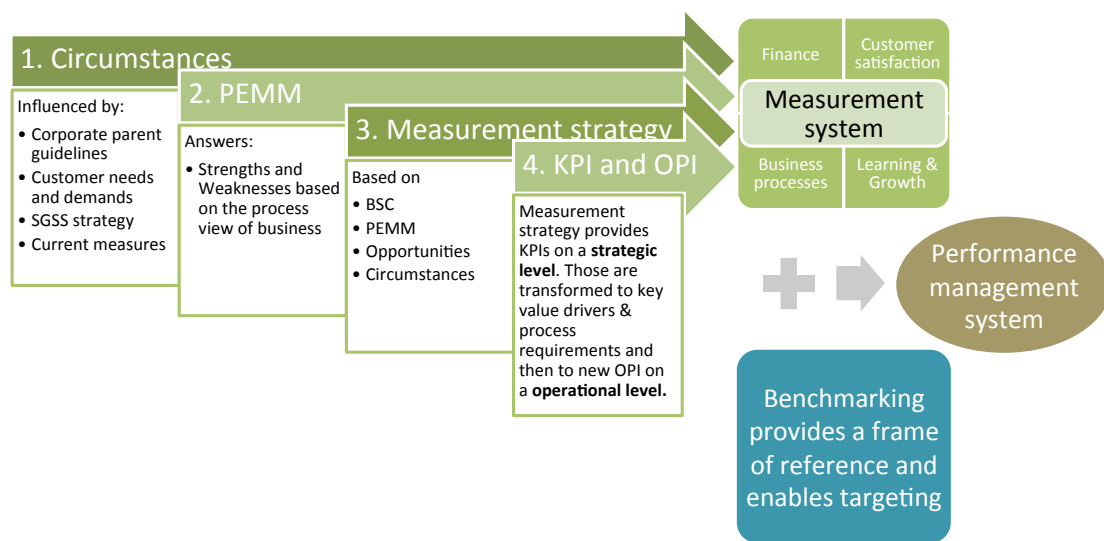
Figure 13, the big picture.[74]

The illustration in figure 13 is related to phase two in the cycle for developing a measurement system, figure 16, and is developed for this study. Note that figure 13 separates a measurement system from a performance management system with respect to benchmarking and setting targets. A secondary note to be made is that the fourth step in this figure in reality is figure 15, which in Ljungberg and Larsson (2012), figure 16 represents the third phase.

J. Trent (2004) presents four pillars of supply chain excellence and one of those pillars is the development of a cross-functional measurement system. J. Trent (2004) explains the importance of a measurements system for SCM; objective measurement supports fact based decision-making, which is an important criteria according to total quality management (TQM). Secondly, measurement is an ideal way to communicate requirements to other members of your supply chain and to promote continuous improvement and change. Finally, measurements help the company identify whether new initiatives have produced the desired results. Measurement may be the single best tool to control a diverse set of supply chain activities and processes.

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[73] Näslund (1999)

[74] The concept or illustration is developed by this study.

4.4.1 Performance requirements

Performance requirements can often exist on all parts of the process map. Performance requirements can be appointed to: objects in, objects out, the process, resources going into the process and on efficiency. This is visualized in figure 14, which is based on Ljungberg and Larsson (2012). Ljungberg and Larsson (2012) further say, even information can have requirements, although information's mostly not required for the understanding of the process and is therefore not included at this stage.
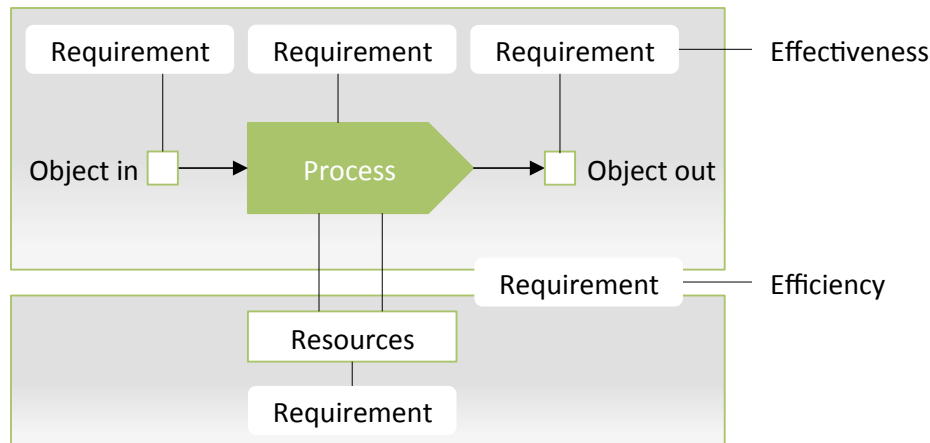
Figure 14, process concepts and related requirements.[75]

Requirements can be internal and external; external requirements can be related to customers, end customers and even suppliers. Requirements might have different perspectives in the form of general requirements and indirect requirements. General requirements span from objects in to objects out and can for example be, short lead times. Indirect requirements are requirements on upstream sub-processes from requirements on downstream sub processes, such as a process that requires a certain finish on its input in order to produce an output that's within certain limits.[76]

Process requirements are transformed into KPIs and OPIs according to the approach in figure 15 to ensure compliance with both customer needs and stakeholder expectations. Requirements in that figure are represented by business priorities and objectives. The figure is developed with consideration to the recommendations from Ljungberg and Larson (2012) surrounding: chose and relate measures.

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[75] Ljungberg and Larsson (2012)
[76] Ibid.

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Figure 15, approach for developing OPI.[77]

Figure 15 illustrates an approach for developing OPIs that are derived from strategy and thereby achieving performance management in operations based on and aligned with corporate strategy. Efficient practice at Action-level (step 4) is left alone in this study; it's in general considered bad practice to manage activity level procedures, as there is a large risk that employees perceive it as intrusive on their personal space.

4.4.2 Measurement system design process

Research has claimed that 70% of all measurement system implementations fail and that implementations sometimes last for several years[78], it's important to consider both hard and soft aspects of the implementation in order to avoid pitfalls. Hard aspects are related to the design & implementation process and soft aspects to change management.

Change initiatives have an ability to decay and become forgotten over time, as the project group splits up and no certain person retains responsibility to administer the change, as everyone has to cope with their everyday work. In order make sustainable change it's important to implement the change into a system and make the system user friendly in order to make it a part of the organisation and its culture. The measurement system is such a system, it ensures a long-term dedication and administration of changes with minor design modifications.

The measurement system is essentially a strategic planning and management tool used to align the organisations operations to its vision and strategy. Primary success factors for the implementation of a measurement system, based on Mukherjee and Pandit (2009) are:
- Obtaining executive sponsorship and commitment.

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[77] The concept is developed deductively by this study.
[78] Bourne and Neely (2003)

- Involving the broad base of leaders, managers and employees in the development.
- Agreeing on terminology, a good starting point is mapping processes.
- Choosing the right measurement champion, preferably an influential manager close to the process at hand.
- Beginning interactive (two-way) communication first.
- Thoroughly working trough mission, vision, strategic results and strategy mapping to avoid rushing to judgement on measures or software.

Ljungberg and Larsson (2012) present a cycle for development of a measurement system (see figure 16) complemented with a measurement cycle, that's a tool for transforming data into useful knowledge, which enables management of processes.
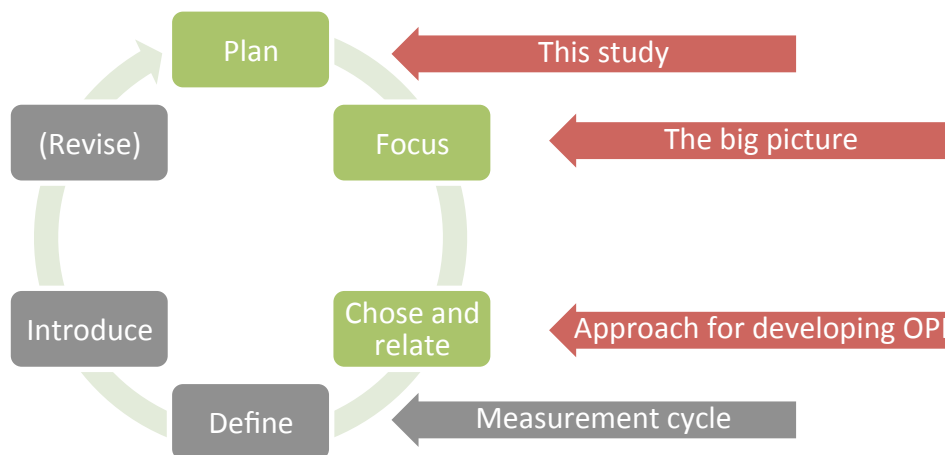
Figure 16, development of measurement system cycle.[79]

The six phases in the cycle (figure 16) are conducted in the following way:
1. Plan the project; it's important to consider the success factors by Mukherje and Pandit at this stage.
2. Focus. This study ensures focus with the "the big picture", figure 13.
3. Chose appropriate measures and relate them to each other. The keyword here is to have a balanced approach according to Ljungberg and Larsson (2012). The balance will be established with the use of the balanced scorecard in this study, see figure 17 and the "approach for developing OPI", figure 15.
4. The end result of the define stage is complete specifications for data collection, compilation of data, presentation, communication, analysis and recommended action, i.e. definition of the measurement cycle components mentioned above. (Steps 4, 5, 6 are outside the scope of this study)
5. Introduce the system to the organization. It's important to consider the primary success factors presented by Mukherjee and Pandit even at this stage of development.
6. Revise is an optional step, that's only introduced when the system isn't optimal.

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[79] Ljungberg and Larsson (2012)

After developing KPIs, value drivers and OPIs for a process, the next step is to set target values on a scale from" basic" to "best in class" to "world class". Basic and best in class standards are set with respect to the industry in which the company operates, world class is on the other hand set with respect to the best performance in any industry and any geographical location. Researching and benchmarking industry and market leaders in different areas is a way of defining the values for best in class and world class. With this approach the company will measure its performance in relation to competitors and consequently become more aligned with its competitive strategy.

4.4.3 Balanced score card

The balanced scorecard (BSC) enlightens that customer satisfaction and financial results are merely results, and that learning & growth as well as business processes are the enablers that help to achieve those results.

Main benefits of using a balanced scorecard are:[80]
- It helps companies focus on what that has to be done in order to create a breakthrough performance.
- Acts as an integrating device for a variety of corporate programs.
- Makes strategy operational by translating it into performance measures and targets.
- Helps to breakdown corporate level-measures, which enables managers and employees at all levels to assess what they need to do well if they want to improve organisational effectiveness.
- Provides a comprehensive view that overturns the traditional idea of the organisation as a collection of isolated, independent functions and departments.

Vision and strategy		
	Quantitative	Qualitative
External/ effectiveness	Financial	Customers & Society
Internal/ efficiency	Business processes	Learning and Growth

Figure 17, modified version of the balanced score card.[81]

The qualitative perspective of the BSC suggests that the measurements in that column primarily are nominal and ordinal. Although, it doesn't mean that the measures can't be interval or quota, only that it's harder to establish and more rare. The quantitative perspective at the other hand is purely out of interval and quota measurements. According to Ljungberg and Larsson (2012), it's not possible to compare the different types of measurements by means other than to determine that they are of different types. See table 3 for exemplification.

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[80] Mukherjee and Pandit (2009)

[81] Dag Näslund

Type	Measurement example
Nominal	Yes, No
Ordinal	Early, right time, late
Interval	40 degrees Celsius
Quota	2 hours

Table 3, measurement example.[82]

Qualitative measures are about "sensing" what might be the right measure for a certain objective. The measures are quantifiable although indirect in their nature and build upon perception of what's right and wrong. It's therefore important to be critical when analysing such measures as they do not give the ultimate answer only indications. Nevertheless, somewhat correct indications are better than no measures at all.[83]

4.4.4 Communicate measures and create a culture

When an understanding of requirements for a process is established by at least some employees, the next step is to communicate and create an overall understanding throughout the entire company. There are generally some "losses" in the process of understanding requirements, for example misunderstanding customer needs or confusing efficiency and effectiveness measures, which often results in differences in perception of what's supposed to be done.

Overall understanding will provide an opportunity for the individual employee to reflect whether or not they contribute to customer satisfaction and what they can do to affect that satisfaction positively. Even if there are major advantages in analysing general customer requirements, each customer should be considered unique until proven otherwise. By creating a culture with overall understanding of the purpose of measures and the purpose of work employees can more easily take own indicatives in the right direction. It's important for everyone in the company to remember that the purpose of measuring is to provide knowledge and not to control employees only for controlling sake.[84]

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[82] Ljungberg and Larsson (2012)

[83] Ibid.

[84] Ibid.

5 Empirical foundation and findings

Empirics contains the actual data that's used in analysis and conclusion, it's both a result of methodology and the theoretical framework. It's not supposed to contain analysis, nor evaluation from the authors and it's supposed to contain all the data (excluding what's found in the appendix) that's mentioned in the subsequent chapters. It's structured in four sub-chapter where the first collects information about SGSS as a whole, second about supply chain related information, third collects information about operations, and the last sub-chapter gathers the challenges in SGSS that are related to the supply chain.

[Establishing Data for Analyses]

5.1 Saint-Gobain Sekurit Scandinavia

Some general information about SGSS is already presented in chapter two, case presentation, which differs from the information that's presented here in that this information focuses more on how they operate, what restrictions that affect them and what they enforce or promote in their every day business.

"SGSS vision is to always be the best supplier in the industry, with the customers and employees in focus, develop and manufacture functional glass. A smart glass delivers more."[85]

SGSS long-term strategy is described in a number of targets, where some of the targets are presented here: [86]
- Place top three in SGSI KPIs.
- Fulfilment of external requirements.
- Flexible workforce.
- Increased internal production of high end products.

The vision and strategy of a company is by this study considered to be the core or spear-tip of performance management and always has to be considered when attempting to set targets, align operations, or just simply make decisions.

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[85] Internal document.

[86] Ibid.

5.1.1 SGSS Excellence

The management system at SGSS, Sekurit Excellence, is structured according to ISO/TS 16949 and ISO 14001, which covers overall business processes. The purpose of Sekurit excellence is for SGSS to operate efficiently, improve working conditions, minimize environmental impacts and achieve customer satisfaction in all areas. It's also a requirement for a majority of customer relations that SGSS is ISO/ TS certified which makes the certification a crucial system for the corporation. How they view, improve and guarantee quality over time is key for the ISO certification.

> "At the right time with the right quality",

-is the view on quality at SGSS.[87] Product quality is continuously in focus at SGSS. The organisation has routines for documentation and communication of quality and quality issues that are updated on a daily basis. This is visualized in the process map as a sub-process (see figure 19). The automobile industry is a demanding industry, where every manufacturer has unique quality related requirements and audits. These requirements are usually even higher than ISO/ TS requirements.

5.1.2 Organization

Operations at SGSS are divided into three process-classes according to ISO certification requirements. Every set of processes has specifications, KPIs, process owners and so on, just as required by ISO. The different process classes are:

- **Controlling processes**; Goals and requirements of the business along with financial follow-ups are include in this class.
- **Customer oriented processes;** Product development, project management, control of supply chains and customer complaints are included. The philosophy of these processes is that they all start with a customer need or needs and end with satisfied customer needs.
- **Support processes;** Such as control of human resources, purchasing, manufacturing, maintenance, measurements and product traceability are included. The logic behind these processes is that they do not offer any real value to the customer but they are required for the main processes to work properly. According to the Lean philosophy and its definition of value; these processes are non-value adding.

The processes interact with each other in a complex network of links and there is a number of defined management tools complementing and supporting these processes and their links. The organisations processes and different classes are visualized in appendix F. The organisation is otherwise divided into six functions and approximately three to four hierarchical levels. The organisation is visualized in figure 18.

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[87] Interview E.2.6
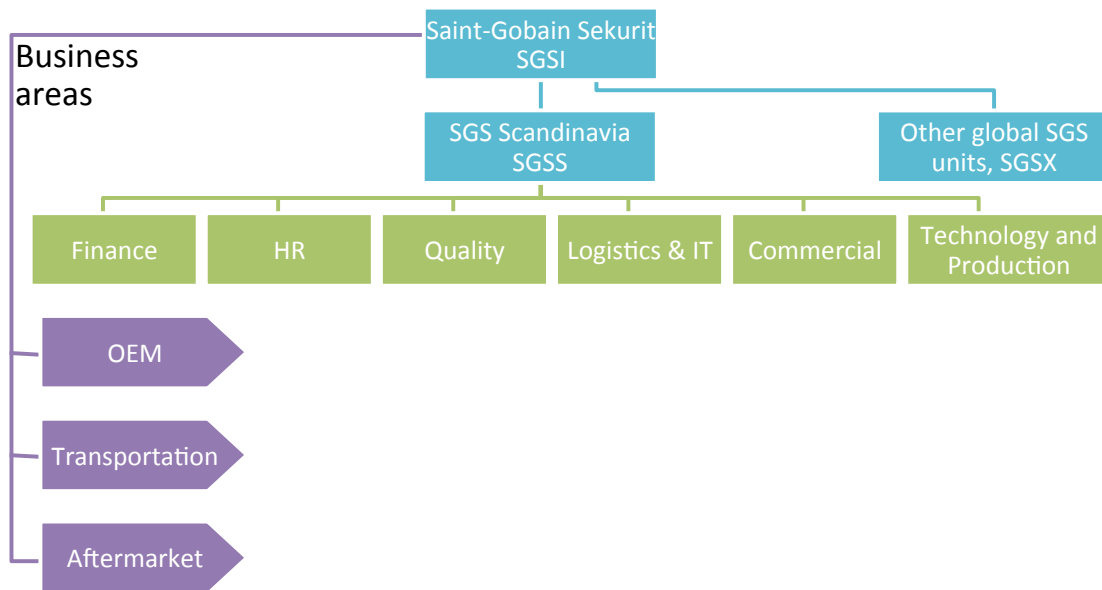
Figure 18, organisational chart. See large illustration in appendix E.

5.1.3 Corporate parent guidelines

SGSI provides SGSS with seven sets of KPIs that SGSS measures and reports on a regular basis on a corporate level. They also provide a list of guidelines that are incorporated into the current measurement system. The guidelines are:

- Reduce the environmental footprint of our sites.
- Deploy lateral policies, eco-design, waste recycling, water, wood, biodiversity, etc.
- Progress workplace health and safety.
- Human resources: promote openness and diversity, dialogue between management and labour, and the professional development of our employees.
- Implement community outreach programs consistent with our positioning.
- Implement a responsible purchasing policy.

