



LUND UNIVERSITY

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*Department of Industrial Management and Logistics*

*Division of Production Management*

## **Process for Developing (Sealing) Sub Systems**

**- An Analysis of the New Product Introduction Process at  
Sealing Technology, Tetra Pak**

Lund, 2012-02-28

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## **Preface**

This master thesis was written during the winter of 2011/2012 as the final part of my, almost five year long, master's degree in Mechanical Engineering at Lund University, Faculty of Engineering. Process orientation, process management and process improvement are new and central ideas in today's businesses. It has been interesting to have had the opportunity to see how a worldwide company works with these matters. The experience has been exciting, intensive and, most of all, fun. I hope that the reader will be able to learn from my effort.

I would like to express my gratitude to my supervisors for providing me with expertise and support. First of all thank you Henrik Widestadh, supervisor at Tetra Pak, for your kindness and guidance during, not only this thesis, but throughout the last years of my education. Thank you Bertil I Nilsson, supervisor at Lund University, Faculty of Engineering for your time and meaningful advice. Your comments, I think, influenced my work and contributed to a better outcome.

Lund, 2012-02-28

Charlotte Carlquist



## **Abstract**

**Title** Process for developing (Sealing) sub systems – *an analysis of the New Product Introduction process at Sealing Technology, Tetra Pak.*

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**Background** Sealing Technology is a function under Key Competences at Tetra Pak that develops integrated end-to-end sealing solutions. Quality improvement is on the agenda and has been on the agenda for a couple of years. The importance of process management has been acknowledged, and a process for developing (Sealing) sub systems has been established. There is a need to evaluate the process map and the process as well as provide plans for how to assure the process quality.

**Purpose** The purpose of this master thesis is to understand the New Product Introduction process and evaluate it, find potential improvement areas and suggest further efforts to ensure the quality of the process. Recommendations of efforts and how to continuously improve will be presented.

**Method** A Systems approach was used to comprehend the complex situation and to guarantee a holistic view of the studied settings. The data was mainly qualitative and four different methods for gathering data were used: interviews, observations, literature review and content analysis. Based on the findings a review of the New Product Introduction process was made to meet the purpose of the project.

**Conclusion** The review of the New Product Introduction process has resulted in the conclusion that the New Product Introduction process describes an efficient developing process and it is an improvement of how the development was performed before the process was created. However, a part of the interviewed employees does not follow the new process, and this for different reasons. There is a gap between where Sealing Technology is at the moment and where they wish to be, and where the author visions them

to be in the future. Therefore areas of focus have been chosen to help Sealing Technology on their way to process excellence. The areas of focus are process orientation, objective and goal, implementation, process measurement and process evaluation and continuous improvements. These will be presented further and discussed in chapter 7, results and recommendations.

**Keywords**

Process Management, Process Measurement, Quality Management, Business Excellence, Change Management.

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# 1 INTRODUCTION

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*This first chapter is a background to the master thesis and will introduce the reader to the studied company, Tetra Pak, and also to the defined problem. The purpose of the thesis will be described followed by the focus and the delimitations and the target group. To conclude, the structure of the report is presented to provide the reader with an overview.*

## 1.1 Tetra Pak

Tetra Pak are specialists in complete solutions for the processing, packaging and distribution of beverage and food products and are present in more than 170 countries around the world.<sup>1</sup> In 2010 74000 million of litres were packed in 158001 million of Tetra Pak packages.<sup>2</sup> Tetra Pak 's vision describes what they are trying to accomplish:

*"We commit to making food safe and available, everywhere."<sup>3</sup>*

The solutions that Tetra Pak creates are designed to be as efficient with resources as possible. Dairy products, juices and nectars, ice cream, cheese, dry foods, fruits, vegetables and pet food are examples of products that can be processed or packaged in Tetra Pak processing and packaging lines. The Tetra Pak mission is:

*"We work for and with our customers to provide preferred processing and packaging solutions for food. We apply our commitment to innovation, our understanding of consumer needs and our relationships with suppliers to deliver these solutions, wherever and whenever food is consumed. We believe in responsible industry leadership, creating profitable growth in harmony with environmental sustainability and good corporate citizenship."<sup>4</sup>*

Tetra Pak core values, which have been a part of the spirit since the very beginning, form and shape the essence of the company culture and keep everybody together as a team and reaffirm what Tetra Pak stands for everywhere in the world. The core values provide an aspiration for the future and they are verbalized as<sup>5</sup>:

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<sup>1</sup> Tetra Pak International website. The company, retrieved 2011-10-03.

<sup>2</sup> Tetra Pak International website, Facts and figures, retrieved 2011-10-03.

<sup>3</sup> Tetra Pak International website. Vision and mission, retrieved 2011-10-03.

<sup>4</sup> Ibid.

<sup>5</sup> Tetra Pak International website. Core values, retrieved 2011-10-03.

### ***Customer focus & long-term view***

*We ensure we add value and inspire our customers because we recognize that they come to us by choice. We dare to lead with a focus beyond tomorrow and take opportunities to learn and grow.*

- ***Quality & innovation***

*We do not compromise on quality. We relentlessly drive for better, fit-for-purpose solutions and breakthrough innovations.*

- ***Freedom & responsibility***

*We have a freedom to take initiative and act decisively in the best interests of Tetra Pak and our customers. We take responsibility for our actions and contribute to the communities in which we operate.*

- ***Partnership & fun***

*We respect and rely on one another and all our stakeholders for exceptional results. We enjoy working together and celebrating our achievements.*

### **1.1.1 Sealing Technology**

Sealing Technology is a function under Key Competences, Packaging Technology, Development & Service Operations at Tetra Pak. It is one of three key competences; the other two are Aseptic and In-line Plastic Moulding Technologies.

Sealing Technology has around 50 employees that are situated in Lund, Sweden and Modena, Italy. The function is divided into four groups: Sealing Systems, Induction Heating, Sealing Integration and Ultra Sonic & Impulse Sealing, each group with an own manager. The function is a provider of integrated, end-to-end sealing solutions to Development & Service Operations. Sealing Technology has the ownership of:

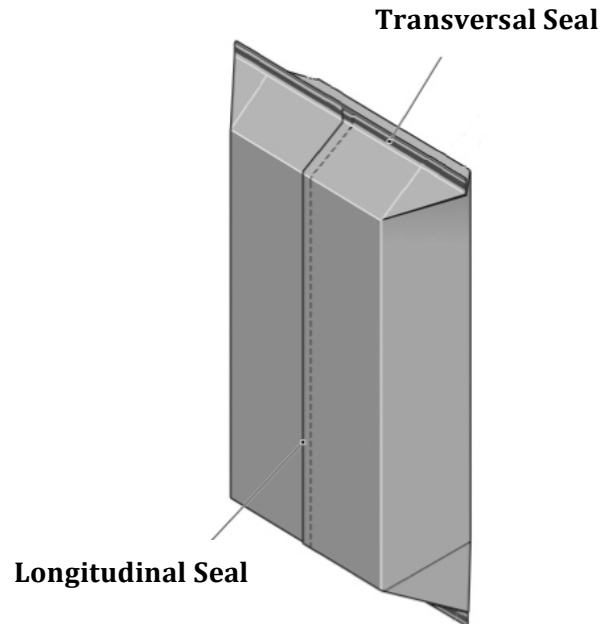
- *Sealing process parameters*
- *Sub-system and components specifications*
- *Sub-system and components validation & verification*
- *Manufacturing process specifications*
- *Quality and issue resolution*

The sealing of packages is usually done with an inductor, generating a magnetic field, creating heat that together with power seals the package. Every package is sealed transversally and longitudinally; the two seals are named transversal seal and longitudinal seal, they are presented in figure 1.<sup>6</sup> This method has been used for several years. For every change, in for example package size or machine configurations; a new inductor needs to be developed and often other components such as generators, transformers and dollies needs to be delivered together with this inductor. The process of developing inductors and other sealing components is

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<sup>6</sup> Tetra Pak Internal, Book of Competence.

very complex. Quality deviations on inductors are considered too high and customers are affected by it.