SGG provides all its business units with best-practice guides in a number of different areas that are optional, and every business unit can utilize them in the best way possible.[88] There are although no guides on the development of measurement systems or process mapping. So this study has a certain freedom in that sense.

5.1.4 Core competences and resources

SGSS core competences are tempered and laminated side windshields but SGSS is also oriented towards more value-adding activities within SGSI, e.g. aquacontrol coating, and therefore manufacture more value-added products compared to other SGSI facilities. Since SGSS capabilities are aligned with those requirements, SGSI has chosen SGSS to be a leader in the European region for highly value-added manufacturing.

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[88] SGG Intranet

Core competences and resources of SGSS are:
- Laminated glass.
- Physical product quality to customer.
- Employee flexibility.

Core competences and resources create a company's competitive advantage and can be considered to be either critical success factors and/ or a part of the value proposition to the company's customers. They therefore strongly affect strategy and need to be incorporated in the measurement system.

5.1.5 SGSS Customers

SGSS acts within a somewhat special environment where their corporate parent markets and sells new projects. Nevertheless they still have to send proposals to their parent and apply for projects meaning that they have to be capable to perform in order to win orders.

The order qualifiers on the market are industry and corporate standards, like ISO-/ TS certificates, and certain computer systems. Production capacity is another prerequisite, but that's more or less a natural requirement for all production. What makes them win orders is having the right capabilities, and the right price level.

The trend that's transpired over the last couple of years is that their portfolio of products has diversified. Both in that sense that SGSS has more technologies coming into their assortment and the number of new projects has increased. The number of new customers and projects has exceeded expectations over the last year.

SGSS is broadening their customer base, which is good in that they are spreading risks and get less tied up to certain customers. The development has negative effects on the supply chain in terms of: number of SKUs increase, batches get smaller, production becomes more complex and transports are harder to consolidate. Every customer needs to be treated differently, and some customers have a couple of different products and even a couple of different facilities that put separate orders and require individual packaging.

Another dimension of complexity that comes into play with the on-going trend is the varying requirements of customers. It's so far been doable to build one set of internal requirements that satisfied all customers, but the requirements are becoming more wide spread with the introduction of new customers and it's therefore becoming less beneficial to use one set of requirements that satisfies all.[89] This is the reason that the increasingly more complex requirements are considered to be one of the greatest challenges for SGSS for the years to come.[90]

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[89] Interview E.2.4
[90] Interview E.2.6

5.2 Supply chain

5.2.1 Map - visualization

Process maps are broken down into three hierarchical levels. The highest level is strategic on a corporate level; describing SGSS organisation and its core processes. The second level describes sub processes and is the last level that's mapped; it describes operations, see appendix I. The third level describes single activities and is not beneficial to map as it would affect the working environment negatively. Some supply chain models like SCOR[91] have two more levels, one that's more holistic for strategic planning and one that's even more detailed for implementation in IT systems. Both of those levels are not of interest for this study.
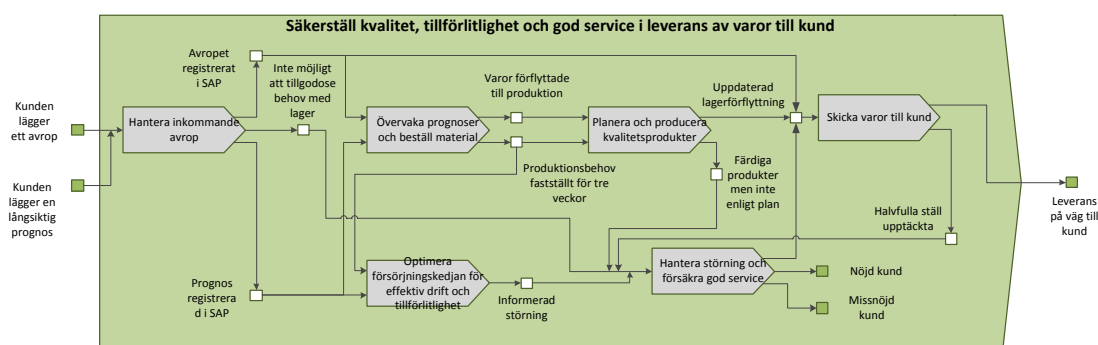
Figure 19, level 1 map of the mapped core process, internal supply chain.[92]

Delimitations to the mapping procedure are discussed in the introduction chapter, although the effects on the map from some delimitations should be clarified.
- No objects from other processes are included even if they in reality do affect a certain process.
- No material flows are mapped which means that the entire production procedure is shrunk to two sub-processes.
- Information mapping is restrained to major information sources, meaning that for example specific search paths in excel are not mapped.
- A result of the project focus is that truck drivers, transport bookers and some other personnel have not been interviewed.

5.2.2 Industry aspects and assets

Suppliers of raw material generally have a lead-time varying between two and three weeks. SGSS production lead-time varies between four to five weeks and the total lead-time including everything from ordering material to dispatch varies in-between 6 to 8 weeks. Their customers on the other hand don't have to put a definite order until the day before dispatch, which forces SGSS to hold storage.

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[91] Supply Chain Council.

[92] The maps are developed in Swedish and are not translated to English.

Lead-time is a fundamental part of a supply chain as it's affected by and it affects storage levels, efficiency, flexibility, reliability, the value proposition and the profitability of the company.

Note: Overall equipment effectiveness (OEE) and production rate (Speed) numbers in the figure 20 are normalized by using the performance of the furnace as a reference. Meaning that all other OEE and speed numbers are divided with the OEE and speed numbers of the furnace so that the numbers that are presented are a comparison between the different production steps and the actual measures.

Cycle	Activity	Week						KPI	
		1	2	3	4	5	6	OEE	Speed
1	Capacity plan								
	Raw material lead time								
	Production plan #1								
	Cutting							97	30
	Cutting & Print							147	23
	Consumables lead-time								
	Furnace							100	100 *reference*
	Production plan #2								
	Cession glass lead-time								
	Consumables lead-time								
	Evaluate if demand is acceptable								
	Assembly							104	16
	BVB grind							-	14
	Consumables lead-time								
	Aqua control							154	9
	Pre-assembly							-	9
	Dispatch								
2	Capacity plan								
	Raw material lead time								
	Production plan #1								
	…								

Figure 20, raw material to dispatch cycle - decomposition of lead-times.

The activities that are shown in figure 20, decomposition of lead-time, are a simplified reflection of the process map that's shown in appendix I. A cycle in the figure begins when an order is handled in the process "Capacity plan" in week 1 (or week X+1, where X is an integer between 1-52) and ends when the last process step in the process map is finished with that exact order. This kind of a decomposition and illustration can highlight whether or not processes are sequential or parallel, and it can help to identify the truly time consuming processes.

SGSS has on average 18 days of inventory according to a manager, which is quite a lot and it's possible to draw the conclusion that it's a result of the setup of their supply

chain activities, see figure 20. Every production step takes approximately one week, including time spent in the buffer. The processing time for their production could finish every order in less than a week. The reasons behind up to seven weeks long lead-time is because of balancing issues and the complexity of production planning. Four different people sequentially plan production and some planning is even done iteratively, i.e. transparency issues and shear complexity disable optimal planning from start.

Figure 21, buffers in production.

Further reasons for the buffers after the first two production steps, se figure 21, is that there are quality[93] issues in the following steps of production and the solution for that is to have a buffer after the first steps to enable easier rework in those steps and continuous production in the first two.

Every customer provides SGSS with forecasts of varying time frames and accuracy. Their largest customer Volvo has fortunately one of the best forecasts. But no customer is obliged to finally order the amount that they have forecasted and as mentioned earlier, their customers lead-times is only one day.

Production uses software that's different from the one that planers or order receivers use, although the systems communicate via SAP[94]. SAP database is updated two times a day, once over night and once at lunch. There is today no automated solution that communicates neither, breakdowns i.e. delays, nor changes in actual production volumes contra planed production volumes. This means that all communication of that kind has to be initiated by employees. Every or almost every employee has a phone with preprogramed numbers so communication should in theory not be that hard to establish.

5.3 Operations

5.3.1 PEMM results and explanation

Process and Enterprise Maturity Model (PEMM) consist out of four levels of maturity, whereas in this research only the two first levels were researched in order to make the questionnaire more user friendly and less time consuming. This was done with the expectation that more answers would be received and thereby get a more representative result. Mentioned in theory, the initial results of PEMM can have a discouraging

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[93] These quality issues are internal and do not affect customers because quality controlls are thorough.
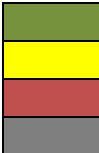
[94] SAP is a full-scale standardised overall business IT- system/ support for enterprises and companies.

effect, the decision to remove the highest two levels was therefore also based on prioritizing lower levels of maturity in order to show the initially greatest holes in their capability and avoid discouraging managers. SGSS can thereafter analyse higher levels on their own after this study. The actual questionnaire was also divided into two parts; enterprise and process maturity where the second part was answered by senior executives and the first by employees in operations. Nine answers were received for enterprise maturity and five for process maturity.

The second part (enterprise maturity) has good reliability as all the members of the executive management team answered it and some other managers' as well. The members are considered to have good or fairly good knowledge in the process terminology and have good overall business awareness so the results are also considered to have high validity. The operators in the mapped process provided answers about process maturity, but only five answers were received. Five out of thirteen possible answers are not considered representative and it's therefore hard to draw general conclusions. Nevertheless the data still provides hints about reality if the answers are focused, i.e. in the case that the answers have a low standard deviation. In one case an employee said that it was hard to know the answerers to the questions and that was the reason that the person didn't return an answer. Other employees complained that they didn't fully understand the questions, which might be reasons that few answerers were received.

		Level 1	*Level 2*	*Level 3*	*Level 4*
Process maturity					
Design	*Purpose*	Yellow	Yellow	Grey	Grey
	Context	Yellow	Yellow	Grey	Grey
	Documentation	Yellow	Yellow	Grey	Grey
Performers	*Knowledge*	Yellow	Yellow	Grey	Grey
	Skills	Yellow	Yellow	Grey	Grey
	Behaviour	Yellow	Yellow	Grey	Grey
Owner	*Identity*	Yellow	Red	Grey	Grey
	Activities	Red	Red	Grey	Grey
	Authority	Red	Red	Grey	Grey
Infrastructure	*Information systems*	Yellow	Yellow	Grey	Grey
	Human Resources	Yellow	Yellow	Grey	Grey
Metrics	*Definition*	Yellow	Yellow	Grey	Grey
	Uses	Yellow	Yellow	Grey	Grey
Enterprise maturity					
Leadership	*Awareness*	Yellow	Green	Grey	Grey
	Alignment	Red	Yellow	Grey	Grey
	Behaviour	Green	Yellow	Grey	Grey
	Style	Yellow	Yellow	Grey	Grey
Culture	*Teamwork*	Yellow	Green	Grey	Grey
	Customer focus	Green	Yellow	Grey	Grey
	Responsibility	Yellow	Yellow	Grey	Grey
	Attitude towards change	Yellow	Yellow	Grey	Grey
Expertise	*People*	Yellow	Yellow	Grey	Grey
	Methodology	Green	Yellow	Grey	Grey
Governance	*Process model*	Green	Yellow	Grey	Grey
	Accountability	Yellow	Yellow	Grey	Grey
	Integration	Yellow	Yellow	Grey	Grey

Table 4, PEMM result.

$$Colour = \begin{cases} Green\ if\ result \geq 70\% \\ Yellow\ if\ result < 70\% \\ Red\ if\ result \leq 30\% \\ Grey\ if\ no\ result \end{cases}$$

The actual answers from which the "percentage result" (here above) is calculated can be found in appendix G.

The colouring rules that are seen here above are different from original ones. The original colouring rules are 80%, 80% and 20%, instead of 70%, 70% and 30%.[95] The reason that the colouring rules are different from the original recommendations is that the original boundaries provide limited guidance in this case. The answers that were

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[95] Hammer (2007)

received had little dispersal, which can be due to two reasons; either that the actual maturity has few extreme values across the board or that people did not fully understand the questions and answered in a way so that their answer would not affect the result.

- Managers agreed in general more with the statements than people in operations with a mean of answers at 3,51 and 2,79 respectively, that could imply that managers are more positively oriented or that they are better informed about the circumstances.
- Mean standard deviation of the answers was 0,87 and 0,86 respectively meaning that in general managers and operators agreed or disagreed equally much on the different statements.
- Ten out of thirteen process capabilities have a higher or equal level 2 rating than level 1. This implying that either the questions were not understood or that there exists some confusion surrounding their processes. It's important to mention that no one was notified prior to the questionnaire that the statements represented two levels of the same capability and the questionnaire (see appendix G) was designed to avoid that kind of associations.
- Four out of thirteen enterprise enablers have a higher or equal level 2 rating than level 1. This implying that the questions were understood and answered according to expectations.

The statistics above indicate that the results are reliable despite the low amount of answers. It also shows that maturity is unbalanced; that is a fact regardless if it's a result of "actual difference" in maturity or maturity not being communicated thoroughly across the company and over hierarchical levels.

5.3.2 Projects, tools and philosophies applied at SGSS

Several quality-related projects, tools and philosophies are in some way applied at SGSS. This means that SGSS either actively uses the tool or have used it at some point in time. Amongst other projects are: WCM project that's currently running and is applied all over the Saint-Gobain Group, OEE, TAK, SMED, Visualization Management, 5S, TPM, Eureka, FMEA, SPS, 6M (Fishbone-diagram), APQP, and besides from this they are ISO/TS 16949 and ISO 14001 certified.[96]

The company is knowledgeable in some of the process terms that are used in this study as a result of the projects and tools that have been performed prior to this one, although there's limited understanding of business process management (BPM), the philosophies behind it, its benefits and terminology. Most importantly, different people in the company have different views on what a process is. Most people see it only as a term for physical flows, i.e. material moving trough different steps in production and being processed. It can't be said for sure if the people that answered the PEMM questionnaire understood the questions correctly and the results of the questionnaire have to therefore be analysed critically.

The World Class Manufacturing (WCM) project is a concept with the purpose to create operational excellence and customer satisfaction. That's achieved with a variety of

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[96] If your unfamiliar with the abbreviations, it's not important for basic understanding.

different tools and techniques, where all the tools that were mentioned earlier are included. The and techniques are divided into eight groups, called pillars, which in a way represent the strategy for reaching the ultimate goals, of excellence and customer satisfaction. The pillars are constructed on a number of fundamental methods for conducting business. The whole concept is visualized similarly to the lean temple; see figure 22 for an illustration of the constructs of the WCM project.
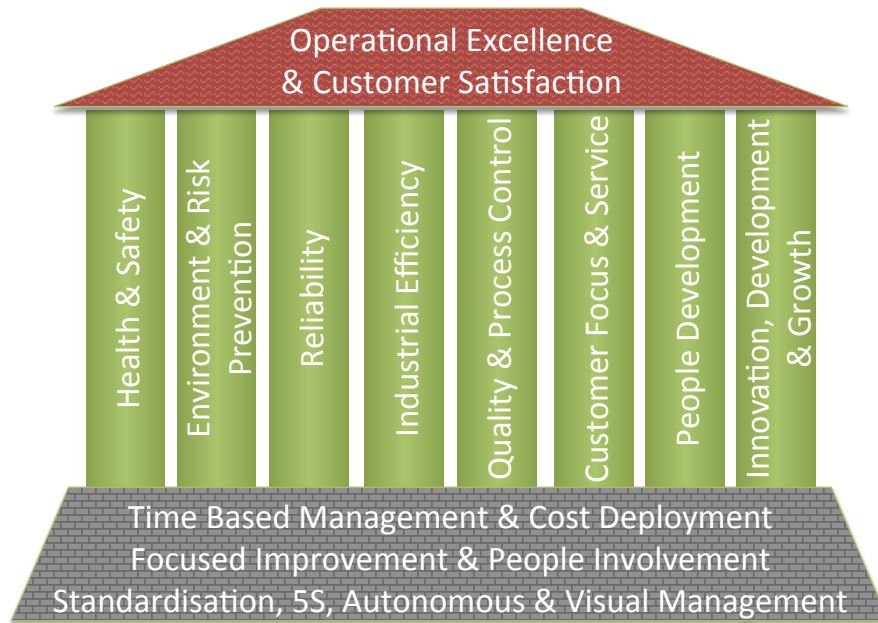
Figure 22, WCM temple according to SGSI.[97]

The WCM project is a large investment at SGSS and something that they spend a lot of time and energy to refine so it's tactically important for this study to develop a solution that's related to WCM in order to make it practically feasible. The same reasoning leads to the conclusion that it's important to create a solution that works well with their ISO certification.

5.3.3 Current measures

SGSS definition of performance indicators: "An effectiveness indicator is a key figure, enabling an objective evaluation of a process-output in relation to a process-input."[98] This view doesn't correspond with the definition of effectiveness and efficiency that's used in this study (see appendix B) and in general, a deeper analysis of the implications of this definition is carried out in section 6.3.1.

SGSS measurement system is based on the balanced scorecard and consists of a vision, strategy, long-term targets and the actual measures.[99] The company has a strong focus on efficiency and quality in their current measures. It appears as if they don't have an ambition to grow any more and are aiming to strengthen their current position by decreasing costs and ensuring compliance with requirements. It also appears as if

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[97] Internal document.

[98] Ibid.

[99] Ibid.

they are turning attention towards their supply chain, still mostly focusing on cost reduction. Their measures are overall financial and quality related, except for the measures that are related to learning and growth, although even learning and growth is mostly related to increasing quality and safety.

5.4 Challenges

In every interview the interviewee was asked what problems that he or she found most urgent to solve for the supply chain to prosper but also what problems that they figured mostly affect SGSS. The answers were in general varying and considered everything from organisational problems to hierarchy and capacity constraints. Some challenges are also identified from observations and the original problem formulation. The challenges that consider the supply chain in some way are presented here:

1. Some employees witness about top-down control from SGSI and/or SGG on a variety of different issues, while others say that it's normal in all large companies and nothing to complain about, hence it's the same everywhere.
2. Two employees that have worked at SGSS for some time explain how the hierarchy has grown over the past years, which prevents communication between departments. Nothing has been communicated to the employees and they find the situation frustrating as it results in unnecessary delays.
3. A lot of time is spent on finding the root cause for delays and there is no pre-determined way of communicating disruptions.
4. Order receivers don't have an overview of the short-term demand and have at some points of time accepted orders that had repercussions on planed orders for the following weeks.
5. It's perceived by some employees that people on the floor don't understand the purpose of the work that they do. In other words, the relation between what they do and how it affects the business.
6. Executive managers say that it's hard to show and breakdown KPIs in such a matter that they are both understood on the floor and at the same time don't reveal to much when e.g. customers come for a visit.
7. SGSS supply chain organisation is currently under reconstruction, which causes confusion.
8. Customer requirements are getting more widespread.
9. Late changes in forecasts and quality issues in production result in continuous re-planning of production.