**Figure 1. Longitudinal and transversal sealing.**<sup>7</sup>

Today, development of other technologies are on-going and in the future Sealing Technology hope to be able to deliver different sealing solutions and components, and these should fulfil customer requirements.

## **1.2 Problem Description**

A few years ago a project started at Sealing Technology, a quality project with the objective to decrease quality deviations on inductors. Root Causes and failure modes had to be understood to eradicate the problems.

During this project, which is still ongoing, the difficulty with not having a well-defined process was revealed. An initiative to map the process for developing (sealing) components/sub systems started but due to changes in the organization it was not until the beginning of the summer of 2011 that a process map was completed, the process is called New Product Introduction (NPI). A finding during this thesis was that everything was not in place when the process was introduced after the summer of 2011 and the situation at Sealing Technology has been very dynamic during the period of this thesis; the organization changed, a new process

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<sup>7</sup> Tetra Pak Internal, Book of Competence.

was introduced and continuous improvements regarding the process and process work were performed. This affected the thesis project and the problem description; therefore the author has divided the problem into two focuses, as presented below.

Sealing Technology understands the need of evaluating the process map, and consequently the first focus of this thesis was to evaluate the mapping process and the process map. The problem was divided into two questions:

- *How is development accomplished today, from need to delivered solution? Is this compliant with the NPI process?*
- *Can the existing process for developing (sealing) sub systems, the NPI process, be improved? How should these potential improvements be implemented?*

The conclusion that the NPI process map was comprehensive and correct was drawn from interviews; it describes a good way of how to develop (sealing) components at Sealing Technology, this will be described further in chapter 5 and 6. Therefore a second focus, or task was decided upon together with Sealing Technology management. The second focus was to evaluate the process, and find ways to assure the quality of it. The second focus is presented in the questions below:

- *How should Sealing Technology assure the quality of the NPI process?*
- *How should Sealing Technology work with the NPI process in the future?*

### **1.3 Purpose and Goal**

The purpose of this master thesis was foremost to explore and understand the process for developing (sealing) sub systems. This should include understanding the development of the process and the activities in the process. Secondly, Tetra Pak's and Sealing Technology's work with the NPI process should be examined and, together with a review of literature, recommendations of how to evaluate the process and continuously improve it will be provided. The goal of this thesis can be divided into three sub goals:

- *Understand the NPI process and process work at Sealing Technology*
  - *Understand today's development process*
  - *Understand the NPI process map and how it was created*
  - *Is there a gap between map and process?*
- *Develop an action plan for improving the NPI process and improving Sealing Technology's work with processes*
  - *How to close gap between reality and process map? (If such a gap exists.)*



- *How to secure the quality of the process and to continuously improve?*
- *What to do in the future?*

The recommendations for how to work with the NPI process and how to assure the quality of it should be provided in a report together with suggestions for further work to be done.

## **1.4 Focus and Delimitations**

This master thesis is limited to the processes inside of Tetra Pak and therefore other companies cannot use this thesis as a base for their own processes. Within Tetra Pak focus is on the NPI process in Sealing Technology, there will be no review of other processes in the company. Standard documents and other templates that are being used throughout the processes are not to be restructured or upgraded because this is not the focus of the thesis.

## **1.5 Target Group**

The group of which this thesis addresses is foremost managers and personnel working at Sealing Technology, Tetra Pak. However personnel from other development departments at Tetra Pak can also find the thesis interesting. It is also relevant for students at Faculty of Engineering, Lund University and it can be relevant for other manufacturing companies, but the fact that not everything is applicable for them must be pointed out.

## **1.6 Structure of the Thesis**

The thesis has a structured layout and all the chapters are introduced with a concise summary of the content, to simplify for the reader and provide better understanding. The structure of the thesis is displayed below.

<b>Introduction</b>	The opening chapter presents the background of the study, the research questions, the purpose of the thesis and the structure of the report.
<b>Methodology</b>	This chapter provides a description of the chosen methodology that has been applied in this thesis. An explanation of different approaches of data collection can be found in this chapter. Different ways to evaluate the research will also be discussed.
<b>Frame of References</b>	A basis for the theoretical framework is presented in this chapter. Fundamental ideas and concepts are

described such as Process Management, process mapping, Process Measurements, Lean, ISO Standard, and Change Management.

**Empirics**

The empirical study is divided into two chapters, one descriptive and one covering reflections. The descriptive chapter reviews Tetra Pak's Global Management System and presents the Global Processes that Tetra Pak follows. Also, Sealing Technology's current development process, the NPI process, will be described comprehensively in the descriptive part, as well as what efforts has been done and will be done regarding this process. The other chapter discusses the reflections regarding the NPI process that was found during interviews.

**Analysis**

In the analysis chapter an analysis, based on both empirical study and the frame of references, of the current process is presented. The identified gaps, inefficiencies is analysed and the potential improvements are pointed out.

**Result and  
Recommendations**

This chapter is a summary of the thesis and the results. The areas of focus for improving the situation can be found in this chapter.

**Conclusion**

To conclude the thesis a discussion regarding the research and an evaluation of the research is provided. Also in the chapter suggestions for future work to be performed are presented and a conclusion ends the thesis.

## 2 METHODOLOGY

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*This chapter presents the research methodology that is used throughout the thesis and the choice of the methodology is motivated. Different data collection techniques are enlightened. A discussion regarding trustworthiness and authenticity of data concludes this chapter.*

### 2.1 Scientific Paradigms

The scientific approach of the researcher affects the choice of research methodology together with a number of other factors like the nature of the research question. To understand the result of a study it is essential to understand the researcher's scientific approach, i.e. the researcher's view of reality.<sup>8</sup> The reasoning for this project was that a case study of the processes for developing (sealing) sub systems at Tetra Pak requires a holistic view to achieve the right results. The different parts of the process, such as the activities, documents, personnel and resources must be examined as a system and therefore a systems approach was used. During the project there will be times when the system is studied from the inside and therefore the actor's approach will in some cases be used in combination with the systems approach. The next three sections will describe the three different scientific approaches, which were all studied to reach the conclusion of which one to use.

#### 2.1.1 Analytical Approach

The analytical approach suggests that there is an objective reality, in which causal relations and patterns can be studied and revealed through research.<sup>9</sup> The whole is equal to the sum of its parts.<sup>10</sup> The researcher should avoid influencing the researched object, and thus distorting the reality. Therefore the researcher must separate himself/herself from the research object to avoid this from happening. The objective is to uncover patterns and relations to find explanations, generalise the results and predict future incidents. The basic assumption is that the world can be analytically decomposed and that each concept can stand alone. Quantitative data analysis by means of statistical procedures is a method that is frequently used in this approach.<sup>11</sup>

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<sup>8</sup> Gammelgaard, B. 2004, "Schools in logistics research? A methodological framework for analysis of the discipline".

<sup>9</sup> Ibid.

<sup>10</sup> Arbner, I. & Bjerke, B. 1997, "Methodology for Creating Business Knowledge".

<sup>11</sup> Gammelgaard, B. 2004, "Schools in logistics research? A methodological framework for analysis of the discipline".