Challenges are in this study interpreted as the causes for non-optimal operations; that is, opportunities for streamlining operations. Every challenge prohibits in some way employees from executing their work in the way that they perceive most efficient. Every employee can be considered to be the most knowledgeable in what they do and their perception has to therefore be considered accurate for the job that they do. Streamlining although has to be conducted holistically so that the system as a whole is improved. Analysis is conducted on the basis of these views in the next chapter.

6 Analysis

This chapter will initially analyse the process map and challenges that SGSS faces. The next step will be to analyse SGSS strategy and translate it into concrete measures in measurement strategy with the measurement system as a result. It will then go on to develop targets and priorities for the different OPI's.
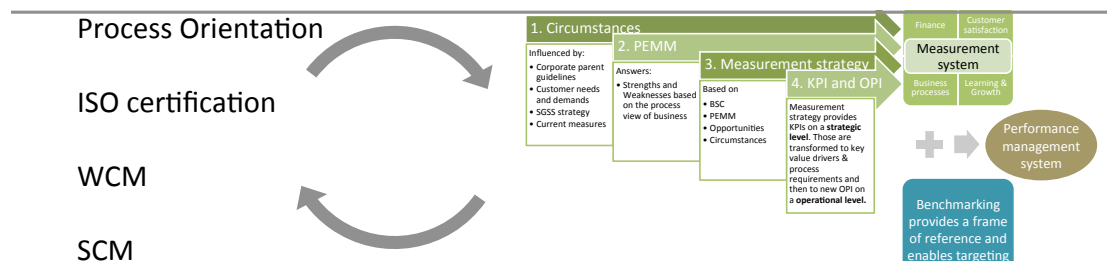
Lack of strategy is one explanation for the problems in the development of performance measurement systems.[100] In many cases strategic goals, as expressed in policies, vision and mission statements and so forth are not very useful, such terms are not well-understood by business leaders.[101] This creates a gap between strategy and operations and this is the part that needs to be improved, in order to create a clear & transparent transformation between the two perspectives.

6.1 Streamlining processes

Most if not all the people that were interviewed at SGSS were perceived as skilled professionals with good intentions and an ambition to help the company and customers. Most people know that customers are important and that the company needs to deliver results[102]. But still 78% of managers answer that employees don't fully understand that purpose, and managers are not ill willed people so the problem has to be more fundamental then that. This is a typical and derived problem from thinking and organizing in functional silos where managers and employees are restrained from affecting circumstances outside of their function[103] and thereby restrained from making changes that affect customers. Streamlining in this sense is about empowering people to satisfy customers' expectation (i.e. reduce functional view), promote free information flows (i.e. reduce hierarchy), and to lead with visions and strategy, not command and control. Most readers are now thinking: "that's easier said than done", well that's of course true. But you will not change unless you try and you can't manage unless you aim, and that's where PEMM comes in to play. It does not provide all the methods that are needed to achieve streamlining nor operational excellence but it does provide targets that help a company aim in the right direction. Numerous methods ex-

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[100] Näslund (1996)

[101] Näslund (1999)

[102] Interviews

[103] Interview

ist for streamlining an organisation from different perspectives[104] and they most often focus on certain areas. PEMM on the other hand provides an holistic perspective of the overall maturity (streamlining) in the organisation which allows the organisation to use any method they prefer to achieve maturity, the result will nevertheless be process orientation, and streamlined processes.

This subchapter 6.2 will provide solutions to earlier mentioned challenges that hopefully will increase the maturity of the organisation, in other words the solutions will be process oriented, and it will provide a platform for further analysis and development of a measurement system. As mentioned earlier it's important for the study to provide solutions that are compatible with both WCM and ISO, and so those aspects will be considered.

6.1.1 Challenges... No more!

"Many manufacturing companies have experimented with various order to delivery (OTD) solutions, some successful, some not. One thing is clear: Order to delivery remains an extremely complex area where a on-size-fits-all solution does not work", Capgemini (2006). The process that's mapped in this study is more or less the OTD process but is slightly more comprehensive. Capgemini (2006) also reveals that according to their experience 70–80% of delays in the OTD process occur in information flows and not material flows, this study has roughly the same perception about the challenges that exist in SGSS.

In section 5.4 a number of challenges are listed as a result of interviews, observations and the original problem formulation. The aim of this section is to find opportunities for improved operations in these challenges. It's been noticed that the challenges that SGSS faces are common in today's business, SGSS isn't alone to face these kinds of challenges and so it's clear that they are not always easy to solve. This study realizes that fact and that the presented solutions might be hard to implement, this will be kept in mind when developing the action plan.

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[104] Harrington (2012)

#	Challenge	Solution
1	Top-down control from corporate parent	Outside the scope of this study.
2	Hierarchy has increased	Empower employees, i.e. distribute responsibilities and authority.
3	Delays of delivery to customers	Determine how disruptions are communicated and automate communication with SAP.
4	No overview of short-term demand	Order receiver should follow up production plans or forecasts.
5	Understand the mission of work	Process orientation, process maps and a process oriented measurement system.
6	Show and break down KPIs	Implement the developed performance measurement systems on visualization-boards.
7	SC organization at SGSS is currently under reconstruction	Define positions and responsibilities.
8	Increasingly more complex customers requirements	High level of communication between supply chain and marketing, decrease hierarchy and promote free communication, implement performance measurement system.
9	Re-planning of production	Decrease buffers or integrate the two production-plans

Table 5, analysing process challenges.

6.1.1.1 Top-down control

This challenge is outside the scope of this study, however it was brought to discussion by several employees and therefore needs to be addressed. Large projects and the highest levels of strategy at SGSS are decided by SGG and SGSI. Top-down control limits responsiveness but at the same time provides SGSS with capabilities that they hardly would afford on their own, e.g. WCM, SAP, marketing, etc. Without deeper analysis, top-down control should exist to some extent as it creates savings but if increased responsiveness is needed the top-down control should be reviewed.

6.1.1.2 Hierarchy has increased

By continuing to have a function-oriented organization, hierarchy continues to have a strong foothold. Hierarchy leads to a reduced capability to adapt to changing requirements, as a result of reduced employee flexibility[105] where flexibility and communication are keys to success.

The problem of hierarchy is that there's limited opportunity for employees to realize own ideas because decisions take time and communication between functions is limited which results in decreased organisational flexibility. SGSS should therefore decrease the hierarchy by reorienting to the process view and follow the advice that process orientation advocates. Open communication flows that are a result of process ori-

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[105] Accenture, the agile organisation

entation will create more opportunities for employees to realize their ideas; which has a strong relation to continuous improvements in the lean & WCM philosophies. The generated ideas are thereafter realized with the help of different tools that are included in WCM.

Process orientation advocates delegation of responsibilities and authority from management to operations. This will result in increased responsiveness to customer requirements, streamlined processes, and increased employee motivation. It might sound like there's no need for managers when orienting towards processes, but there is, their role in the organisation is just not quite the same. According to Hertzberg (1968), empowering, giving recognition, and enabling employees achievements will create motivation, which will profit SGSS.

6.1.1.3 Delays of delivery to customers

A fault tree analysis[106] is carried out for challenge 3, since this challenge was perceived to be the main problem by the interviewed employees; it's in addition the only challenge that directly affects customer relations. The fault tree analysis is visualized in appendix K and it shows that many of SGSS challenges are related and even more so root causes for the undesired event. If SGSS manages solve a majority of the other challenges that will automatically lead to a decrease in delays.

Delays of delivery to customers cause extra costs for SGSS and unsatisfied customers. Causes for delays could be lack of articles in storage or (rarely) delayed transports. Lack of articles is the main problem for delays, see appendix K for complete fault tree analysis. Lacking of articles is often a result of disruptions in production or forecasts not matching with actual customer demand. Quality related reasons that cause disruptions in production are handled by the WCM project and are left out in this study. Another issue related to the disruptions is missing communication between employees about disruptions. According to some interviews, SGSS reports disruptions either by mail, phone, or physical meetings; options are great to have sometimes but have options without standardization can also be confusing. It was also mentioned that some parts of production don't understand the urgency of communication and therefore don't prioritize informing downstream personnel when a problem has occurred. This is considered to be one of the root causes to delays. If communication had worked properly, front desk personnel would not have accepted orders that could not be fulfilled.

A solution is to automate the communication via SAP since overall communication mostly is carried out trough SAP. It might be challenging to implement changes into the software but the gains of the change will be elimination of a root cause for delays, which is a valuable gain.

6.1.1.4 Overview of short-term demand (part of "delays of delivery to customer")

This challenge is one of the causes for delays of delivery to customers (challenge 3), see appendix K. One of the causes for this problem is customers that change forecasts

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[106] See theory chapter, section 4.3.4.

with "short" time frames. Order receivers are front desk personnel at SGSS and they are responsible for receiving orders & forecasts, dispatching orders, and contacting customers when delays occur. Thus the order receivers are aware of changes in customer demands at an earlier stage than others at SGSS. This allows them to respond more rapidly to changes in forecasts or demand; it also allows them to understand how disruptions are affecting customers and therefore have a key role to play both in the beginning and at the end of the core process. Motivated order receivers with the right abilities can solve this challenge and be an important connection point with customers that captures feedback and secures high service.

During this study and after this challenge was communicated the supply chain manager implemented a solution to the problem; the order receivers look at a three week forecast before accepting orders from customers. In that way they secure that the demand does not exceed the volumes from production plan #2, see figure 20.

In more detail, they shouldn't accept more than production plan #2 allows by analysing planed storage-levels in comparison to the demand. This approach will mitigate re-planning, increase reliability and reduce costs for extra transports. Agility is a popular and frequently used topic in supply chain management; nevertheless it's useful for this problem. The objective of agility is for management to respond to short-term changes in demand or supply quickly. Measure agility by measuring the relation between number of satisfied short-term changes and total number of short-term changes. The challenge is although not completely solved, customers are still allowed to change forecasts that are longer then three weeks but SGSS still base their main production on forecasts that are six to seven weeks, this issue is further discussed in section 6.1.3 lead-time optimization and customer service.

6.1.1.5 Understand the mission of work
A holistic view is a prerequisite for understanding the mission/ purpose of work (i.e. sub-processes) in relation to other parts of the organization (i.e. main process). In order to increase this understanding SGSS should use the process map that's developed by this study(see appendix A), which provides a mutual perspective of the entire process. The map will enable employees to get an overall understanding and hopefully increase both motivation and ability to carry out changes. The visualization of the measurement system will enable employees to concretely understand how their work is related to the corporate vision, strategy, and customer satisfaction, which hopefully will help to further increase motivation and alignment.

6.1.1.6 Show and break down KPIs
Measures aren't shared to the entire organization and lack of distributed KPIs is considered to be a problem. The illustration of the measurement system in figures 26 & 27 (section 6.4.4) shows the connection between strategy (KPIs) and operations (OPIs) without revealing sensitive information to customers. The measurement system can be illustrated on visualisation boards and thereby become a mutual forum for discussions.

6.1.1.7 Supply chain organization at SGSS is currently under reconstruction

A prerequisite for aligning new organisations is the understanding of where resources are needed in comparison with the current distribution of resources. The process map visualizes what resources that are required throughout the process, and should therefore be used as a support for realigning the new organisation. This approach will guarantee that responsibilities are distributed in the most appropriate way. The process map acts as a good platform for communicating the new organisation and for future redesigns. It also, in the same sense as the measurement system, acts as a good forum for discussions and together with the measurement system provides a more or less complete picture of the purpose of work and the purpose of changes. For instance, "Act process 2" (see section 6.1.2) has the purpose to manage disruptions and ensure good service, which is related to the corporate vision trough a number of OPIs, to key value drivers, to a number of strategic objectives, to a corporate vision that clarifies the importance to keep customers in focus.

6.1.1.8 Increasingly more complex customer requirements

SGSS ambition is to always satisfy customer demands, it might sound obvious but few companies actually have targets set to 100 %. One of the goals at SGSS is to secure two new projects per year, but the last year they secured a lot more than that and they also have an ambition to increase and widen value-adding activities. Since the current supply chain is constructed for larger batches it's not ready for the implications of the marketing strategy. The increasing number of products with the current SC will lead to increased lead-times. One observed result from this is that production has problems with increasing disruptions and thereby late deliveries, see fault tree in appendix K.

In order to better adapt the supply chain with today's as well as future requirements, a company should integrate processes, i.e. make sure that marketing understands the SCs preconditions[107] and that the SC understands the requirements of marketing and the marketplace. One of the implications from PEMM is that an organisation has to map cross-functional processes, i.e. core processes, and integrate its core processes, which will increase alignment and adaptability.

Reliability is a measure that will help the organisation understand how well it is able to align its supply chain with marketing. Reliability measures how well the organisation meets its promises e.g. lead-time, service level, communication accuracy etc. And it will provide a platform for further focusing of actions.

6.1.1.9 Re-planning of production

Since focus is on always meeting customer demands, SGSS have chosen to follow that directive by re-planning production even if it causes problems and additional costs. This is done based on prioritizing customer satisfaction and thereby fostering long-term relations.

To what extent SGSS should meet the short-term changes could be decided in relation to competitors service levels instead of just saying "100% service" and absorbing all

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[107] Observation.

the additional costs that it brings with it. According to an interview, SGSS does not consider competitors in their marketing strategy. Without a deeper study on competitors service levels or benchmarking best practice / world class it's impossible to give a concrete recommendation about appropriate service levels. But this is also a case where the symptom and not the root cause is attacked; the re-planning issue is further analysed in section 6.1.3, lead-time optimization and customer service.

6.1.2 Proactive process with feedback and improvement

Continuous improvement is important for every organisation and it's important to make the continuous improvement cycle, PDCA, a part of every process to ensure that the process continuously improves itself. According to ISO[108], an organization should ensure proactive management of all processes, to ensure that they are effective and efficient. The PDCA analysis in figure 23 shows that the mapped core process actually is well designed and reaches the third level that's illustrated in figure 12. The process is proactive with feedback loops and even contains two sub processes for "acting" and making changes.
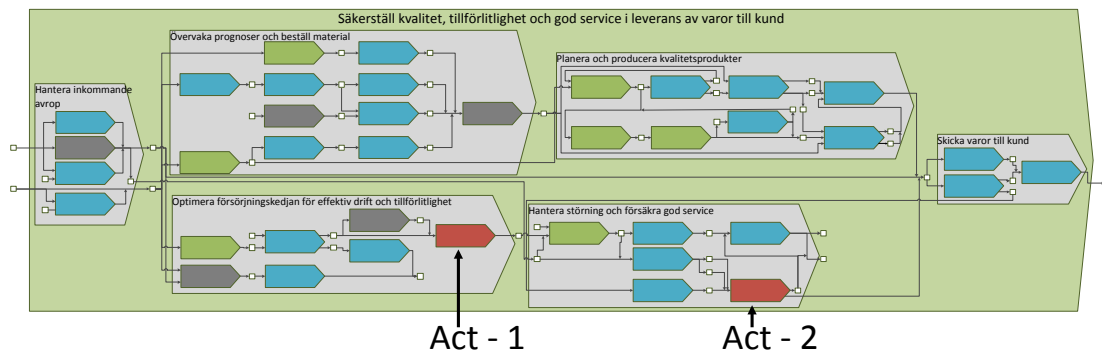
Figure 23, PDCA analysis.

"Act - 1" process is focused on improving manufacturing processes at the moment, which is understandable (due to quality focus and WCM project) but it could and should be redesigned to have more responsibility for the performance of the internal supply chain to solidify the PDCA cycle. The process itself is truly process oriented as it collects representatives from all the major functions in order to create cross-functional solutions. It therefore offers a great opportunity for cross-functional problem solving in relation to SCM.

"Act - 2" process is responsible for correcting mistakes but does not have the authority to initiate any process related changes at the moment. The process could be assigned responsibility to systematically provide suggestions for improvements or perhaps document different faults that are encountered and the solutions that were applied to solve those faults, and also to occasionally deeper analysis could be conducted and larger changes initiated based on these facts.

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[108] See theory chapter, section 4.3.2.

6.1.3 Lead-time optimization and customer service

At least three out of the six weeks long lead-time is a result of buffers, if all buffers were to be removed lead-time would shrink to optimally three weeks in total. The reasons for creating buffers is in general to connect two production steps with different production rates, in that way the bottleneck can run for longer time periods and either build or consume a buffer depending on where in the flow it's located.

Buffers can have a positive effect on OEE performance and SGSS measures OEE but not WIP so the optimization of buffers, and thereby lead-time, might have been forgotten which will be considered by the measurement system.