### **2.1.2 Systems Approach**

The systems approach states that the world must be understood in terms of mutually dependent components, as a system with parts, links, goals and feedback mechanisms. The sum of the parts does not equal the whole. Therefore splitting reality into parts is pointless. In systems approach the term “holistic” is used as opposed to “atomistic”, however within the boundaries of the system.<sup>12</sup> Knowledge depends on the system and the pursuit for an absolute truth is exchanged by the search for a resolution that works in practise.<sup>13</sup> The pragmatism of the systems approach suggests that the researcher should be very near the research object, to be able to make an impact on the system.<sup>14</sup>

### **2.1.3 Actor’s Approach**

This approach views the world completely different than the analytical and systems approach. The reality is not objective and the whole exists only as meaning structures, which are socially constructed and knowledge creation depends on the researcher’s interpretation.<sup>15</sup> The approach claims that it is unmanageable to make prediction built on external cause-effect-relations of social reality due to human beings’ intentionality. The ultimate objective is to understand and construct the future from within, the researcher being part of the research reality, and primarily via qualitative studies.<sup>16</sup>

## **2.2 Research Methodology**

Methodology is the basic working method that sets principles and structures for how a study is performed.<sup>17</sup> The existing amount of knowledge of the research object is of importance when choosing which type of study that will be carried out and on what level of ambition.<sup>18</sup> The levels of ambition and when they should be used are described in table 1.

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<sup>12</sup> Gammelgaard, B. 2004, “Schools in logistics research? A methodological framework for analysis of the discipline”.

<sup>13</sup> Arbner, I. & Bjerke, B. 1997, “Methodology for Creating Business Knowledge”.

<sup>14</sup> Gammelgaard, B. 2004, “Schools in logistics research? A methodological framework for analysis of the discipline”.

<sup>15</sup> Arbner, I. & Bjerke, B. 1997, “Methodology for Creating Business Knowledge”.

<sup>16</sup> Gammelgaard, B. 2004, “Schools in logistics research? A methodological framework for analysis of the discipline”.

<sup>17</sup> Höst, M., Regnell, B. & Runeson, P. 2006, “Att genomföra examensarbete”.

<sup>18</sup> Wallén, G. 1996, “Vetenskapsteori och forskningsmetodik”.

**Table 1. Level of ambition/strategy for research.**

<b>Level of Ambition</b>	<b>Description</b>
<b>Exploratory</b>	Exploratory, investigating, studies are conducted when there is little knowledge in the field and when trying to find basic understanding. <sup>19</sup>
<b>Descriptive</b>	Descriptive studies are used when basic knowledge and understanding of the area is acknowledged and the goal is to describe but not explain the relationships that exist. <sup>20</sup>
<b>Explanatory</b>	Explanatory studies are performed when looking for deeper knowledge and understanding and when both explanation and description of a field are required. <sup>21</sup>
<b>Improving/ normative</b>	Normative studies are executed when there is already knowledge and understanding within the research area and the goal is to provide guidance and actions for improvement. <sup>22</sup>

This study will aim at being at a level of ambition that is exploratory but when understanding of the “as-is” process is obtained the project will go in to a second phase where the level of ambition will be more improving/normative and where potential improvements and guidance for future will be reviewed.

### **2.2.1 Strategy of Research**

This master thesis follows a time plan that was created to make sure that all parts of the project will be covered. A timeline from project specification to conclusion is presented in figure 2. In the diagram the different phases of the project overlap each other, to show that they are not done in isolation, rather they build on each other. There is an interrelation between the phases, which is not illustrated in the diagram. This means that even though one phase is over they are all still connected, for example findings in literature review will be used in the analysis, and also during the interviews and so on.

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<sup>19</sup> Wallén, G. 1996, “*Vetenskapsteori och forskningsmetodik*”.

<sup>20</sup> Ibid.

<sup>21</sup> Ibid.

<sup>22</sup> Ibid.

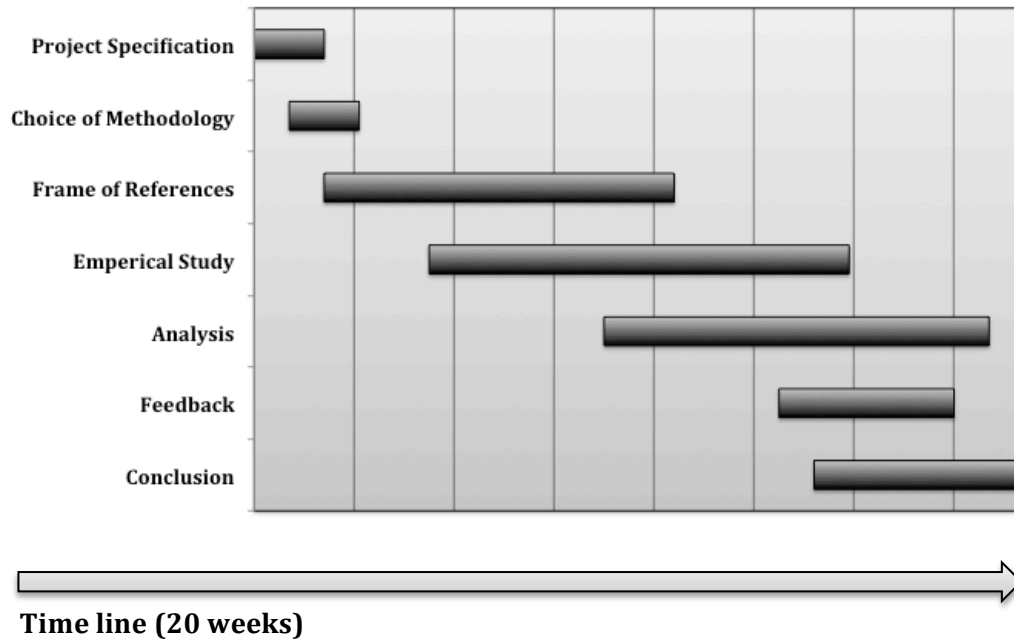


Figure 2. Time line containing the seven phases of the master thesis.

### 2.3 Data Collection

There are many different sources of information that can be used in research.<sup>23</sup> According to Frankel et al. eight frequently used methods for collecting data are; interviews, surveys, observation, focus groups, case studies, experiments, literature reviews, and content analysis. These methods for collecting data is suited for different research issues, there are not one particular technique that is superior to another. To acquire good trustworthy data that is essential for a successful analysis a mixture of different sources of information is preferred.<sup>24</sup> The different techniques of gathering data can be used in combination to complement each other.<sup>25</sup>

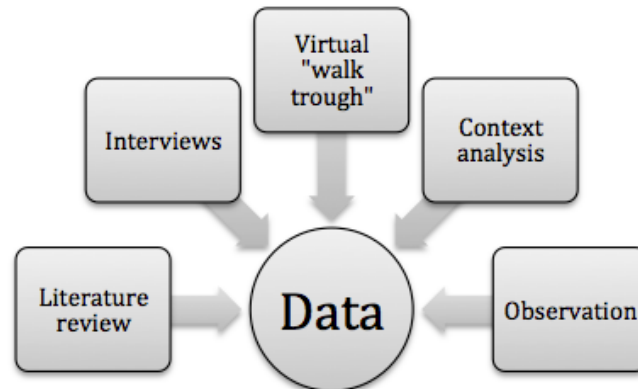
Four methods for collecting data have been used during this thesis to complement each other and to get a good base for analysis; this is illustrated in figure 3. The methods that foremost will be used are interviews, observations, literature reviews and content analysis. They fit the research question and were possible to conduct. A conclusion drawn from several sources of information is stronger than a conclusion

<sup>23</sup> Höst, M. & Runeson, P. 2009, "Guidelines for conducting and reporting case study research in software design".

<sup>24</sup> Ibid.

<sup>25</sup> Frankel, R., Näslund, D. & Bolomole, Y. 2005, "The "White Space" of the Logistics Research: A look at the Role of Methods Usage".

based on a single source.<sup>26</sup> During the literature review of process redesign and process improvement other methods for collecting data was suggested, see Section 3.7.2. The method of interviews/virtual “walk trough” will be used in combination with interviews. Data will be gathered from the personnel performing the process, they will describe their part of the process and this is the objective of the interviews. In the coming sections the four methods for data collection will be discussed.



**Figure 3. The data collections methods used to create data.**

### **2.3.1 Interviews**

Interviews are often designed as personal meetings between an interviewer and respondent(s), but can cover a variety of formats. The benefits of interviews are that they are insightful and provide a perceived causal interference.<sup>27</sup> There are three different types of interviews, unstructured, semi-structured and fully structured. In an unstructured interview the interview questions are formulated as general concerns and interests from the researcher.<sup>28</sup> The conversation is open, the interview provides a “depth” and the object is to uncover the underlying beliefs, attitudes, and feelings on a topic.<sup>29</sup> The opposite of this is the fully structured interview where the questions are clearly formulated in the same order for all the respondents. It is similar to a questionnaire-based survey. A semi-structured

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<sup>26</sup> Höst, M. & Runeson, P. 2009, “Guidelines for conducting and reporting case study research in software design”.

<sup>27</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, “The “White Space” of the Logistics Research: A look at the Role of Methods Usage”,

<sup>28</sup> Höst, M. & Runeson, P. 2009, “Guidelines for conducting and reporting case study research in software design”.

<sup>29</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, “The “White Space” of the Logistics Research: A look at the Role of Methods Usage”,

interview is planned, with questions, but it is not essential that all questions are asked and be followed in the same degree as in a fully structured interview.<sup>30</sup>

The format of the first interviews during this thesis were unstructured to assure a depth, provide a good understanding of the processes and uncover what the respondents really had to say without any influence. The person being interviewed described the part of the process he or she is involved in and provided information about unnecessary activities, and improvement opportunities. If a second round of interviews were performed in a semi-structured way to assure that missing information was brought up and discussed. Feedback on the conclusions was made in a structured interview to all the respondents. The respondents for the interviews were chosen in consultation with managers at Sealing Technology, to assure that important employees and key persons from all parts of the development process were represented. In addition to this, some interviews have been performed that were not planned from the beginning, but that were required to understand other parts of the organization. The respondents are listed in the references under interviews; names and positions of the respondents can be found there.

### **2.3.2 Observation**

Observations include documenting the behavioural patterns of people, objects, and events in a methodical way to acquire information about the phenomenon of interest. The observation records are often referred to as field notes. This method assumes that behaviour is purposeful and expressive of deeper values and beliefs. The observer's role can vary from complete observer to complete participant.<sup>31</sup> It is especially relevant to use observations where it is suspected that there is a deviation between the "official" view of matters and the "actual" case.<sup>32</sup> The observation process is sensitive for the risk that the observer's perception can be influenced by personal factors and beliefs; the collected data can differ depending on observer.<sup>33</sup>

To get a deeper understanding of some activities in the process some observations or virtual walk troughs has been conducted. The checkpoint meetings, also known as Release Forum, have been observed to see if and how they support the following of the process. A walk along the production line for inductors and dollies was performed to get an overview of the work being carried out there.

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<sup>30</sup> Höst, M. & Runeson, P. 2009, "Guidelines for conducting and reporting case study research in software design".

<sup>31</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, "The "White Space" of the Logistics Research: A look at the Role of Methods Usage",

<sup>32</sup> Höst, M. & Runeson, P. 2009, "Guidelines for conducting and reporting case study research in software design".

<sup>33</sup> Denscombe, M. 1988, "A Good Research Guide - for small-scale research projects".



### **2.3.3 Literature Review**

The review of literature contains a comprehensive analysis and systematic summary of other author's previously collected data, e.g. secondary data.<sup>34</sup> This data collection method has the advantage of gathering a great share of data within a short amount of time and with little economical resources. This is a way to review existing knowledge and theories concerning a specific area, however it is important to be aware of the fact that the information could be bias and not fully comprehensive.<sup>35</sup>

The study of literature was extensive and concepts regarding process management were identified. A review of several methods for process mapping, process improvement, process measuring and process analysis has been made. Furthermore, Lean production and Lean thinking has been studied to understand the essentials. To conclude, a review of the field change management was performed to understand the challenges of changing an organization and to be able to use this when recommending implementation of a new process. The search was done based on some key search words, such as, process mapping, process improvement, process redesign, process change, as well as Lean and change management. Known authors in the different fields were discovered and used as references, for example Michael Hammer and Paul Harmon in process change and John P. Kotter in change management.

### **2.3.4 Content Analysis**

Content analysis can provide a broad coverage of data over an extended time span through the study of documents, websites and archival records. The data sources can consist of published and unpublished documents, company reports, memos, letters and newspaper articles and so on.<sup>36</sup> Knowledge of the history and context surrounding a specific setting comes, in part, from reviewing documents. Documents from the past must be reviewed with some scepticism. The greatest strength of content analysis is that it is unobtrusive and nonreactive, it can be conducted without disturbing the setting in any way.<sup>37</sup>

Relevant Tetra Pak documents were reviewed, mainly regarding processes and assessment of processes, but also regarding the organization and the objectives and deliverables for Sealing Technology. The managers provided these documents. The internal websites were also studied, as well as the Product Quality Management

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<sup>34</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, "The "White Space" of the Logistics Research: A look at the Role of Methods Usage",

<sup>35</sup> Björklund, M. & Paulsson, U. 2003, "Seminarieboken – att skriva, presentera och opponera".

<sup>36</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, "The "White Space" of the Logistics Research: A look at the Role of Methods Usage",

<sup>37</sup> Denscombe, M. 1988, "A Good Research Guide – for small-scale research projects".

(PQM) system and Activity Planner (AP) that handles all activities regarding sealing components.

## **2.4 Qualitative or Quantitative Research Approach**

Research approaches vary from quantitative approach, which is the more scientific, objective one, to qualitative approach, which is the interpretive, subjective and more constructive style. There are advantages and disadvantages with both and usage of them should be based on the problem, because different research problems require different research approaches. When studying the processes of Tetra Pak from the inside, using data collection methods as observations and interviews, the major part of data will be qualitative. The structure of the data collection will be flexible, and not completely fixed from the beginning. This provided a deep understanding of the processes and therefore it is mainly a qualitative research approach that will be used, the two approaches are described in the following two sections.

### **2.4.1 Quantitative**

The quantitative research approach is designed to quantify the gathered data and subsequently statistically generalise it. The intention is to create new knowledge that can be added to existing knowledge and to disregard false hypothesis.<sup>38 39</sup> Examples of arguments for quantitative studies are that the results easily can be shown in diagrams and graphs, the reliance through the statistical calculations and the trustworthiness because the analysis is based on objective laws and not the researcher's value. Awareness of threats, like false pretences that can compromise the objectivity, is essential for good research quality, and to remember a good research require good quality of data.<sup>40</sup>

### **2.4.2 Qualitative**

Qualitative research approach allows the researchers to study social and cultural phenomena. The style is more subjective and it argues that the world is fundamentally relativistic and therefore one need to understand it from the inside, i.e. from the point of view of the individuals who are directly involved in the activities being studied.<sup>41</sup> Qualitative studies provide excellent and deep understanding and a holistic view because the data is formed from social settings and it considers the entire situation. Other explanations and contradictory results should always be reviewed to provide more credibility. Gathering and analysing of

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<sup>38</sup> Denscombe, M. 1988, "A Good Research Guide – for small-scale research projects"..