The buffer after the furnace is hard to decrease, as it's both a result of production planning complexity and physical distance in the facility. The OEE and production rate (speed) data that's presented in empirical foundation[109] on the other hand shows that the furnace shouldn't be a bottleneck and the need for a buffer after the furnace should therefore not be necessary. It's also possible to argue that the buffer before the furnace is unnecessary as the aggregated speed of the three cutting lines is fairly well balanced with the furnace. To say anything about the other buffers is at this moment not possible as it would require a deeper analysis of volumes and flow patterns. However the numbers don't currently fully support the existence of buffers and the focus of analysis therefore turns its attention towards production planning complexity, see figure 24.
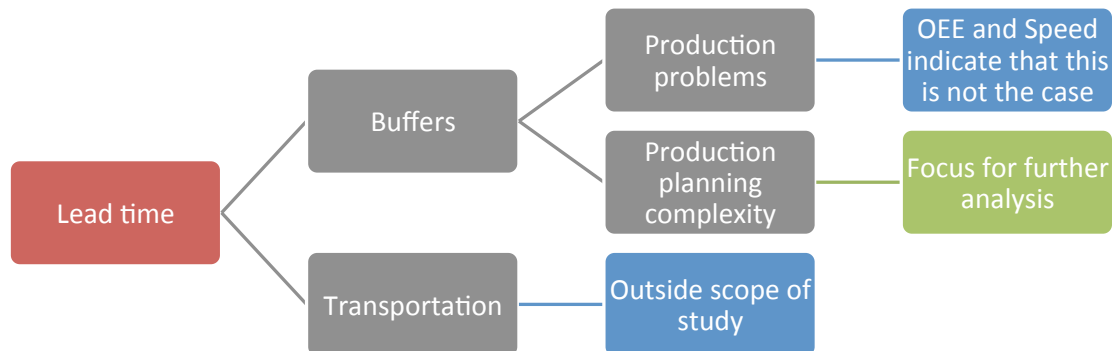
Figure 24, simplified lead-time breakdown.[110]

Production planning would consume lesser resources if the number of re-planning occasions could be reduced. Re-planning is as mentioned earlier a result of two factors, quality issues and customers changing forecasts. Late changes in forecast do not only cause re-planning but also delays in delivery to customers as shown in fault tree analysis, appendix K. A solution to this issue is partly already implemented as discussed in section 6.1.1.4. The solution could although be extended to include the entire lead-time and both planning steps, see figure 21. Create three restrictions for forecast changes to fit with the safety stocks in finished goods, the buffer after furnace, and raw material. Those restrictions would cause decreased flexibility but simplify production planning. From the customers perspective it would cause less delays, i.e. less variability in lead-time and order fulfilment and thereby higher reliability, but at the same time cause perceived longer lead-times as it demands a higher accuracy from the

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[109] See empirical foundation and findings chapter, section 5.2.2.
[110] Figure is developed by this study.

customer regarding their forecasts. But if lead-time could be shortened by reducing buffer stock that negative effect could be avoided. Less WIP also means that more safety stock could be held in raw material, that together with a, for instance, two week reduction in internal lead-time would cause a boost in customer service in terms of flexibility & reliability (see figure 25) and still with less re-planning.
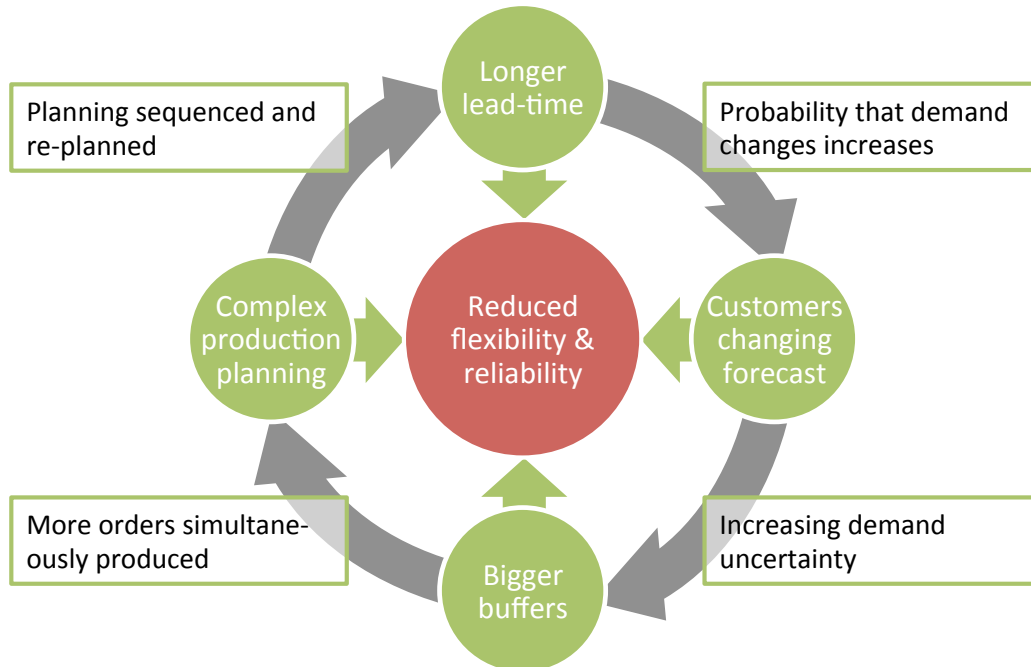
Figure 25, lead-time & WIP (buffer) relation.[111]

6.2 Vision & Strategy alignment

"SGSS vision is to always be the best supplier in the industry, with the customers and employees in focus, develop and manufacture functional glass. A smart glass delivers more."[112]

In order to be the "best supplier" in the industry with the customer in focus the company has to treat their value proposition as a key asset and have a outside in perspective to strategy. The outside in perspective means that qualities such as reliability, fill rates, order fulfilment lead-times and customer requirements are keys to success and not internal perspectives, such as efficiency, cost, etc. Employees in focus implies that employees are core assets and critical for high performance, meaning that the employees motivation and ability to execute are strategic issues. Employee satisfaction and motivation is achieved with fulfilment of Maslow's hierarchy of needs,[113] but Vroom (1964) suggests that the performance of employees is a function of both ability and motivation so SGSS has to secure both aspects. People need both ability and motivation to perform well, and if one out of both factors is unfulfilled performance will be inefficient.

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[111] Figure is developed by this study.
[112] Internal document
[113] Robert L.B, Nicholas C.W, and Terry P. (1984)

SGSS long-term strategy is described in a number of targets, where some of the targets are presented bellow. [114]

- Place in top three in SGSI KPIs.
- Fulfilment of external requirements.
- Flexible workforce.
- Increased internal production of high end products.

In order to align and operationalize SGSS strategy, the company has to benchmark its performance against top performers both inside SGSI and across the industry and set up targets in its supply chain that correspond with their vision. As SGSI's ambition is to be the world leader in all its business areas, this practically means that SGSS has the ambition to be the world leader in these certain KPIs.

6.2.1 Strategic opportunities in the on-going trend

"The executives most likely to say that their company's level of risk has risen are those in manufacturing, …" -McKinsey, Understanding Supply Chain Risk

The on-going trend where decreasing margins, increased variety of products and shorter life cycles, continuous introduction of new technologies, smaller order sizes and a larger portfolio of global customers[115] requires a supply chain that's agile, adaptable and aligned.[116] SGSS is a company that over the years has developed operational capabilities to increase efficiency and the company has competed with advantages that are a combination of high quality and large-scale production. SGSS has done that very well, however, times are changing and bringing new concerns to them.

This is of course a threat for profitability and brings increased pressure on supply chains; but at the same time it's a change that affects all competitors on the market and the realisation comes about that the company that successfully exploits the changing circumstances will have a substantial strategic advantage when going into the future. According to a survey by the Supply Chain Council and Hoovers (2006), 94 % and 93 % of the total costs at GM and Ford respectively were represented by SC costs.[117] In the case of SGSS where they neither market nor sell products the cost of the supply chain might represent an even greater share of the total cost. Meaning that even the slightest changes in SC cost will have large effects on profitability, so efficient and effective management of the supply chain should be a strategic focus and the measurement system should be developed to enable and promote this change throughout the organization.

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[114] Internal document.
[115] Interview
[116] See theory chapter 4.3.3.
[117] Supply Chain Council

Experience tells us that many non-supply chain managers do not fully understand what supply chain management truly entails or realize the advantages of a well-managed supply chain. Furthermore, these managers may not know how they contribute to the success or failure of their company's supply chain initiatives.[118] Process orientation will create a more widespread understanding of how everything works together and that SCM is not only a function but also a fundamental component of the organisation that affects everyone.

A triple-A supply chain is well suited in the automotive industry, especially at a supplier like SGSS where customers are powerful and demanding, operations represent the greatest costs, and both suppliers and customers are global.

6.2.2 Strategic implications from PEMM results

Once again it's important to mention that the actual PEMM consists out of two more levels, which are quite a leap forward in maturity. The results were low but that's expected for every company that's in the beginning of process orientation initiatives.[119]

1. What can be mentioned first and foremost about the result is that SGSS needs to invest in increasing level 1 capabilities and enablers across the board to create a firm foundation for further improvements.
2. Secondly, their currently greatest weakness is that they don't have process owners in practice even if they exist on paper and are assigned according to their ISO certification. The process owner is an important figure in a process organisation and even more so for a process based measurement system as he or she will have responsibility for cross-functional measures.
3. As mentioned before, it's clear that SGSS has worked with processes earlier in all the different improvement projects that have been conducted over the years. Although, there's a noticeable difference between the rating on process and enterprise maturity, 3.52 and 2.79 respectively, which can be a result of top down management, in the sense that managers carry out the different projects and are knowledgeable about what has happened and how that is connected with every thing else and the point that the projects might not have been thoroughly communicated to operators. A case where managers do the thinking and operators do the work[120]. This is of course not easy but true, sustainable change requires involvement.
4. The standard deviation was fairly low in both cases meaning that operators and managers likewise are coordinated amongst each other, which was expected.
5. The fact that ten out of thirteen level 2 process capabilities had a higher scoring then corresponding level 1 is quite unexpected. It both strengthens the fact that level 1 maturity has to be prioritized and that changes have to involve all the employees in order to make them sustainable.

The strategic implication of the result is that process maturity should be prioritized, as it's currently low with focus on process ownership. Make the role of the process own-

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[118] J. Trent (2004)

[119] ISO 9001 is considered to be a process orientation initiative in that it requires process mapping, ownership, etc.

[120] Referencing to "The West Will Lose" preface.

er known and empowered trough out the organisation. The role of the process owner is an active position and the person should work with continuous improvements, employee involvement and customer satisfaction over time.

6.2.3 Business priorities

SGSS core competences and resources correspond well with their vision, they are good at laminated glass which fulfils the part of "a smart glass delivers more", they have good physical quality in their products and employees have multiple skills which fulfils the part of "with customers and employees in focus". This study doesn't intend to neither alter the vision of the company nor the overall strategy but it wishes to highlight the growing importance of supply chain management and process orientation. It might sound obvious but process orientation is a prerequisite for a process oriented measurement system, which in turn is the way forward to high performance. By promoting process orientation and SCM it's required to widen the scope of the current strategy and redefine some of the long-term goals of the company to create a better fit with the promoted views.

Business priorities will however remain the same, that is that SGSS aspires to be the best supplier in the industry as well as keep customers and employees in focus while endorsing smart windows. Every objective that is added or redefined are benchmarked against these priorities and prioritized thereafter.

6.3 Measurement strategy

This study will focus on KPIs that are of greatest interest for the supply chain, although the approach that's used to break down business priorities to key value drivers and OPI is applicable no matter what the focus is. This chapters' logical path is:

$$Corporate\ strategy \implies Measurement\ strategy \implies Strategic\ objectives \\ [KPIs]$$

6.3.1 Remark: definitions are important

The definition that SGSS uses for performance indicators is constraining on both creativity when developing measurements and the process view in the corporation. It also limits the understanding of differences between internal contra external perspectives of performance, which prohibits employees from achieving a good understanding of the measurement system. SGSS definition of performance indicators: *"A effectiveness indicator is a key figure, enabling an objective evaluation of a process-output in relation to a process-input"*.

The definition doesn't allow measurement on neither resources nor processes as it only mentions comparison between inputs and outputs, which by definition only allows measuring effectiveness. Effectiveness is defined as: effectiveness is determined without consideration to cost and aims at the capability of doing the right things. "Without consideration to cost" prohibits measuring resources.

The company measures other parts of business performance in reality, which makes you wonder what input and output actually is in the eyes of the employees. In order to measure for example efficiency, input and output has to contain something else then actual results of processes. The definition of efficiency is: the comparison of what is actually produced or performed with what can be achieved with the same consumption of resources, it's also known as doing things right. This clearly aims at the resources that are required to make a product and the management of those resources.

The word effectiveness in the definition is constraining itself, it implies that all indicators have to be a ratio between two measures and that no measure on it's own is enough. This kind of a usage of words doesn't allow measures such as process maturity, number of customer projects etc. and leaves the organisation without a number of important measures. Ratios are good for benchmarking purposes but they are also restraining for internal use.

6.3.2 KPIs needed to achieve customer satisfaction

The outside in perspective that's mentioned in section 6.2 doesn't change much in reality, perhaps because SGSS already has that perspective and their performance measures are developed to fit a value proposition that's developed from the customers point of view.

SGSS doesn't have a clarified and internally communicated value proposition today although everyone knows that the company produces quality products, needs to withhold good customer relations, and that their operations have to be reliable in order to satisfy customers.[121] SGSS even has a core process for handling customer complaints and building customer relations, see appendix F. Quality products is something that's thoroughly measured and ensured in their current measurement system. The company has further identified that it's strategically important to provide innovative products and technologies for their long-term success. This has a correlation to the fact that SGSI has decided that SGSS is one of the enterprises top producers of advanced windshields in the European region[122] and so innovation has to be an important capability for customer satisfaction.

SGSS current (unofficial) value proposition is:
- Quality products.
- Reliability.
- Service & commitment.
- Innovative products.

Customer needs have to be incorporated into the measurement system to attain a process oriented measurement system according to Ljungberg and Larsson (2012). These four values reflect customers' needs and therefore have to be measured and safeguarded in a process oriented measurement system.

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[121] Interview E.2.2 – E.2.6
[122] Observation with high interaction and awareness

This section has identified the following Strategic Objectives (KPIs):
- Quality products
- Reliability
- Service & commitment
- Innovative products

6.3.3 KPIs needed to exploit the on-going trend

The objective of agility is for management to respond to short-term changes in demand or supply quickly, in terms of the SC being able to handle external disruptions smoothly.[123] Disruptions can be a result of volatile demand & uncertain supply and they are simultaneously reinforced by internal business complexity. Agility is a result of a number of qualitative and quantitative factors where both infrastructure and process orientation are vital to achieve agility, simultaneously as following demand trends and changes in supply are important as well. Companies that can sense, asses, and respond to these pressures faster than rivals will be better at capturing the opportunities and mitigate the downside risks.[124]

Adaptability aims at enabling the SC to adjust its design in order to meet structural shifts in markets; it also means that the SC is able to modify its network to strategy, products, and technologies.[125] Working proactively with adaptability is more or less about risk management. The company needs to create plans for both risk avoidance and risk management. But adaptability is not only about risk management, it's also about having employees that can enable adaptability . In order to create an adaptive workforce a company has to use appropriate collaboration techniques and empower every employee to contribute to the overall knowledge of the company[126]. Process maturity and especially capabilities like knowledge, skills, and behaviour of performers is a suitable way to measure and achieve internal adaptability.

The objective of alignment is to create incentives for better performance across the supply chain; one part in alignment is to design measurements "correctly" to be able to create beneficial incentives for the supply chain as a whole, and thereby increase profitability for every single company.[127] Executives overlook across company problems because they are difficult to detect and it's tedious and time consuming to define roles, responsibilities and accountability for a string of businesses that they don't control directly.[128] Process orientation provides a solution to that problem in the form of the process owner, culture and governance that at the highest level of maturity "has extended its process model to connect with those of customers and suppliers. It also uses the model in strategy development". So not only does enterprise maturity create capabilities that connect and align companies with customers and suppliers it also makes sure that the company is internally aligned and requires that the process model is used for strategic planning. High enterprise maturity might not be the holy solution for achieving alignment in the supply chain but it's certainly a large step in the right

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[123] Lee (2004)

[124] McKinsey, agile operations for volatile times

[125] Lee (2004)

[126] Accenture, the agile organization.

[127] Lee (2004)

[128] Narayanan and Raman (2004)

direction. Alignment (internal perspective) had low scoring in PEMM and should therefore be prioritized even if SGSS doesn't prioritize external alignment.

This section has identified the following Strategic Objectives (KPIs):
- Adaptability
- Agility
- Alignment

6.3.4 KPIs needed to streamline processes

Subchapter 6.1 provides several implications about possible measures that could help to improve performance. Two measures that although stand above others trough their strong relation to Business Priority, employee focus, are ability and growth. But it's also clear through the fault tree analysis and thereafter lead-time analysis that stock levels and WIP are important for SGSS to consider.

SGSS has 18 days of inventory but only measures finished goods inventory, it would be a good idea to measure raw material and WIP levels also to attack the whole problem and not just the end result. This measure would perhaps also attack all the buffers that exist in production and help to reduce lead times. Another measure that could help to optimize the whole process is cash-to-cash[129] cycle times; it would provide a different perspective on lead-time and at the same time highlight the importance of WIP. Measuring lead-time would perhaps also turn focus towards the complexity that currently exists in production and ultimately information issues between the different functions. Measuring lead-time would also bring to light the effects of prototype production on overall customer satisfaction.

The Global Commerce Initiative together with Capgemini released a report stating that KPIs for the future supply chain have to change in order to address sustainability.[130] Current measures, measure efficiency and those will continue to be important however sustainability will become an ever more important perspective to consider as regulation gets tougher, fuel prices continue to rise and cities become more inhabited. The following measures were presented after analysis of five external forces that most probably will shape the industry and three on-going industry trends:

Current KPIs
- Service levels
- Cost reduction
- ROI
- Gross Margin Return
- Return on Brand Equity
- Inventory
- Traceability

Sustainability KPIs
- Energy consumption
- CO_2 emissions
- Traffic congestion
- Water consumption
- Security compliance
- Infrastructure simplification

This study makes a separation between KPIs and OPIs depending on the strategic importance of measures that is quite rare in current literature. Which results in that some of the KPIs that are presented above, as a result of the measurement strategy and cur-

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[129] Financial measure that shows for how long a company has to finance its inventory.
[130] Future Supply Chain 2016

rent Strategic Objectives are translated to OPIs. These measures are then checked against current measures at SGSS, challenges and proposed solutions in the "approach for developing OPI" in order to determine what OPIs that ultimately are recommended in the measurement system.

This section has identified the following Strategic Objectives (KPIs):
- Working Capital
- Moral
- Growth

6.3.5 Balancing measures

The balanced scorecard[131] says that business measures have four perspectives and that a well-balanced measurement system should include all four perspectives. So far all four perspectives are included but the measurement system is partly unbalanced. Both the financial and business perspectives need to be complemented. The four perspectives are now represented by:

Financial: Profitability (chosen on the basis of SGSS current strategy)
                         Working capital

Customers & Society: Quality products
                         Reliability
                         Service & Commitment
                         Innovative products

Business processes: Adaptability
                         Agility
                         Alignment
                         SGSI top 3 (chosen on the basis of SGSS current strategy)

Learning & Growth: Moral
                         Ability

6.4 Break down procedure

The breakdown procedure consists out of three steps. The big picture provides the breakdown approach from guidelines, context and business performance to a measurement strategy and thereby a number of strategic objectives. Strategic Objectives are then transformed into key value drivers in the first step, those are then transformed into OPIs and finally to action according to figure 15, approach for developing OPI.

6.4.1 Strategic objectives to Key value drivers

The first breakdown step allows a logical transition between strategy and operations instead of a perhaps mathematical transition. A direct transition from strategic objectives to operational performance indicators might prohibit a person from analysing

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[131] See theory chapter, section 4.4.3.

what's truly important and focus on what's possible at the moment both in terms of OPI and strategic objectives. For example, measuring the number of team projects to follow a strategy that aims to develop flexibility might not be obvious. But if those two are connected with "multitalented employees and teamwork" on a "key value drivers" –level it might become somewhat clearer. More than that, it enables a visual connection between strategy and operations, which is not always that clear.