<sup>39</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, "The "White Space" of the Logistics Research: A look at the Role of Methods Usage".

<sup>40</sup> Denscombe, M. 1988, "A Good Research Guide – for small-scale research projects".

<sup>41</sup> Frankel, R., Näslund, D. & Bolumole, Y. 2005, "The "White Space" of the Logistics Research: A look at the Role of Methods Usage".

data should be done objective and not be affected by the researcher's personality and prejudices. Deficiencies with the qualitative research approach are the difficulties of determine whether a qualitative study can be generalised and the time consuming analysis.<sup>42</sup>

## **2.5 Data Analysis Approach**

When analysing data there are two approaches that are frequently used; the inductive approach and the deductive approach. There is also a third approach, an alternative to the other two and not that commonly used, called the abductive approach. This thesis is an observation of the processes for Product Development and Technology Development, together with the observation a literature review of process management will be deployed to make an analysis and to in the end suggests potential improvements. The approach used is an inductive approach in combination with the abductive approach. The following three selections presents the three approached that was the basis for this reasoning.

### **2.5.1 Induction**

An inductive approach suggests that gathered data is analysed in order to create a theory, which means the researcher concludes the implications of the findings for the theory that encouraged the whole exercise. The findings are fed back into the theory and the research findings associated with a certain area of analysis.<sup>43</sup> This approach has been criticised due to the fact that the theory will not include anything that is not in the empirical data, but the approach is however good when making an exploring study.<sup>44</sup>

### **2.5.2 Deduction**

With a deductive approach it is the other way around. The researcher, on the foundation of what is known in a particular field and of theoretical considerations in relation to that field, deduces a hypothesis that must then be subjected to empirical scrutiny. The scientist must transform the hypothesis into operational terms and also specify how data can be gathered in relation to the concepts that make up the hypothesis.<sup>45</sup>

### **2.5.3 Abduction**

Induction and deduction are combined to give a logical reasoning where existing theories are used for the analysis at the same time as the researcher can use the

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<sup>42</sup> Denscombe, M. 1988, "A Good Research Guide – for small-scale research projects".

<sup>43</sup> Bryman, A. 2008, "Social Research Methods".

<sup>44</sup> Wallén, G. 1996, "Vetenskapsteori och forskningsmetodik".

<sup>45</sup> Bryman, A. 2008, "Social Research Methods".

empirical data to find new relationships. Abduction is a way to draw conclusions about what is the cause of an observation. The problem is that there is no clear connection, however conclusions can be drawn from exclusion of factors, complemented with tests and examination through practical experiments. Abduction is not a method that can be used schematically; it requires experience in the area of the issue or experience of similar cases.<sup>46</sup>

## **2.6 Evaluating the Research**

In quantitative research two important criteria for evaluating and confirming quality is validity and reliability, but their relevance for qualitative research has been debated. Different writers have proposed that qualitative studies should be assessed by other criteria than the quantitative studies. Two major criteria has been suggested, these are trustworthiness and authenticity.<sup>47</sup> The evaluation of this research will be discussed further in chapter 8.

### **2.6.1 Trustworthiness**

The criteria trustworthiness is divided into four areas; credibility, transferability, dependability and conformability. Each of which has a corresponding criterion in quantitative research.<sup>48</sup>

#### ***Credibility***

When numerous possible versions of an aspect of social reality exist it is the credibility of the version that a researcher arrives at that is going to determine its acceptability to others. The creation of credibility involves both ensuring that research is carried out according to the principles of good practice and presenting research findings to the members of the social world who were studied for confirmation that the investigator has correctly understood this world.<sup>49</sup>

Triangulation and respondent validation are two methods for assuring credibility to a project and this is used in form of data triangulation, which means the use of different sources of data, and feedback for personnel during the analysis and conclusion of the project.

#### ***Transferability***

In qualitative research there is a depth rather than the breadth that exist in quantitative research. This could be an issue, but as long as the researcher provides

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<sup>46</sup> Wallén, G. 1996, "Vetenskapsteori och forskningsmetodik".

<sup>47</sup> Bryman, A. 2008, "Social Research Methods".

<sup>48</sup> Ibid.

<sup>49</sup> Ibid.

a solid description, which means large amounts of details of the studied object, others can make judgements about the possibility to transfer the research findings to other settings.<sup>50</sup>

This thesis has a strong focus on Tetra Pak's processes, and the analysis of these cannot be applied to any process. However, since the description of the processes is comprehensive as well as the description of improvements this can be of use to others to understand or improve their own processes.

### ***Dependability***

To assure dependability of qualitative studies researchers should undertake an "auditing" process, i.e. save records from all phases of research, in an accessible manner, to assure that outsiders can review the researchers work.<sup>51</sup>

Of course all data and information gathered is saved, not only for the reason that others should be able to take part of it but also for myself to be able to look back on the information gathered, which is necessary during a project that is on going for 20 weeks.

### ***Conformability***

Acknowledging that complete objectivity is difficult in social research, conformability is concerned with ensuring that it is obvious that the researcher has not allowed personal values to influence the performance of the research or the results deriving from it.<sup>52</sup>

During the period at Tetra Pak an open mind has been important for the purpose of the thesis. Personal values has not affected the research, instead some personal values of the employees at Sealing Technology have been heard regarding processes and this have been a basis for how work with processes should be handled to be as effective as possible.

## ***2.6.2 Authenticity***

Authenticity raises a set of matters regarding the wider political impact of research. These issues discuss if the research impartially represents different viewpoints, and furthermore if the members of the social setting are helped to attain an improved understanding by the research and better insight in the perspectives of other members. Additionally, it refers to if the research has encouraged the members of

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<sup>50</sup> Bryman, A. 2008, "Social Research Methods".

<sup>51</sup> Ibid.

<sup>52</sup> Ibid.

the social environment to participate in action and to inspire them to change their circumstances.<sup>53</sup>

There have been very different viewpoint of the process work being performed at Sealing Technology, and these opinions are presented and discussed in the thesis. Certainly this will allow the people to get a better understanding of the situation and what difficulties occur when people do not see things in the same way. This will help to comprehend what can be done to improve the situation.

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<sup>53</sup> Bryman, A. 2008, "Social Research Methods".

## 3 FRAME OF REFERENCE

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*This chapter is a summary of the studied literature of relevant areas. Foremost different methods for process management, process mapping and analysis are presented but the chapter also include information about, measurement of processes, the balanced scorecard, LEAN, ISO standards and change management.*

### 3.1 Process Management

Presently one of the most valuable characteristics of an organization is its ability to adapt to the dynamic setting in which it operates. Therefore organizations are forced to continuously evaluate their competitive position and to search for innovations and competitive advantages.<sup>54</sup> Implementing process management and process-oriented structures will help organizations to be more responsive to this increasing change.<sup>55</sup>

In recent decades, companies have been orientated to perform efficient execution of individual functions, which has led to a local optimization and perfection of functional areas. Local optimization, however, cause the interrelationships of the operational functions to retreat into background.<sup>56</sup> Rummler et al. announces that process management is the right way to look at an organization to be able to understand, at a sufficient level of detail, how the company produces value to the customers and other stakeholders.