For a person working with for example cutting edges of a plate after a punching operation, it's not certain that the person understands that his accuracy is connected to a strategic objective that measures customer satisfaction. But if those two are connected via a value driver, e.g. immediate fit in assembly, the person will have a better understanding and hopefully, in general, be more motivated to do a good job every time, perhaps even come up with own ideas on how to improve immediate fit in assembly.

It also provides the option that not all measures have to be operational, still showing how everything works together to reach the same goal. It shows how managers and operators work together towards the same goals. Some literature use the notation process requirements instead of key value drivers, but this study has chosen to go with the later as to create a notation that's less restraining and the word value is more easily related to performance.

6.4.2 Key value drivers to operational performance indicators

After successful transformation from strategic objectives to key value drivers this step should not be hard. Although some useful pointers to keep in mind when developing OPIs:

- Process oriented OPI are those that span processes and can measure cross-functional performance.
- OPI can exist on different process-hierarchical levels meaning that they can be more or less strategic/ tactical/ operational.
- OPI can be both of qualitative and quantitative nature.
- OPI can measure efficiency and effectiveness.
- OPI have to reflect their corresponding key value driver.
- They have to create beneficial incentives for the company and not create hidden actions.
- They have to be objective in order to support fact-based decision-making and continuous improvements.

Follow these guidelines and have a creative mind-set when developing the measures.

6.4.3 OPI to Action

Managers should have a clear vision and develop objectives accordingly with mutual consensus with employees. Furthermore, the manager should empower all employees and give them confidence to achieve stated goals, Salman, et al. (2011). Performance management is an inseparable part of strategy development and keenly focuses on effective utilization of human resources.[132] This last step of the breakdown is crucial as

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[132] Salman, et al. (2011)

it's the step that finally solidifies the operationalization of strategy. But it's a step that's done between a manager and employees so it has been disregarded in this study.

6.4.4 Measurement system – Visualization

The result of the breakdown procedure is the measurement system that's visualized in figures 26 and 27. The visualization concept is strongly related to the breakdown procedure and is also developed by this study. The measures in the measurement system are a combination of measures that SGSS are applying today and a result of the complete analysis, i.e. fault tree, strategic opportunities in the on-going trend, balancing measures, etc. A majority of the shown measures are although a result of analysis and not measures that SGSS are using; those measures therefore also have a strong relation to existing theory. The measures that SGSS are applying are also renamed in most cases for confidentiality.
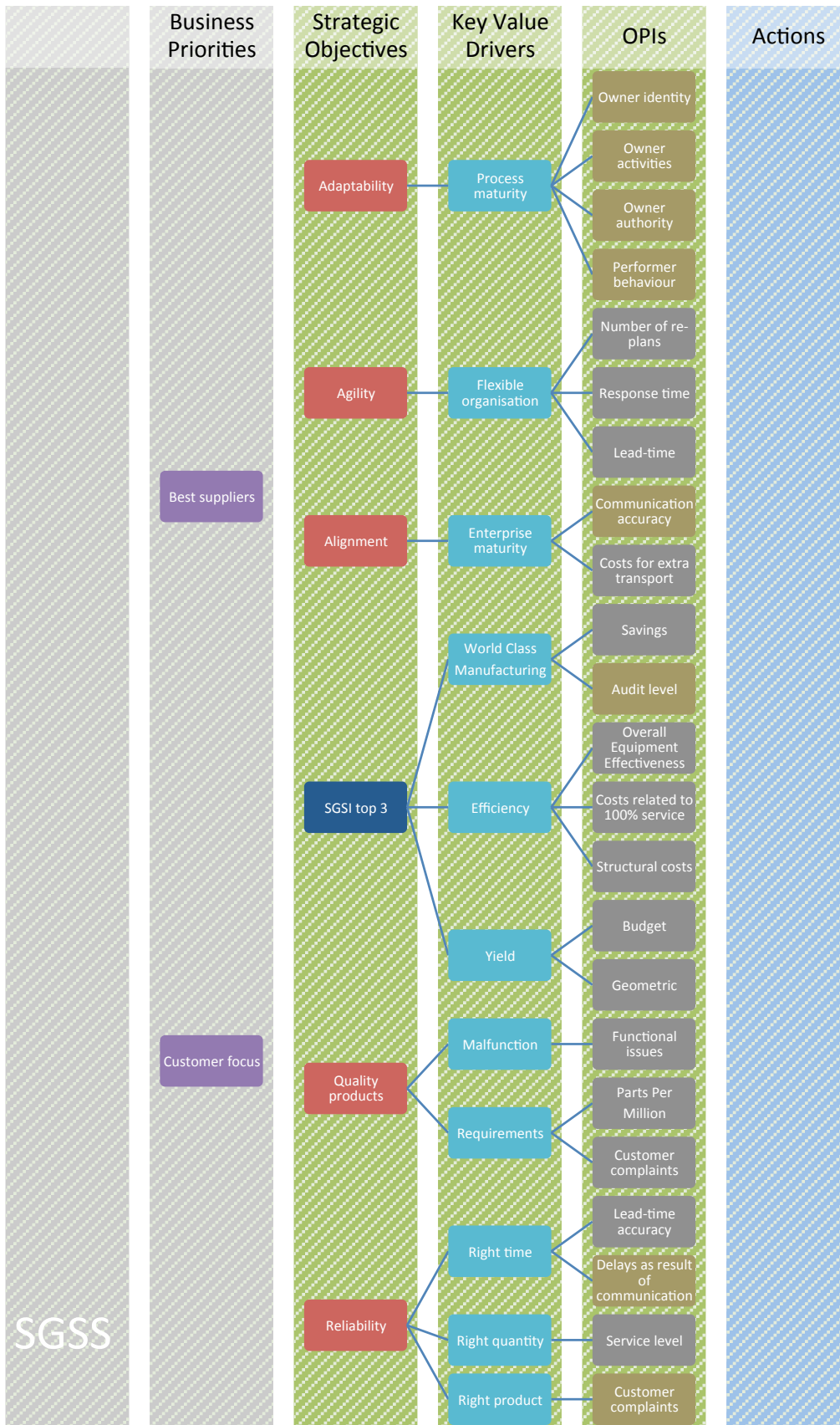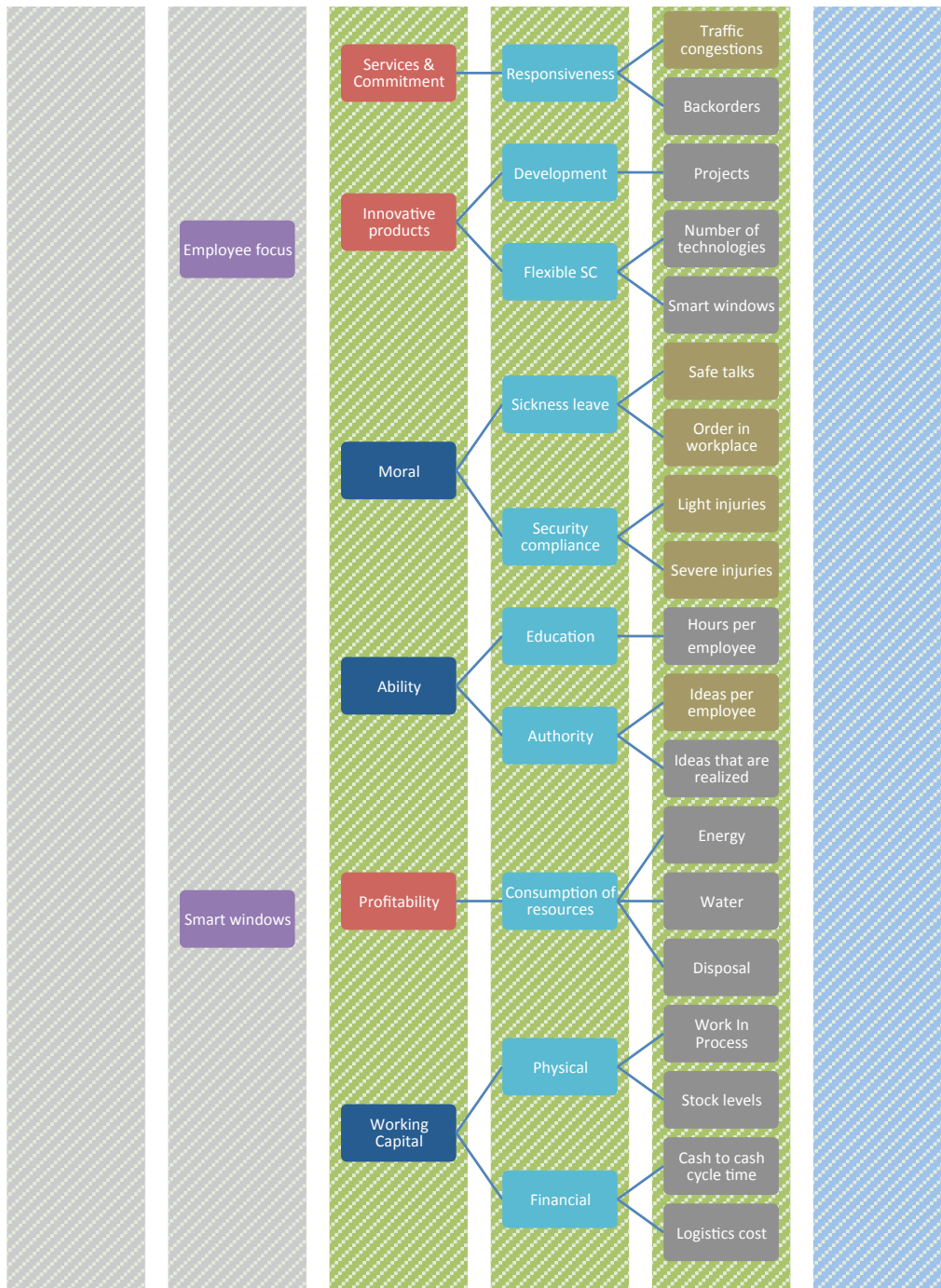
Figure 26, KPI break down, visualization 1 of 2.

Figure 27, KPI breakdown, visualisation 2 of 2.[133]

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[133] Concept developed by this study.

6.5 Gap analysis & Critical Success Factors

6.5.1 Setting up targets - where do we want to be

After the measurement system is developed it's time to create a connection between business priorities (vision) and strategic objectives (strategy) as this isn't shown in the measurement system, figures 26 & 27. In order to determine targets for different objectives it's necessary to determine the implications of those objectives to the companies' vision. The approach for setting targets can be seen in table 6 where a set of business priorities-priorities also is presented. The priorities-priorities are used to highlight the varying importance of different priorities. The current set of business priorities' weighting is determined by this study as to show an example of how it can look. But it's something that's every business has to adapt to their own conditions and update them when appropriate.

Business-priority best supplier is considered to represent the whole business and therefore reflects the other priorities so it's assigned the highest weighting. Smart windows are important for the long-term survival and development but it represent a limited part of business operations and is therefore assigned the lowest weighting. Customer and employee focus represent the external and internal perspectives of business and are long-term development priorities that reflect both the value proposition and business capabilities so they are assigned an equal but high weighting.

Strategic objectives	Business priorities				Average score - Importance to business success	Target
	Best Supplier	Customer focus	Employee focus	Smart windows		
Weighting	35 %	25 %	25 %	15 %	100 %	
Adaptability	5	4	5	3	4,5	WC
Agility	5	5	3	3	4,2	WC
Alignment	5	3	5	3	4,2	WC
SGSI top 3	5	2	2	2	3,1	BiC
Quality products	5	5	4	2	4,3	WC
Reliability	5	5	5	3	4,7	WC
Services & Commitment	4	5	5	3	4,4	WC
Innovative products	4	5	2	5	3,9	BiC
Moral	2	5	5	2	3,5	BiC
Ability	4	5	5	3	4,4	WC
Profitability	3	2	2	1	2,2	B
Working Capital	3	2	2	2	2,4	B

Table 6, targets for strategic objectives.

The scoring in table 6 is set on a scale from 1 - 5, where 5 implies that the factor is highly important for achieving that certain business priority.

$$Average\ score \begin{cases} > 4 \Rightarrow Target = World\ Class\ (WC) \\ \leq 4 \Rightarrow Target = Best\ in\ Class\ (BiC) \\ < 3 \Rightarrow Target = Basic\ (B) \end{cases}$$

The strategic objectives with the highest average score are those that are most critical for business success, called critical success factors (CSF). As the company competes on a global stage with global competitors, it's necessary to identify numerous objectives with targets on a world-class level. The targets should not be static over time, instead they should adapt to changes. A company can't set all targets to world class as that would consume all resources or worse, by not focusing and prioritizing action the company would end up with mediocre results on all objectives instead of prioritizing and achieving clear advantages in certain areas.

6.5.2 The Gap - prioritizing and focusing action

In order to execute a gap-analysis, extensive benchmarking has to be conducted to determine the frame of reference, which in turn is necessary for determining the performance Gap. Table 7 shows an example where the first strategic objective, adaptability, with its corresponding OPIs are analysed. World-class performance in that case is known thanks to the construction of PEMM, although SGSS current performance in relation to competitors is unknown. The performance GAP is an indication of the companies position in relation to competitors. It's determined as the gap between the companies current and targeted performance. The targets of strategic objectives are used for their corresponding OPIs.

NOTE: The current performance that's used in the example is set in relation to PEMM and not competitors and can't be considered SGSS competitive condition.

OPI	Gap			Frame of reference			Priority
	Current ⊙	Target ✪	Gap	Basic Class	Best in Class	World Class	
Weighting		60 %	40 %				100 %
Owner identified	2	8	6	⊙		✪	7,2
Owner activities	1	7	6	⊙		✪	6,6
Owner authority	1	9	8	⊙		✪	8,6
Performer behaviour	3	7	4		⊙	✪	5,8

Table 7, example of performance gaps based on strategic objectives targets.

The OPIs that have the highest performance gap and are CSF will be assigned higher priority numbers implying that they need a greater allocation of resources. Calculation of priority number:

$$Priority = 40\% * Gap + 60\% * Target$$

The weighting is set so that high targets are prioritized for resource allocation. The reason is that it's more resource intensive to improve high performance than low. If for example two OPI have gaps that are 2 but their targets are 5 and 9 respectively, this type of weighting means that the latter will be allocated more resources. The *priority* on the other hand has to consider both the gap and target to distinguish between OPIs that have the same target but different gaps as larger gaps require more resources to close.

7 Conclusions

"The west will lose", is an excellent summary of the challenges that corporations are facing in this modern age. The heritage from the industrial age, with Taylor, glorification of hierarchy, and divisions of labour is embedded in everything that we do and it's a premise for everything that we do. The world has changed, we have to adapt to the change in our minds, culture, and how we view the organisation of labour. This chapter concludes how process based business development together with a performance management system helps to meet this new age at SGSS.
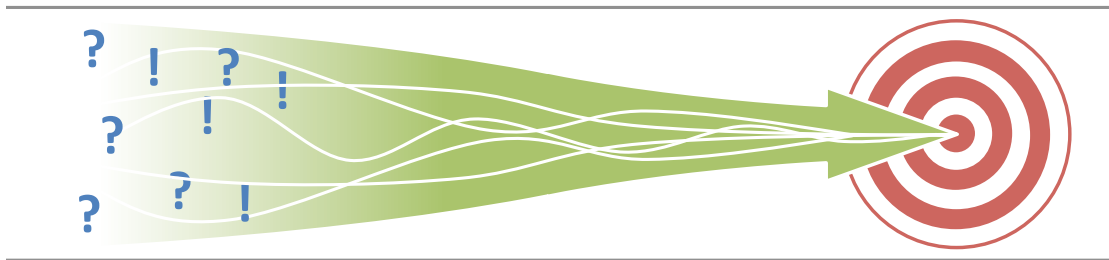
7.1 Discussion

All in all SGSS is a healthy company that does most things right and it's hard to find areas for bigger improvement, in regard to the purpose and deliverables of this study that are considered broad. PBBD and the development of performance management systems are also wide subjects and there are many different ways to move forward with a problem formulation that's as broad as the one of this study.

SGSS is a functional organisation that at this current state tries to embrace processes into its functional organisation without fully embracing the paradigm shift. It's standing in the middle of the road trying to use different methods and approaches to increase its performance, and achieves to do so but it has a greater potential that waits to be exploited.

The company is good at keeping good quality on the physical products that leave their site. They on the other hand lack in communication routines towards the employees that handle customer relations when quality issues occur and therefore loose some flexibility. This naturally leads to late detection of missing material for those employees and leaves them in messy situations. The company has high service requirements so the problems that occur are mostly dealt with in one way or another, although to a cost that's unnecessarily high. It's important to point out that SGSS is a supplier with high effectiveness, i.e. quality, service levels and external lead-times are all satisfying, even if delays to customers do occur. The improvement potential that exists concerns efficiency, which is suiting as the purpose of this study as a whole is streamlining.

It's natural that efficiency suffers as SGSSs supply chain becomes more complex, customers and suppliers are more global and this is a trend that most certainly will

continue. Complex supply chains have potentially more delay points, greater uncertainties, and hence the need for greater coordination, communication and monitoring. To meet these challenges SGSS should focus their attention onto creating a triple-A supply chain from an external perspective, but improving efficiency and its capabilities through process orientation.

7.2 Project targets reached

7.2.1 Problem & purpose

This study considers that it has provided SGSS desired results and managed to both identify the opportunities that were question marks in the problem discussion and provided solutions that will resolve the problems that were mentioned. Short recap on the problem discussion, it consisted of:

- Weak circumstances for overview from management point of view.
- Thoughts about the supply chain processes potentials for improvement.
- Distribution of responsibility is not clarified
- Delays of delivery to customers.
- Perceived problems may further include, long lead- times to customers, unsatisfying service levels, inefficient production planning and high amounts of WIP (Work In Progress) in the supply chain.

A problem that has been excluded from the project is prototype production as it falls under a different core process and delimitations dictate that this study is not supposed to provide recommendations to other core processes. It's although discussed briefly in the thesis, as it's a part of fault tree analysis.

The study has fully fulfilled its purpose and delivered according to the agreement (that is the project plan) between the steering group and the project group. It has further upheld the agreed time plan, tollgates, and documentation without exceptions. The original purpose and deliverables has changed slightly during the study but only to become more comprehensive and without undermining the requirements of the agreement.