The regularly used, “traditional” organization chart shows which people have been grouped together for operating efficiency and it shows reporting relationships, however it does not show what the organization do, for whom they do it or how they do it. An overview of the flow of work, the customer and the product is what process management provides an organization with. “Critical interfaces, which occur in the “white space” on an organization chart, become visible in the horizontal view.”<sup>57</sup> Figure 4 illustrates the management of white space between functions. The

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<sup>54</sup> Becker, J., Kugeler, M. & Rosemann, M. 2003, “Process Management A Guide for the Design of Business Processes”.

<sup>55</sup> Downs, D., Lindsay, A. & Lunn, K. 2003, “Business processes – an attempt to find a definition”.

<sup>56</sup> Becker, J., Kugeler, M. & Rosemann, M. 2003, “Process Management A Guide for the Design of Business Processes”.

<sup>57</sup> Rummler, G.A. & Brahe, A.P. 1991, “Managing the White Space”.

strengthening of a company in its totality and the reduction of existing interfaces require a focus on the cross-functional business processes.<sup>58</sup>

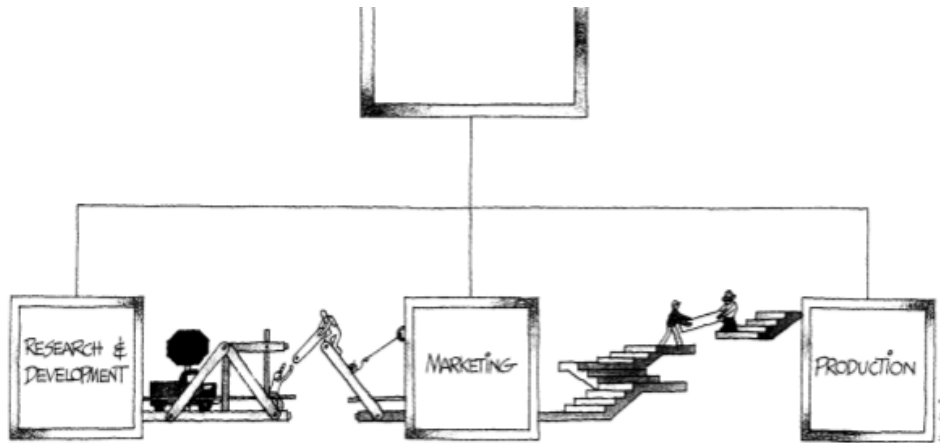


Figure 4. The managing of “white space” between functions.<sup>59</sup>

### 3.2 Processes

It is essential to understand the adequate nature of business processes when utilizing process management. Numerous definitions of what a process is exist; three of these are presented below.<sup>60</sup>

*“A process is a repetitive used network of activities linked in order and which uses information and resources to transform object in to object out, from identification to satisfaction of customer need.”<sup>61</sup>*

This first process definition contains the important elements of a process. From this definition a process can be compared to a road with clear start and end, from customer need to customer satisfaction. A road that crosses different areas of responsibility, functions. The definition also express the importance of adding information and resources to create value and transform object in to object out.

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<sup>58</sup> Becker, J., Kugeler, M. & Rosemann, M. 2003, “Process Management A Guide for the Design of Business Processes”.

<sup>59</sup> Rummler, G.A. & Brahe, A.P. 1991, “Managing the White Space”.

<sup>60</sup> Downs, D., Lindsay, A. & Lunn, K. 2003, “Business processes – an attempt to find a definition”.

<sup>61</sup> Ljungberg, A. & Larsson, E. 2001, “Processbaserad verksamhetsutveckling”.



*“A business process is a collection of activities that takes one or more kind of inputs and create an output that is of value to the customer. A business process has a goal and is affected by events occurring in the external world or in other processes.”<sup>62</sup>*

This is a second definition, which is very similar to the first one but here it is also stated that the external environment is affecting the process. The statement that the process goes from customer need to customer satisfaction is not as clear as in the first one, however there is a big emphasizes on that the process has a goal and that the output should create value for customers.

*“An activity or set of activities using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process.”<sup>63</sup>*

This third definition is quite short, and without knowledge of processes it is not as clear as the other two. The importance of understanding processes is crucial and how an organization defines a process is of significance because it is guiding the view upon process work, what is encompassed and what is excluded, what methods are being used and furthestmost what results are achieved.<sup>64</sup>

### **3.3 Process Orientation**

*“An organization that, in all its thinking, emphasises process as opposed to hierarchies with a special emphasis on outcomes and customer satisfaction.”<sup>65</sup>*

The quotation above is a description of a process-oriented organization. A process-oriented approach is of great importance to the success of any business.<sup>66</sup> It has become clear that all organizations are compounds of business processes, although not all businesses have a process view. Nevertheless, a process approach can be applied on any organization. Business process orientation represents the focus on business flow as it proceeds across an organization.<sup>67</sup>

The objective of process orientation is to adjust the function-orientated paradigm in the organization and thereby change to a process perspective on systems and structures together with attitudes, values and organization culture. Figure 5

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<sup>62</sup> Downs, D., Lindsay, A. & Lunn, K. 2003, “Business processes – an attempt to find a definition”.

<sup>63</sup> The Swedish Standards Institute. (SIS) 2008, “Svensk standard SS-EN ISO 9001:2008 – Ledningssystem för kvalitet – Krav (ISO 9001:2008)/Quality management systems – requirements (ISO 9001:2008)”.

<sup>64</sup> Ljungberg, A. & Larsson, E. 2001, “Processbaserad verksamhetsutveckling”.

<sup>65</sup> Urgan, M. 2006, “Towards a better understanding of process documentation”.

<sup>66</sup> Ibid.

<sup>67</sup> Skrinjar, R., Stemberger, M.I. & Hernaus, T. 2007, “The Impact of Business Process Orientation on Organizational Performance”.

illustrates how an organization goes from functional paradigm to process paradigm, and the relation between them and process-orientation. When a business adopts the process concept and applies the new way of thinking the benefits of it will come, however it is first when process orientation is fully used that an organization can benefit from all new perspectives and advantages within it.<sup>68</sup> Business process orientation represents the understanding of the business flow, but it is only the first step towards a process-based organizational structure. Process orientation is a broader term than the process organization, because an organization can reach a certain degree of business process orientation maturity without being strictly organized horizontally.<sup>69</sup>

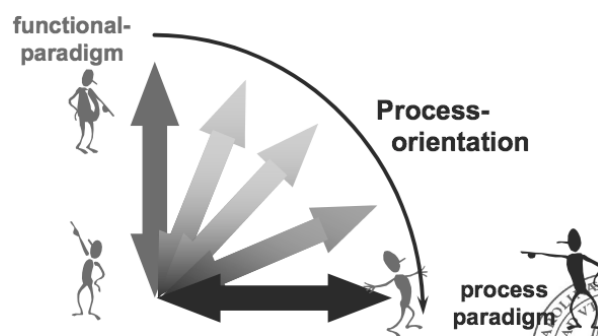


Figure 5. Process orientation – a change in paradigm.<sup>70</sup>

### 3.4 Process Identification

The identification and understanding of different types of processes is fundamental when developing and controlling processes. In literature there are three main types of processes that exist to be able to portray an organization in an appropriate way. What they are called can vary, but there are three names that are most commonly used; these three are core processes, support processes, also known as sub-processes, and management processes. These main processes are presented in table 2.<sup>71</sup>

<sup>68</sup> Skrinjar, R., Stemberger, M.I. & Hernaus, T. 2007, "The Impact of Business Process Orientation on Organizational Performance" ..

<sup>69</sup> Ugan, M. 2006, "Towards a better understanding of process documentation",

<sup>70</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>71</sup> Ibid.

Table 2. Types of processes.<sup>72</sup>

Type of Process	Description
<b>Core process</b>	These processes represent the most important value creating parts for the customer and give an overview of the organization.
<b>Support process (Sub process)</b>	These processes are not value creating themselves and not critical to the success of the company but are needed in order to support and make the core processes work as good as possible.
<b>Management process</b>	These processes are needed to control and coordinate the core and support processes.

### 3.5 Process Documentation

Good management of processes is very much dependent on how well they are comprehended. In turn, understanding of a process requires documentation. Process documents can be categorized into two: process maps and process flowchart/diagram. Process documents are very popular since they are practical tools for understanding, analysing, improving work processes and also for educating personnel. The realised ISO 9001:2000 standard requires that business processes important to product realisation be flowcharted or mapped.<sup>73</sup> Documentation of processes secures that the work in the process is performed in a uniform and established manner, if it is not already.

#### 3.5.1 Process Mapping

Process maps represent the events and sequences of activities of a process in a graphical illustration. The maps can be seen as a tool for reviewing or evaluating a process or parts of a process. The identification of how a process or current system operates is critical for identifying improvement opportunities.<sup>74</sup>

If using process mapping four major benefits can be obtained. First, a holistic view that helps understand interrelationships between processes will be obtained. Second, it gives all employees, from managers to line-personnel, buy-in to the finished product. Third, it helps employees to understand how their work adds

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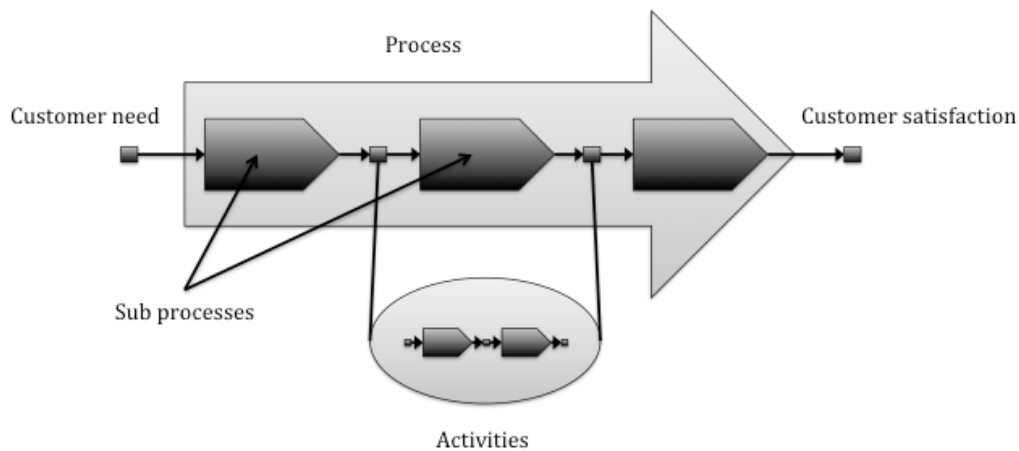
<sup>72</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>73</sup> Ungan, M. 2006, "Towards a better understanding of process documentation",

<sup>74</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

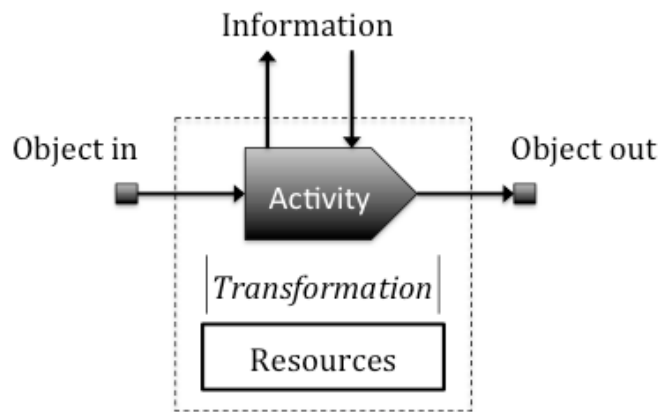
value. Finally, the focus is on the customer and how the customer sees the company.<sup>75</sup>

The process map should bring together everyone’s understanding of the process and thereby show the “real” process. The level of detail in mapping can differ depending on the purpose of documentation. However, every process consists of sub-processes and activities, from customer need to customer satisfaction. An illustration of a process can be seen figure 6.



**Figure 6. A process and its sub processes and activities.<sup>76</sup>**

The components of a process are object in, activities, information, resources and object out. The relation between the components is clarified in figure 7.



**Figure 7. The components of a process.<sup>77</sup>**

<sup>75</sup> Jacka, J.M. & Paulette, J.K. 2009, “Business Process Mapping: Improving Customer Satisfaction”.

<sup>76</sup> Ljungberg, A. & Larsson, E. 2001, “Processbaserad verksamhetsutveckling”.

<sup>77</sup> Ibid.

The description or definition of the components is found in table 3 below.<sup>78</sup>

**Table 3. Description of the components of a process.** <sup>79</sup>

<b>Process Component</b>	<b>Description</b>
<b>Object in</b>	The component that starts the process/sub process/activity. Object in comes out of the closest previous activity or process.
<b>Activity</b>	A series of actions that that uses resources to process and refine object in.
<b>Information</b>	Supports and/or controls the process. Information enables the executing of the process.
<b>Resources</b>	The resources, in form of for example, persons, equipment, facilities, needed to perform the activity
<b>Object out</b>	The result of the transformation of object in. Object out becomes object in for the closest succeeding activity in the process.

There exist several types of methods for mapping processes, as well as different use of symbols to visualize different things on the map, the illustrations above are only one way to visualize a process and its components. This way is commonly used and it is very easy to grasp, therefore this way is chosen. However, the most important thing is to be consequent when mapping processes.<sup>80</sup> Most companies have their own regulations of how processes are illustrated and since it is common to use software that is what sets the restrictions/rules for how it is presented.

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<sup>78</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>79</sup> Ibid.

<sup>80</sup> Ibid.

### 3.6 Developing a New Measurement System

The creating of a new measurement system can be described very generally in an eight-step model. The eight steps are all equally important for the success of the measurement system. In figure 8 an illustration of the model is presented.<sup>81</sup>



Figure 8. Model for developing a new measurement system.<sup>82</sup>

The eight steps in the model are described below:<sup>83</sup>

- **Secure management's trust and engagement**  
*Management engagement is important when performing changes in an organization and this applies to the creation of a measurement system as well.*
- **Develop competence**  
*The employees that will be affected by the measurement system must have knowledge regarding processes, quality and measurement principles. Common objectives should also be developed.*
- **Map the process**  
*A comprehensive mapping of the process should be made to visualise and clarify sub processes, activities, information flows, object in and object out, and the relation between them all.*
- **Determine customer requirements**  
*The customer requirements should be the starting point for the measurement system. The goal is to understand customers and other stakeholders and satisfy their needs; therefore it is essential to understand these.*

<sup>81</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>82</sup> Ibid.

<sup>83</sup> Ibid.