7.2.2 Five deliverables, five solutions

Solutions that this study has provided to SGSS are summarized in this section.

7.2.2.1 Deliverable 1, process map:

- Developed a stencil in Microsoft Visio for mapping processes.
- Developed definitions and rules for mapping based on Ljungberg and Larsson (2012)
- Developed:
  - o Core process map, see figure 19.
  - o Core process map with sub processes, see appendix I.
  - o Specifications in the form of a core process map with information and resources, (definition of measurements is found in appendix C).

7.2.2.2 Deliverable 2, measure business performance:

Performance is measured with the help of a PEMM questionnaire to identify organisational strengths and weaknesses, see table 4, that are used in deliverable three. Business performance is measured in terms of maturity and process orientation to determine how streamlined the organisation is both vertically and horizontally.

7.2.2.3 Deliverable 3, find opportunities for improvement and recommend solutions:

Analysis that was conducted to identify opportunities and threats:
- Analysis of challenges that were brought to attention during interviews.
- Context analysis (Section 6.2.1, Strategic opportunities in the on-going trend), see section 6.2.1.
- Fault tree analysis, see appendix K.
- PDCA analysis, see figure 23.
- Lead-time & WIP analysis, see figure 25.

Recommendations are presented in section 7.3.

7.2.2.4 Deliverable 4, develop a performance management system:

The performance management system is developed deductively and consists of both existing theory and contributions by this study to existing theory that result in an performance management system with recommended measures and targets.
- Conducted the first three phases in the cycle for developing measurement systems, see figure 16.
- Developed "the big picture" concept that develops a measurement strategy from an external perspective on business, see figure 13.
- Developed an approach for breaking down strategy to OPIs, see figure 15.
- Developed a method for illustrating the measurement system, see figures 26 & 27.
- Developed an approach for developing targets and determining CSF, see table 6.
- Developed an approach for prioritizing OPIs, see table 7.

This study has not finished the development of priorities between measures because delimitations did not allow benchmarking the frame of reference.

7.2.2.5 Deliverable 5, action plan:

The action plan is based on the recommendations, that is deliverable three, and is illustrated in subchapter 7.4. The action plan shows how SGSS within a time frame of two years can implement the recommended actions and streamline both the internal supply chain and company as a whole. Delimitations that are discussed in chapter one are abandoned in the action plan as a response to the results from context-, fault three- and PEMM-analysis but also existing theory about supply chain management and performance management systems that all point to the fact that in order to streamline the supply chain changes have to be made across the company.

7.3 Recommendations

Recommendations are divided into three parts, the first is recommendations that only require time and involvement, secondary recommendations require some investment in education and longer dedication over time periods, the tertiary set of recommendations are full-scale projects and require dedicated budgets. There are in total 15 recommendations that are supposed to solve the challenges that have been discussed throughout the study.

1. **Primary**
1.1 Visualize the process map and measurement system to enable people to better understand the purpose of work and its relation to strategy.
1.2 Use the process map for communicating and analysing change initiatives to increase understanding and clarity.
1.3 SGSS should define their value proposition and communicate it throughout the company so that every one understands exactly what it's that they are supposed to be good at.
1.4 Strategy should focus more on the supply chain perspective of business and use it as a means for competitive advantages.
1.5 Restrict changes in forecast to the different safety stocks in the supply chain.
1.6 The gap analysis that's conducted in chapter six is an example of how targets and priorities systematically can be set, which creates a platform for fact-based decision-making. Use it to create own targets and priorities.
1.7 Redefine the definition of a performance indicator to not restrict creativity and the process view.

2. **Secondary**
2.1 Map core processes and integrate them with each other.
2.2 Reorient to the process view in order to reduce hierarchy. In order to better understand the path forward it might be an idea to consider the higher levels of PEMM in order to know in which direction to aim.
2.3 Standardize communication by mapping and enforcing process maps.
2.4 Solidify the PDCA cycle in the core process by redesigning "act" process one to have responsibility for the supply chain and "act" process two to systematically document faults and provide suggestions for improvements.

3. **Tertiary**
3.1 Delegate responsibility and authority by empowering process owners, involving employees into decisions, and creating systems that allow employees to get their ideas realized.
3.2 Automate some communication with IT in order to reduce stress and mitigate the human factor.
3.3 There is room for improvement according to the PEMM questionnaire; SGSS should at the moment focus on the lower levels of PEMM.
3.4 Benchmark the frame of reference and systematically use the outside in perspective when developing targets for OPI to increase competitiveness and efficiency.

7.4 Action plan

The action plan illustrates in which order recommendations should be implemented and an approximated required time for the different implementations, see figure 28. It's divided into three phases where the content of the first phase mainly contains the primary recommendations and acts as an initiating period that aims to prepare the organisation for the change initiative, that is the second phase. The second phase is the actual implementation of more demanding undertakings, which will require investments, time, and dedication. The third phase consists out of continuous improvement efforts such as reorientation to the process view, delegation of responsibilities, and different PEMM related aspects.
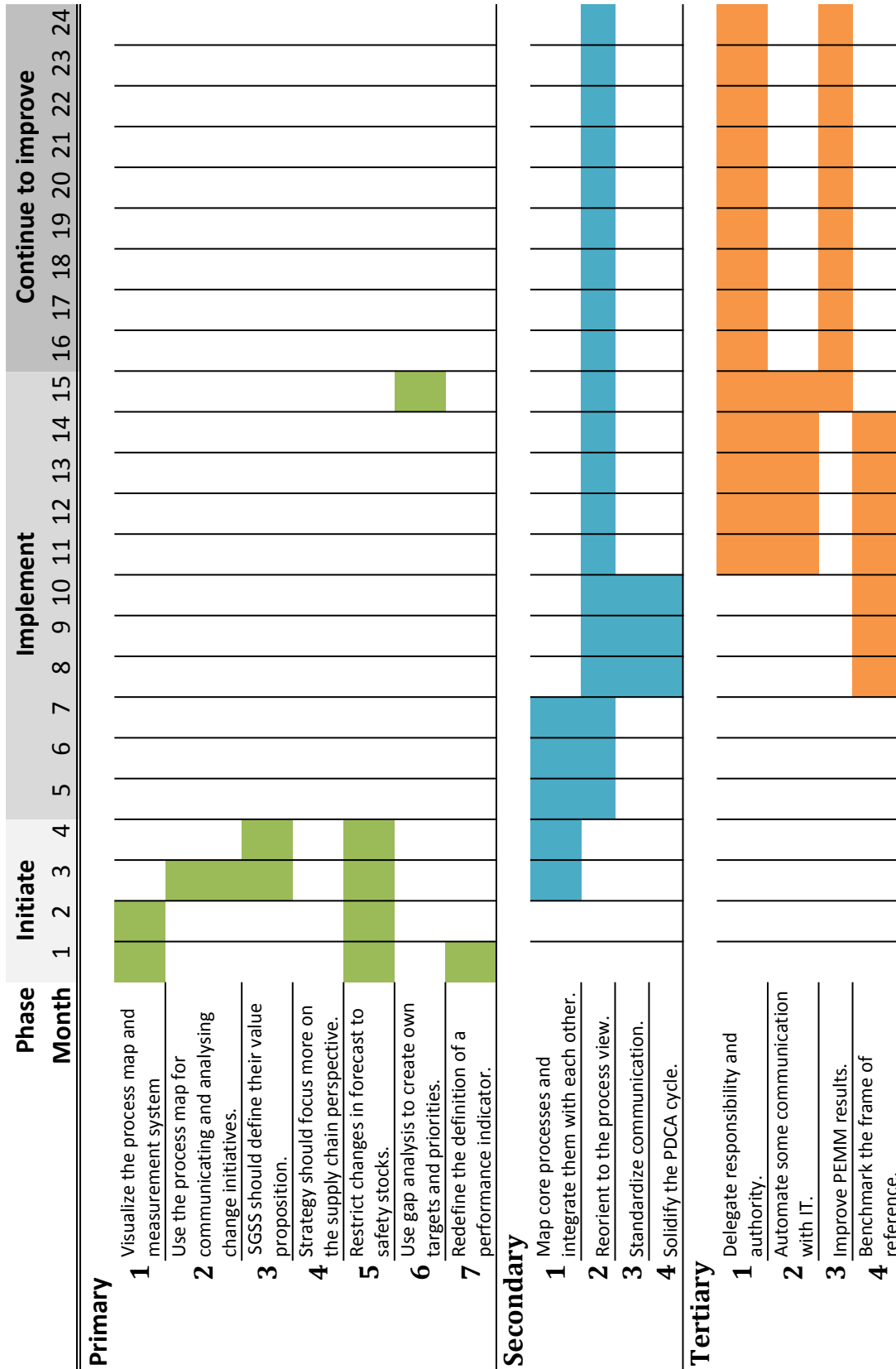
Primary

Task		Phase: Initiate (1–4) · Implement (5–15) · Continue to improve (16–24)
1	Visualize the process map and measurement system	Months 1–2
2	Use the process map for communicating and analysing change initiatives.	Months 3–4
3	SGSS should define their value proposition.	Month 4
4	Strategy should focus more on the supply chain perspective.	
5	Restrict changes in forecast to safety stocks.	Months 3–4
6	Use gap analysis to create own targets and priorities.	Months 14–15
7	Redefine the definition of a performance indicator.	Month 1

Secondary

Task		
1	Map core processes and integrate them with each other.	Months 3–7
2	Reorient to the process view.	Months 5–9
3	Standardize communication.	Months 8–10
4	Solidify the PDCA cycle.	Months 16–24

Tertiary

Task		
1	Delegate responsibility and authority.	Months 12–24
2	Automate some communication with IT.	Months 15–24
3	Improve PEMM results.	Months 7–13
4	Benchmark the frame of reference.	Months 7–15

Figure 28, action plan.

Clarification:
Recommendation one-four is not provided a time-period in the action plan. The reason for that is that it's something that should happen immediately and continue to be a given fact over the time period of the action plan.

Recommendation two-one, map core processes and integrate them with each other, aims at the remaining processes from delimitations, see figure 1 and the recommendation aims at the mapping of information flows.

The row that shows the time period 1-24 months does not mean that month 1 is equal to January, instead it means that month 1 is equal to any month in a year whenever SGSS decides to execute the action plan.

8 Discussion & contribution

This chapter discuses the performance management system in order to explain its place in the organisation and how it can contribute real value. It also explains why the authors consider the system to be an addition to existing literature on performance management systems.

Contribution
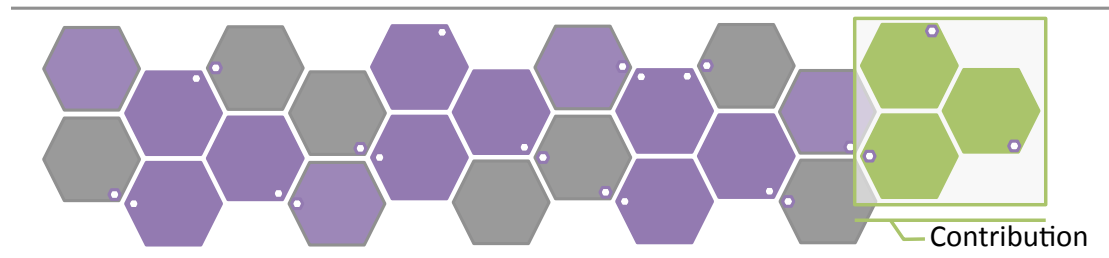
8.1 Discussion

The performance management system is an important tool for streamlining an organisation, aligning operations (functions), and creating a clear connection between strategic management and operational activities, but it's also a component in a system and not the whole system. It's great for leading the organisation in the right direction just like a steering wheel leads the car in the right direction, but just as the steering wheel needs a gas pedal to make the car move in a certain direction does the performance management system need a type of pedal to move the organisation in that direction. That pedal is the reward system in an organisation and that will determine how intensely the organisation focuses on achieving certain goals. The number of metaphors and similarities that could be mentioned in this discussion are infinite but it's better to not overdo it. Anyway, if a company is managed correctly, see appendix D, the system can be a tool that helps to create a culture that values continuous improvements, process orientation, and engaged employees. But in order to do that the system has to become integrated into the infrastructure of the organisation and thus become a crucial connecting point between everything that an organisation is, see figure 29.
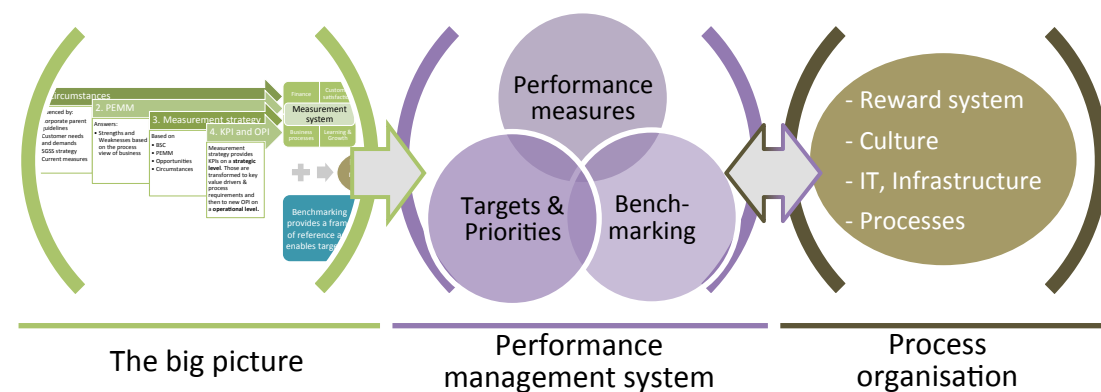

Figure 29, the system. See appendix D for guidelines.

"Todays problems are a result of yesterdays solutions."[134] In other words, companies have to get better at making decisions in order to avoid adding unnecessary costs to the future. The performance management system will help decision makers make better decisions by:

- Providing them with facts that are related to corporate strategy.
- Relating performance targets to reality, that is competitors and customers.
- Aligning the data on which decisions are made across the organisation.

The performance management system will also help employees in operations to understand why decisions are made by having a visualized measurement system that's developed from an external perspective i.e. customers, and thus they can relate decisions to both customer needs, their own work and strategy.

"Despite almost two decennials of work with process orientation in a variety of different areas, it seems that the majority of organizations are traditionally function oriented and structured hierarchically" Ljungberg and Larsson (2012). Process orientation is hard work that demands dedication, but it's necessary for improving performance and to meet increasing complexity and lowering margins. There are two core messages that process orientation encourages, the first is to view your organization holistically and the second to utilize your workforce full potential and capabilities trough empowerment and enabling involvement. A starting point to a holistic view is to map processes and a good point to start enabling involvement is by enabling understanding of the organization with a visualized performance management system. These two tools in a combination help organizations achieve high performance trough process orientation.

8.2 Our contribution to science

This study has deductively managed to combine, adapt and improve several separate parts and thereby developed a performance management system that satisfies the needs of a modern, high-end company like SGSS. This study has thus contributed to the existing knowledge that's available in literature.

This study argues that it has executed the development of these tools and theories in a scientific manner with high credibility based on thorough methodology for collection of data and a live case example where triangulation has been applied.[135] That should make these tools valid, reliable, and representative for any organisation that wishes to utilize them for managing their operations. There is according to this study a missing link in current literature for the development of complete performance management systems that these tools and theories do link together. Our contributions are summarized on the next page together with a summary of the void that they help to fill. Our contribution to science is divided in four tools and theories.

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[134] Ljungberg, A. Larsson, E. (2012)
[135] See methodology chapter, subchapters 3.2 and 3.5.

Approach to breakdown Strategic objectives to OPI.
- Figure 15
- Page 38

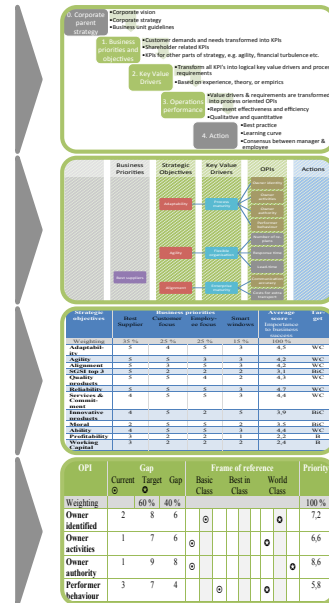A concept for visualization of OPIs in direct relation to Business priorities.
- Figures 26 & 27
- Pages 73-74

Systematic method to determine targets and identify CSF.
- Table 6
- Page 75

Systematic method to establish priority between measures.
- Table 7
- Page 76

The first two tools help to develop and visualize a measurement system based on and developed from the organisations vision and strategy. The breakdown approach is more closely described on pages 72 to 74. The last two tools connect the measurement system with targets and priorities so that a complete performance management system is obtained. These two tolls determine targets for the different measures from an outside in perspective and priorities between measures based on benchmarking a frame of reference where the current performance gap is identified.

Finally the void that these contributions help to fill is:
- Clear and logical connection between strategy and operations that can be visualized.
- Systematic outside-in perspective to managing performance in order to align the company's competitive strategy with operations.
- Process oriented measurement system that supports process orientation.

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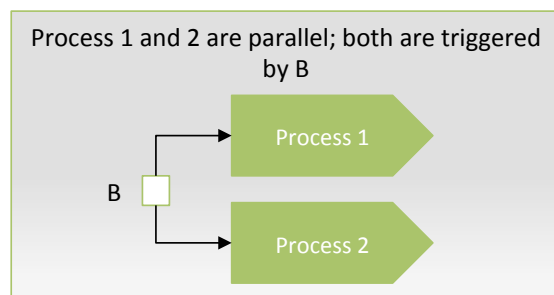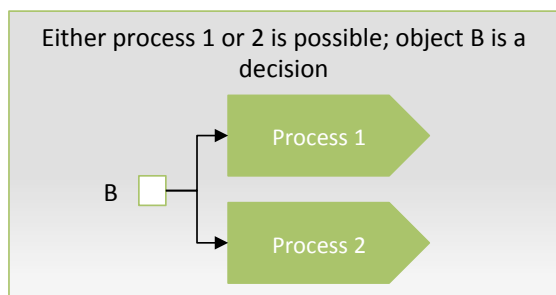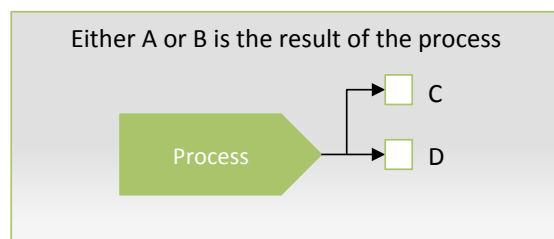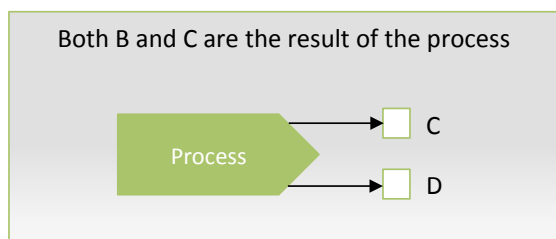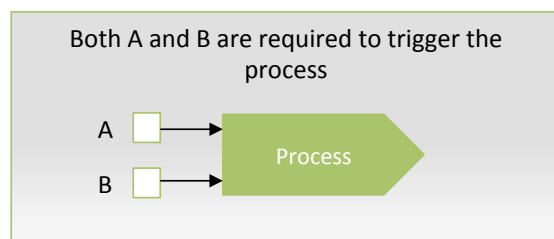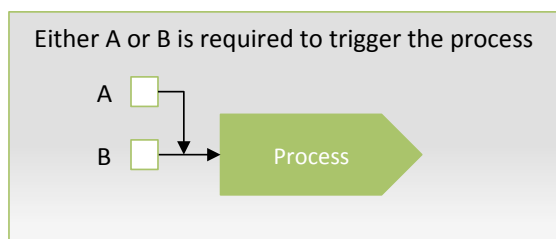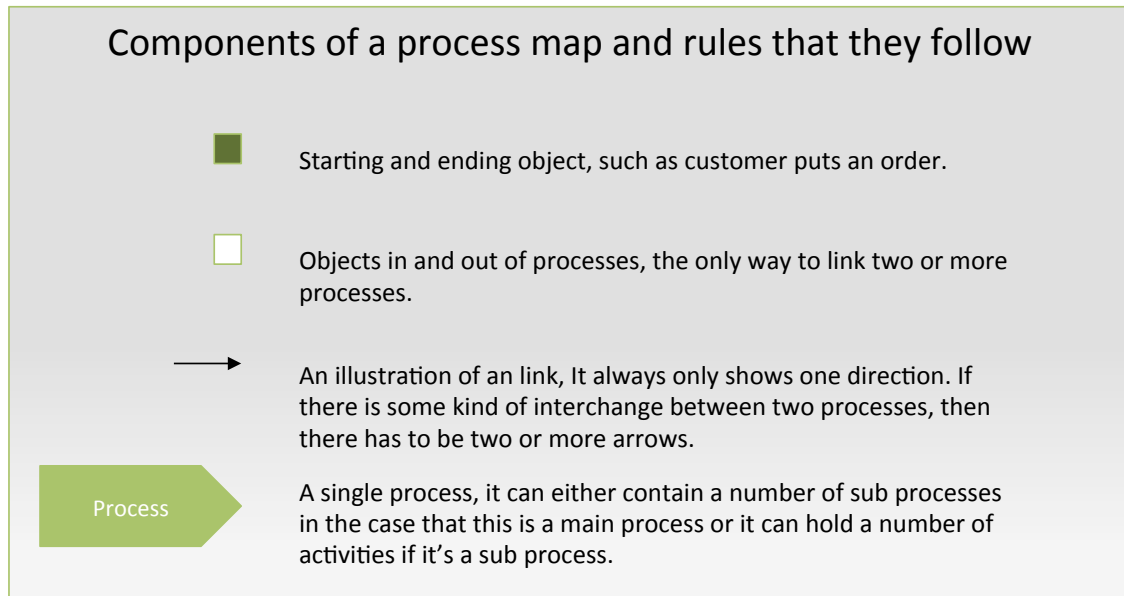
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Appendix A – Process map components

Illustration of different components in a process map, based on Ljungberg and Lars-son (2012).

Components of a process map and rules that they follow

■ Starting and ending object, such as customer puts an order.

□ Objects in and out of processes, the only way to link two or more processes.

→ An illustration of an link, It always only shows one direction. If there is some kind of interchange between two processes, then there has to be two or more arrows.

Process — A single process, it can either contain a number of sub processes in the case that this is a main process or it can hold a number of activities if it's a sub process.

Either A or B is required to trigger the process

A □
B □ → Process

Both A and B are required to trigger the process

A □ → Process
B □ →

Both B and C are the result of the process

Process → □ C
→ □ D

Either A or B is the result of the process

Process → □ C
→ □ D

Either process 1 or 2 is possible; object B is a decision

B □ → Process 1
Process 2

Process 1 and 2 are parallel; both are triggered by B

B □ → Process 1
→ Process 2

Appendix B – Definitions

Most of the definitions are obtained from www.businessdictionary.com, while others are slightly modified.

Activity	Measurable amount of work performed to convert inputs into outputs.
Core process	Key activity or cluster of activities that must be performed in an exemplary manner to ensure a firm's continued competitiveness because it adds primary value to an output.
Effectiveness	Effectiveness is determined without consideration to cost and aims at the capability of "doing the right things".
Efficiency	The comparison of what is actually produced or performed with what can be achieved with the same consumption of resources, it's also known as "doing things right".
Flow	Focuses on the process as a machine and does not consider resources or the interaction between processes.
Infrastructure	Basic and usually permanent framework which supports a superstructure and is supported by a substructure.
Management process	Coordinate and manage core and support processes.
Measurement	Quantifying values into specific units.
Measurement system	A system of measurements that aim to align business operations with, and pursue, corporate strategy.
Object	The output and input from processes.
Operational *(Different from operations)*	Firm's performance measured against standard or prescribed indicators of effectiveness, efficiency, and environmental responsibility such as, cycle time, productivity, waste reduction, and regulatory compliance.
Operations	The outcome from operations is the harvesting of value from assets owned by a business.
Performance indicator	In business, these are used for evaluating specific goals and objectives.
Performance management system	Measurement system that includes targets and priorities & CSF.
Process	Sequence of interdependent and linked procedures which, at every stage, consume one or more resources to convert inputs into outputs.
Process Owner	Person who has the ultimate responsibility for the performance of a process in realizing its objectives measured by key process indicators, and has the authority and ability to make the necessary changes.
SC operations	Operations activities related to the supply chain department.
Strategic	Decisions or plans designed to impact favourably the key factors on which the desired outcome of an organisation game, system, venture, or war, depends.

Streamline	To improve the efficiency of a process, business or organization by simplifying or eliminating unnecessary steps, using modernizing techniques, or taking other approaches.
Sub process	One or more tasks that accomplish a significant portion or stage of a process.
Supply chain	Entire network of entities, from supplier of raw materials to end customer. Although in this thesis it mostly refers to the triadic entities, first tier supplier, SGSS, and first tier customer.
Support process	Activity or function that supports the day-to-day operations of an organization.
Tactical	Involving or pertaining to actions, ends, or means that are immediate or short-term in duration, and/ or lesser in importance or magnitude, then those of strategy or larger purpose.
Upstream/ downstream	The flow from raw material to the end customer is the downstream flow, and vice versa for upstream.

Appendix C – Measure explanation

Only the measures that are introduced by this study are explained. The explanations are meant to act as an inspiration source for further development and are not general definitions. The actual definition is a result of enablers and constraints by infrastructure, IT, and other factors that this study has not looked into.

Ability	Number of skills per employee, this will in a way also be a measure of flexibility in the organisation.
Adaptability	Measure the stability of the SCs profitability over longer time periods.
Agility	Measuring the relation between the number of satisfied short-term changes and number of short-term changes.
Alignment	The standard deviation of answers in a PEMM audit will reveal how aligned the organisation is. Alignment in the SC is measured via the cooperation and integration between partners.
Backorders	The number of orders that are waiting to be delivered because of stock outs or mean number of order that are queue.
Cash to cash cycle time	Calculate the time operating capital is out of reach for use.
Communication accuracy	Measure the number of times that a handover (object between processes) has to be corrected or is missing.
Costs for extra transports	The total cost of additional/ not planed/ not included in the invoice transports.
Customer complaints	Number of complaints and their severity.
Delay as result of communication	Measured in the number of times that an object/ handover is missing and causes a delay.
Ideas per employee	Number of ideas per employee.
Ideas that are realized	Number of realized ideas.
Innovative products	Ask customers.
Lead-time	The time from that an capacity plan for a certain forecast/order is finished to the time when the same order is delivered to the customer.
Lead-time accuracy	The number of times that a promised lead-time is not fulfilled or the deviation of a promised lead-time.
Moral	Define different levels of satisfaction and moral, e.g. according to Maslows hierarchy of needs and ask employees what they think.
Number of re-plans	The number of times that the production for a certain week and a certain production step is re-planed.
Number of technologies	The number of different production technologies that are available to customers.
Owner activity	According to PEMM.
Owner authority	According to PEMM.
Owner identity	According to PEMM.
Performer behaviour	According to PEMM.
Quality products	Ask customers.

Reliability	Ask customers.
Response time	Measure the cycle time for order fulfilments.
Service & Commitment	Ask customers.
Service level	The most accurate way to measure service levels is either by measuring the proportion of demand that can be satisfied from stock or the proportion of time that stock is positive.
Stock levels	Level of stock in raw material and/ or finished goods.
Traffic congestion	Compare predetermined normal delivery times with actual delivery times.
WIP	The level of partially finished goods that are not in raw material inventory or finished goods inventory.

Appendix D – Managing with the performance management system

These management examples are based on Mukherjee and Pandit (2009):

1. Targets, measures and KPIs are renewed and adapted to corporate strategy once a year. They are then, with a top down approach, translated to operational targets and goals. It's appropriate to use the development of a measurement system cycle, figure 16.

2. Measures are followed up once a month by top management and more frequently in operations. . It's appropriate to use the measurement cycle that's presented by Ljungberg and Larsson (2012) for this purpose.

3. The BSC measures are presented on a dashboard where everyone can see the measures on a daily basis. The measures are visualized with a Du-Pont like structure that shows how the different OPI and KPI interact and affect each other, see figures 26 & 27.

4. Continuous improvement cycles and agreement on tools and techniques are agreed according to the WCM temple and process map.

5. Separate measures into different levels of priority[136], for example CSFs and others, see tables 6 & 7 for priority development. Keep in mind to not use to many measures that will undermine the importance of the measures that matter.

6. Measures that are within 99% of the target value or higher are marked with green, measures that are in between 90 -99% from the target are marked with yellow, measures that are beneath 90% of the target value are marked with red. (This is only an example, PPM for instance should have other boundaries).

7. KPI measures have a more narrow percentiles scope for green, yellow and red, it's determined by management.

8. KPI's are broken down to CSFs, OPIs and action plans for all employees.

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[136] Hill and Hill (2007)

Appendix E – Organisation; Structure

Corporate Parent
- Operations in 64 countries
- Sales € 42.116 Billions
- Nearly 195 000 employees

Divisions
- 11 General Delegations, geographical specializations
- About 50 activities
- 1 000 + consolidated companies

Business Unit Specialization
- Sales € 9.7 Billions
- Nearly 61 000 employees

Business Units
- Operations in 41 countries
- Sales € 5.5 Billions
- Over 34 000 employees

Markets
- Operations in 22 countries
- Sales € 1.9 Billion
- About 12 100 employees

Internal organization at SGSS in Eslöv
- Sales € 550 Millions
- About 150 employees

Functions

Regional specializations

Internal SC functions

Chart elements:

- Saint Gobain Group SGG
- Innovative Materials | Construction Products | Building Distribution | Packaging Verallia
- Flat Glass | High-Performance Materials
- Saint-Gobain Glass SGX | Saint-Gobain Solar SGX | Saint-Gobain Sekurit SGSI | Glassolutions SGX
- SGS Scandinavia SGSS | Other global SGS units SGSX
- CEO
- Finance | HR | Quality | Logistics & IT | Commercial | Technology & Production
- SC & Distribution | Service center GBG
- Internal Logistics – Planning/Supply | Internal Logistics – Inbound handling | Customer service/outbound handling

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137 SGG presentation March 2012, SG innovative materials presentation 2012, and SG annual report 2011.

Appendix F – Organisation; Processes
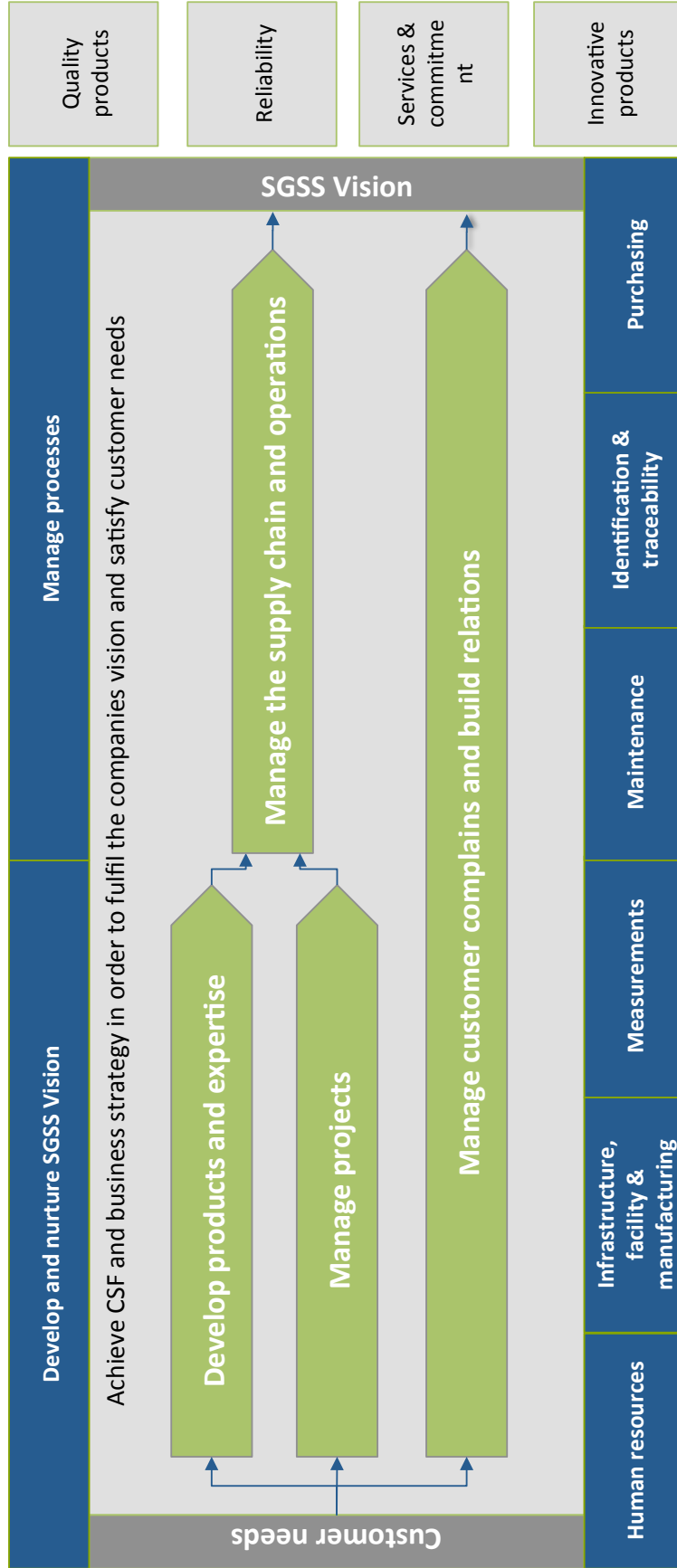
Appendix G – PEMM questionnaire and answers

Mätning

Syfte

Answers - 1 2 3 4 5

Processen har utformats från början till slutet. Chefer använder process organisations-designen i första hand som ett hjälpmedel för prestanda-förbättring.

Processen har gjorts om från början till slut för att optimera dess prestanda.

Sammanhang

Processernas ingångar (det som aktiverar processen/ något slags behov), utgångar (det som processen levererar, t.ex produktionsorder, plocklista), leverantörer och kunder har identifierats.

Kundernas behov och krav på processerna är kända och överenskomna.

Dokumentation

Dokumentationen av processen är främst funktionell, men den identifierar kopplingar mellan de organisationer som deltar i genomförandet av processen.

Det finns en "början till slut" dokumentation av processens design.

Utövare

Kunskap

Utövare kan namnge den process som de utför och identifiera nyckeltal i dess prestanda.

Utövare kan beskriva processens totala flöde, hur deras arbete påverkar kunder, övriga anställda i processen och processens prestanda, samt nödvändiga och faktiska prestandanivåer.

Kompetens

Utövare är skickliga i problemlösning och tekniker för processförbättring.

Utövarna är skickliga i lagarbete och tar eget ansvar.

Beteende

Utövare har en viss grad av lojalitet till processen, men känner sig i första hand lojala till deras funktion(ex. Logistik & IT, Produktion, osv.).

Utövare försöker följa processdesignen så att den utförs på rätt sätt, och arbetar på ett sätt som gör det möjligt för andra anställda som utför samma process att utföra sitt arbete på samma sätt.

Ägare

Identitet

Processens ägare är en individ eller en grupp informellt tillsatta i syfte att förbättra processens prestanda.

Företagets ledning har skapat en officiell processägare-roll och har fyllt den positionen med en chef som har inflytande och trovärdighet.

Aktivitet

Processens ägare identifierar och dokumenterar processen, som sedan kommunicerar informationen till alla som utför processen och är delaktiga i mindre förändringsprojekt.
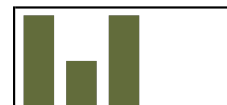
Processens ägare informerar andra inom organisationen om processens resultat och vilka mål som finns i framtiden. Processens ägare ser även till att främja förbättrings-arbete och förändringsarbete; ägaren planerar genomförandet av, och säkerställer att förändringarna överensstämmer med processens design.
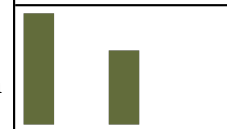
Auktoritet

Processens ägaren utövar påtryckningar av förändringar till fördel för processen, men kan bara uppmuntra funktionella/avdelnings chefer att göra förändringarna.

Processens ägare kan sammankalla ett team för genomförande av förändringar i processenoch kan implementera förändrignar, samt har viss kontroll över kostnaderna av förändringarna.

Infrastruktur

Informationssystem

Ett IT-system stödjer processen.

Ett IT-system konstruerat genom funktionella komponenter stödjer processen.

HR system

Funktionella chefer belönar funktionella kunskaper och lösningar av funktionella problem i ett process sammanhang.

Processens design är utgångspunkten för definitioner av roller, arbetsbeskrivningar och utveckling av kompetens profiler. Arbetsträning är baserad på processens dokumentation.

Mätning

Definition

Processen har vissa grundläggande kostnads- och kvalitéts-mätningar.

Processen har en process-mätning från input till output som grundas i kundens behov.

Användare

Chefer använder processens mätningar för att analysera processens prestanda, identifiera orsakerna till felaktigt utförande, och för att bedriva funktionella förbättringar.

Chefer använder processens mätningar för att jämföra processens prestanda i jämförelse med andra företag för se om den är konkurrenskraftig på internationell nivå. Mätningarna används även i jämförelse mot kundkrav och för att bestämma processens mål i prestanda.
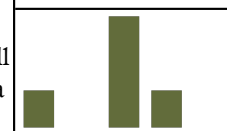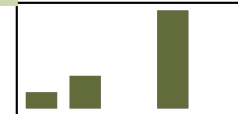
Ledarskap

Medvetenhet

Företagets ledning känner till behovet av att förbättra verksamhetens effektivitet men har endast en begränsad förståelse för begreppet processorienterad verksamhet.

Åtminstone en högt uppsatt chef har en djup förståelse för konceptet "processorienterad verksamhet", dvs hur företaget kan använda konceptet för att förbättra företagets effektivitet och vad som krävs för att genomföra det.
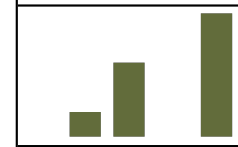
Orientering

Ansvaret för processprogrammet ligger hos en mellanchef.

En högt uppsatt chef har tagit ledning och ansvar för utveckling av processorintering i företaget.

Beteende

En högt uppsatt chef stödjer och investerar i operativa förbättringar.

En högt uppsatt chef har offentligt satt upp höga prestationsmål i termer av kundbehov och är beredd att tillsätta resurser och göra stora förändringar genom att ta bort "vägspärrar" för att uppnå dessa mål.
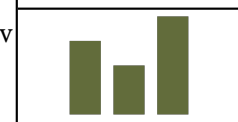
Stil

Ledningen har börjat gå ifrån en top-down (hierarkisk) organisation till en mer öppen och samarbetsvillig organisation.
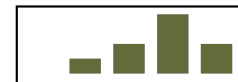
Ledningen som leder process-utvecklingen är passionerade för behovet att förändra och för "processen" som anses vara det viktigaste verktyget för förändring.

Kultur

Teamwork

Lagarbeten är projekt fokuserade, tillfälliga och olika till utformning.

Företaget använder ofta tvärfunktionella projektteam för förbättringsarbetet.

Kundfokus

Det finns en utbredd förståelse för att kundfokus är viktigt men en begränsad förståelse för vad det innebär. Det finns också osäkerhet och oenighet om hur man ska möta kundernd behoven.
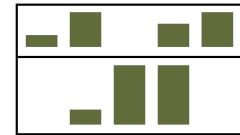
Anställda inser att syftet med deras arbete är att leverera utomordentligt kundvärde.
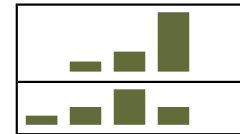
Ansvar

Ansvaret för resultat ligger hos chefer.

Anställda som syns utåt, t.ex. leveransbevakare eller projektingenjörer, börjar ta ansvar för resultaten.

Attityd mot förändringar

Det finns en växande acceptans i företaget för behovet av att mindre förändringar.

Anställda är beredda på betydande förändringar i deras arbetsmetoder.

Expertis

Personer

En liten grupp anställda har en djup förståelse för betydelsen av processerna.

Finns en kärna av expertis i företaget som har kompetens inom radikala förändringar av processer och genomförandet av förändringarna, projektledning, kommunikation och ledning av förändringar.
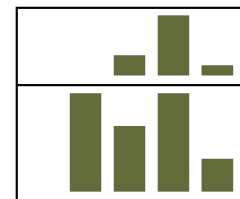
Metodik

Företaget använder en eller flera metoder för att lösa problem som berör operativa förendringar och för att bedriva stegvisa processförbättringar.

Ansvariga för radikala förändringar i processerna har tillgång till en grundläggande metodik för utförandet.
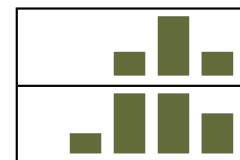
Styrning

Processmodell

Företaget har identifierat vissa verksamhetsprocesser.

Företaget har utvecklat en komplett modell över företagets processer som ledningen har accepterat.

Ansvarsskyldinghet

Funktionella chefer ansvarar för prestanda och är projektledare för förbättringsprojekt.

Processägare har ansvar för deras enskilda processer samtidigt som en styrningscomitee är ansvarig för företagets övergripande framsteg med processer.
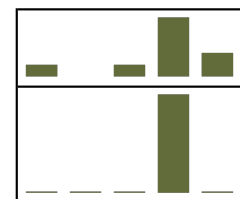
Integration

Det finns en eller flera grupper som förespråkar och stödjer eventuella och distinkta operativa förbättrings tekniker.

Ett informellt samordningsorgan tillhandahåller behövande utveckling av processer medans en styrgrupp allokerar resurser för process-utvecklingen
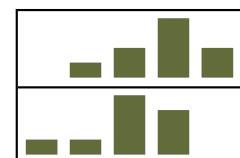
Appendix H – Mapping guide

Interview Guide

Purpose:	
Mapping Level:	
Focus:	
Goals:	
Interviewee:	
-Position:	
-Company:	
Approach:	
Date:	DD-MM-YYYY
Recording (J/N):	
-Recording ID:	REC [Same as Interview ID]
Duration:	
Interview ID:	[Company unit abbreviation].[Mapping level].[Interview nbr.]

Context/ supporting information

| Process mapping procedure	1. Define the process purpose and its starting and ending points.
	2. Define the different hierarchical levels of the map and select the level that is being mapped.
	3. Brainstorm the process all eventual activities and putt them on post it notes. Focus on what is done and not how.
	4. Arrange the activities in the correct order.
	5. Putt together and add activities.
	6. Define object in and out of every activity. Make sure that every activity is connected to another activity through an object.
	7. Ensure that al activities are on the same hierarchical level and that they have appropriate names.
	8. Iterate steps 4 to 7 until a satisfying map is obtained.

Figure 1, process-mapping procedure.
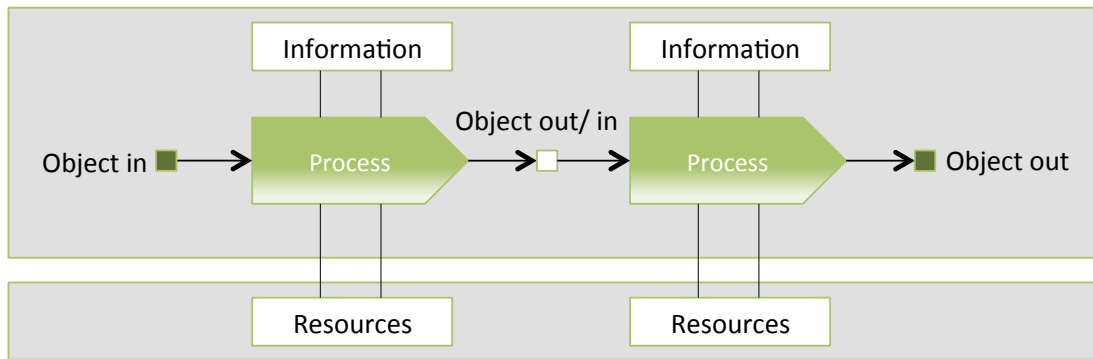
Figure 2, process model.

- *Object in* activates the process and is some type of a need.
- *Object out* is what the process delivers i.e. its result.
- *Object out/ in* are also interfaces between different processes.
- *Information in,* is of steering or supporting character that doesn't trigger the process.
- *Information out,* is a deliverable of the process that does not represent its main result.
- *Resources* are employees' and/ or consultants etc. that perform the process, but also machinery, computers, programs etc.

Opening questions
1. What is it that you do?
2. What are the main processes that you are a part of?
3. What are the greatest challenges that you and the SC at SGS face in the near/ and long term future?

Key Issues
1. What is the purpose of the process/ how would you describe it?
2. Would you like to describe the main processes, i.e. the main process steps?
   a. What are the interfaces in-between the processes?
3. What are the names of the responsible people for all the processes mentioned above?
   a. In what functions do they belong?
4. Have you identified any problems in processes, and if Yes, what problems?

Summary

Appendix I – Third level process map

Three maps are developed in this study. Except from the core map that is seen in the document, see figure 19, and this map, a third map was developed that contains specifications such as information, resources and definitions. That information is although considered confidential and is therefore not included in the thesis.
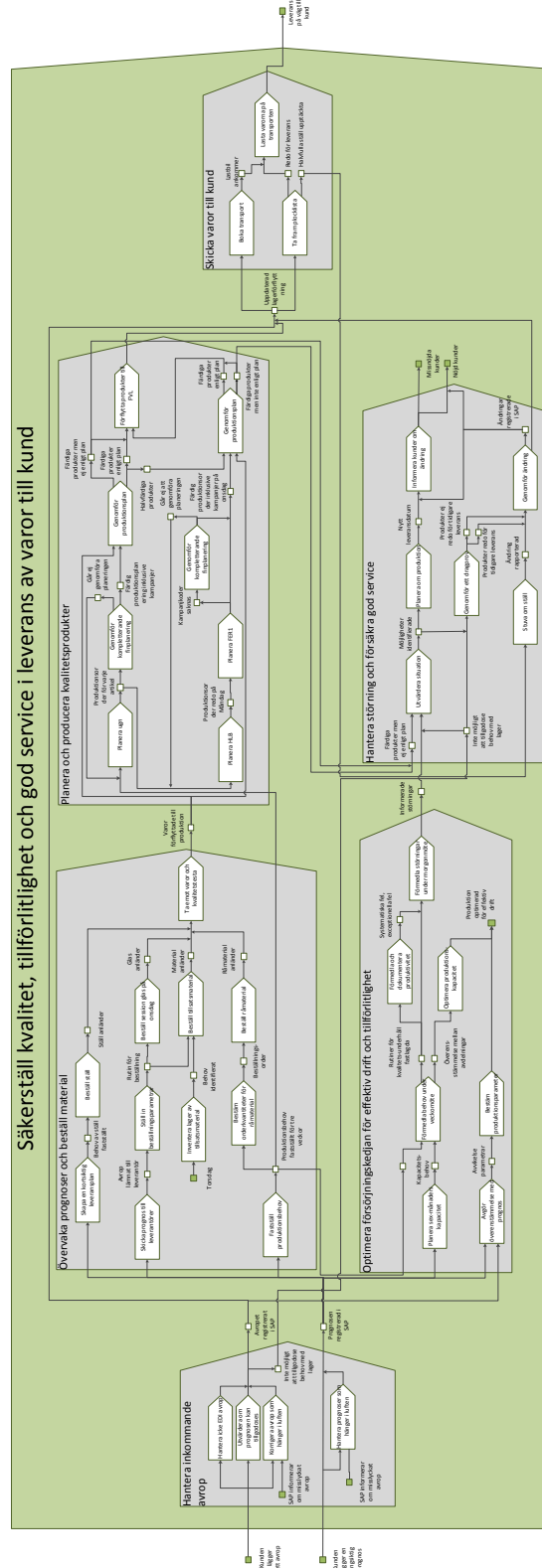
Appendix J – Benchmarking enabled

"Benchmarking enabled," implies that performance management systems and process maps are prerequisites for benchmarking. In order to make benchmarking possible, it's necessary to identify, map, measure and understand processes.[138] Benchmarking on the other hand is a prerequisite for determining appropriate targets, or as some call it: the performance gap for the performance management system.[139]

Benchmarking is used both in a reactive way to counter threats and in a proactive way to exploit opportunities. The proactive side is more difficult and at the same time necessary if the business is growing. It's also important to recognize that benchmarking is not only about comparing measure to measure, instead effective benchmarking is 20% measures and 80% best practice.[140] Companies need to asses themselves against externally derived standards and these can be identified from a number of different company classifications, including:[141]

- ➢ Other parts of the same company – i.e. internal benchmarking
- ➢ Direct competitors
- ➢ Companies in the same industrial sector but not direct competitors
- ➢ Latent competitors
- ➢ Companies outside the industry

Benchmarking can further focus on four different areas of the organization, namely: process, function, performance and strategy. This study is focused on benchmarking processes and performance and therefore it's those two areas that are of interest for benchmarking. Although, process mapping is "only" a means for achieve performance management and so the only actual area of interest is benchmarking performance. A 12 phase, 54-step benchmarking process has been recommended by Kodali and Anand (2008), see figure below, as a result of benchmarking 35 different benchmarking models from consultant firms, academia and organisations.
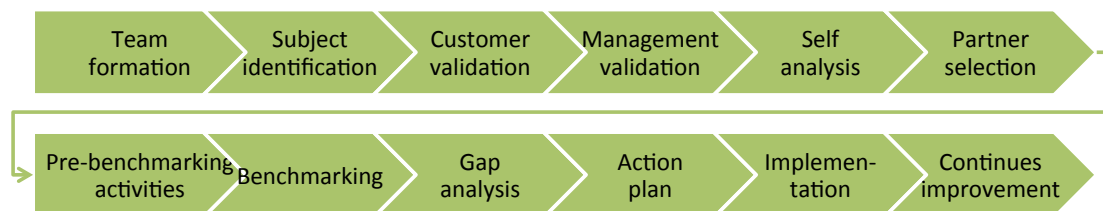
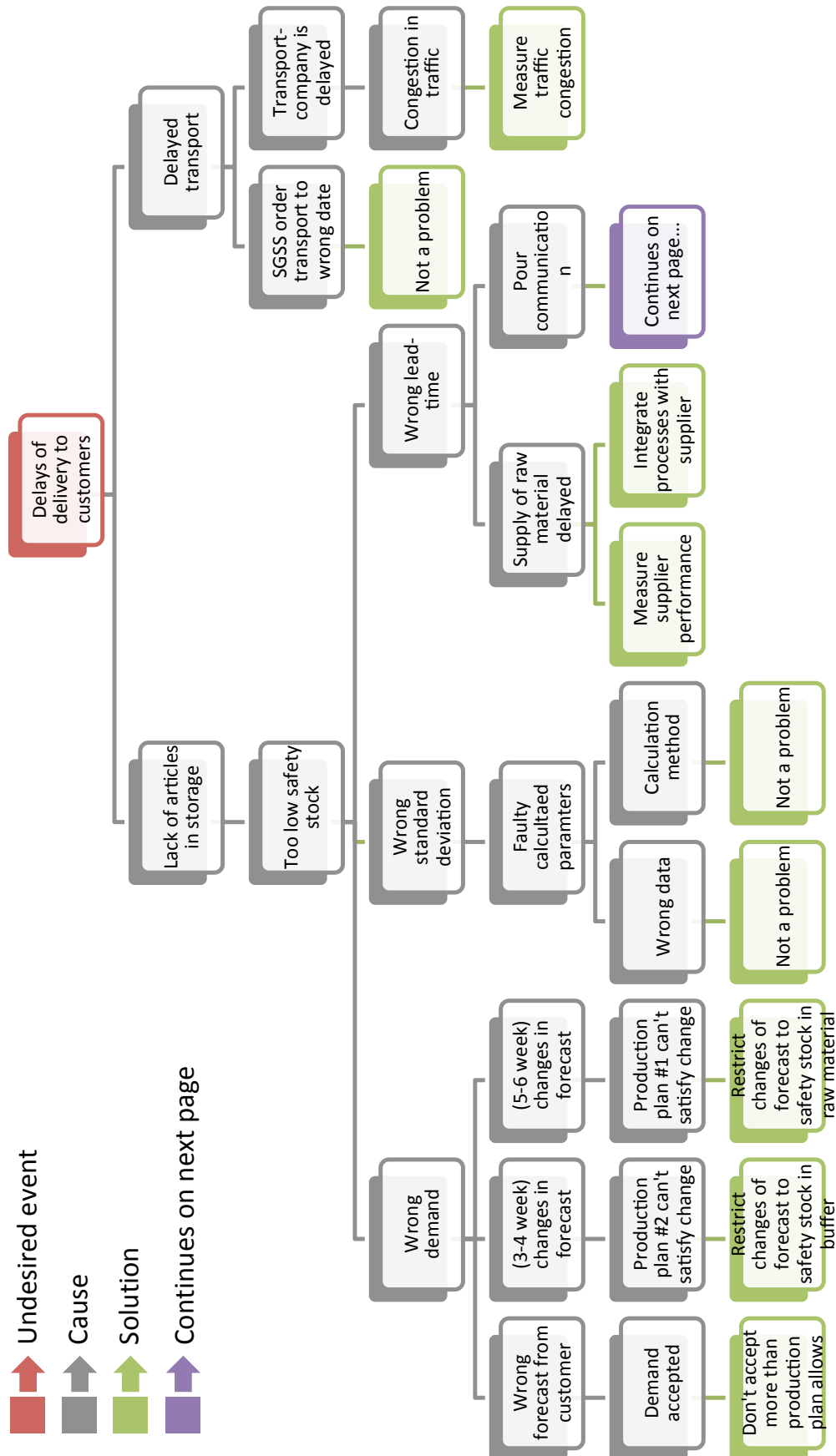12 phases of Kodali and Anand (2008), benchmarking process.

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[138] Ljungberg and Larsson (2012)
[139] Zairi (1998)
[140] Zairi (1998)
[141] Hill and Hill (2007)

Appendix K – Fault Tree analysis

Legend:
- Undesired event
- Cause
- Solution
- Continues on next page

Delays of delivery to customers

Delayed transport
- Transport-company is delayed
  - Congestion in traffic
    - Measure traffic congestion
- SGSS order transport to wrong date
  - Not a problem

Lack of articles in storage
- Too low safety stock
  - Wrong lead-time
    - Pour communication
      - Continues on next page…
    - Supply of raw material delayed
      - Integrate processes with supplier
      - Measure supplier performance
  - Wrong standard deviation
    - Faulty calcultaed paramters
      - Calculation method
        - Not a problem
      - Wrong data
        - Not a problem
  - Wrong demand
    - (5-6 week) changes in forecast
      - Production plan #1 can't satisfy change
        - Restrict changes of forecast to safety stock in raw material
    - (3-4 week) changes in forecast
      - Production plan #2 can't satisfy change
        - Restrict changes of forecast to safety stock in buffer
    - Wrong forecast from customer
      - Demand accepted
        - Don't accept more than production plan allows

XXII