- **Relate strategy and goals to the process**  
*The measurement should be related to strategy, and the strategy must be decomposed until there is a relation to the process. The gap between strategy and operations should be closed.*
- **Select and derive measures**  
*This step is the core of the measurement system, and after this complete measurement specifications should exist. In the specification the method for information gathering for measurement, the compilation of measurements, the presentation of measurements and the analysis of measurements should be stated.*
- **Set goals for the measures**  
*The goal for the measures should be based on the actual results of the new measurements.*
- **Implement measurement system**  
*The implementation of the measurement system should be on going throughout the other steps and this step is only to control that it was successful. During the development project the purpose and objective of the measurement system should be communicated to the people involved in the process to make sure that the measurement system is accepted.*

### 3.7 Measuring Processes

The objective of measurement is to create knowledge and understanding, which are important conditions for development and improvement. The major questions when measuring are what to measure and why to measure it. These are of great importance, as well as the way of measuring. The identification and decision of measures should start from a high process level and continue to the lower levels; also it should start from the end of the process going backwards to the beginning of the process.<sup>84</sup>

Two sets of measures regarding process performance exists, one set is broad in scope and applicable to all processes, this includes cycle time, cost and quality. The other set includes effectiveness, efficiency and adaptability.<sup>85</sup> Literature suggests different approaches of measuring processes. The section above described how to develop a new measurement system, and in the coming sections some common approaches for measuring processes that has already been developed will be presented. The Balanced Scorecard approach will be brought up because Tetra Pak uses it and because it is a basic and well-known tool. Two Business Excellence models, The Malcolm Baldrige National Quality Award excellence model and the European Foundation of Quality Management Business Excellence Model, are

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<sup>84</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>85</sup> Ibid.

presented. These have been chosen for the reason that they are the two largest and most commonly used models. ISO Standards regarding quality, quality management and measuring of processes will be presented. Every company under the ISO Certificates must follow the requirements set up.

### **3.7.1 Balanced Scorecard Approach**

The Balanced Scorecard approach includes the measuring of internal business processes, it is an approach that represents a major effort to link strategies to specific measures. It emphasizes that focus should be on a handful of measures that are most critical to the organization. The Balanced Scorecard guards against sub optimisation, by forcing managers to consider all the important measures together, it lets them see whether improvement in one area may have been achieved at the expense of another. The approach suggests that strategy could be conceptualized from different perspectives and each perspective has its own key performance indicators (KPIs). The four perspectives are presented in table 4 below.<sup>86</sup>

**Table 4. The four perspectives of the Balanced Scorecard approach.<sup>87</sup>**

<b>Perspective</b>	<b>Focus</b>
<b>Financial</b>	These KPIs focus on revenue growth, cash flow, and profitability and tells the company how they look to the shareholders.
<b>Customers</b>	These KPIs focus on segments of market and specific groups of customers and set goal and measures for each group, these measures have the objective of showing how the customer sees the company.
<b>Internal business processes</b>	These KPIs focus on measures of internal business process success, these measures determines what the company must excel at.
<b>Innovation and learning</b>	These KPIs focus on measuring if the technical infrastructure and employees with the required skill and knowledge are available, these tell the company if they can continue to improve and create value.

The objectives of the internal business processes measurements are to determine which processes are most critical, and specific measures, such as cycle time, quality, employee skills, productivity and responsiveness, to track them.<sup>88</sup>

<sup>86</sup> Kaplan, R.S. & Norton, D.P. 1992, "The Balanced Scorecard – Measures That Drive Performance", Harvard Business Review.

<sup>87</sup> Harmon, P. 2003, "Business Process Change: A manager's Guide to Improving, Redesigning, and Automating Processes".

<sup>88</sup> Kaplan, R.S. & Norton, D.P. 1992, "The Balanced Scorecard – Measures That Drive Performance", Harvard Business Review.



### **3.7.2 ISO Standard**

Swedish Standards Institute (SIS) develops different standards and is a member of the International Organization for Standardization (ISO). For a business the adopting of applicable standards have the objective of creating greater efficiency and profitability. There are two standards regarding process management, Quality Management Systems – Requirements (ISO 9001:2008) and Managing for the sustained success of an organization – A quality management approach (ISO 9004:2009).<sup>89</sup> Further, there is one standard regarding measurement management, Measurement Management Systems – Requirements for measurement processes and measuring equipment (ISO 10012:2003).

#### ***ISO 10012:2003<sup>90</sup>***

This standard treats measurement management of a company. It describes that an effective measurement management system ensures that measuring equipment and measurement processes are fit for their intended use. The importance of a management system is pointed out. Measurement processes should be considered as a specific processes aiming to support the quality of the products by the organization. Management processes should be planned, validated, implemented, documented and controlled. For each measurement process, the relevant process elements and controls should be identified.

#### ***ISO 9001:2008<sup>91</sup>***

The standard concerning Quality Management Systems (QMSs) explains that an organization shall determine the processes needed for the quality management system and thereafter plan and implement the monitoring, measurement, analysis and improvement needed for these processes. A model of a process-based quality management system is shown in figure 9, from customer requirements to customer satisfaction.

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<sup>89</sup> Swedish Standards Institute. About SIS, retrieved 2011-10-24, <http://www.sis.se/en/content/about-sis/The-world-needs-SIS/>

<sup>90</sup> The Swedish Standards Institute. (SIS) 2003, "Svensk standard SS-EN ISO 10012:2003".

<sup>91</sup> The Swedish Standards Institute. (SIS) 2008, "Svensk standard SS-EN ISO 9001:2008".

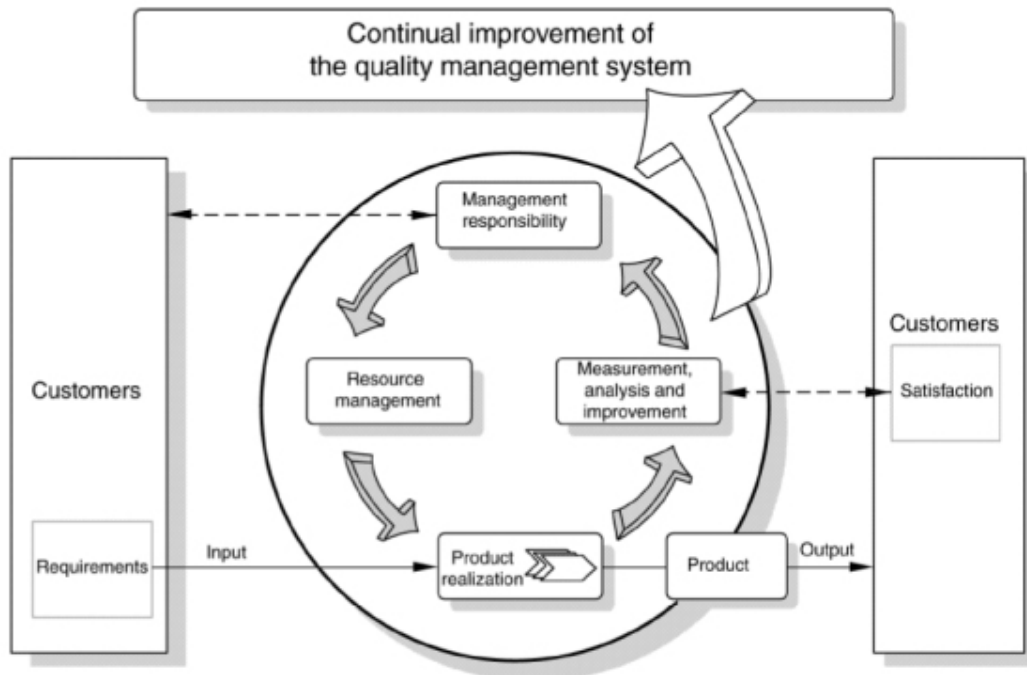


Figure 9. Model of a process-based QMS. <sup>92</sup>

### **ISO 9004:2009<sup>93</sup>**

This standard states that an organization should ensure the proactive management of all processes to guarantee that they are effective and efficient, in order to realize its objectives. Processes and their interrelationship should be assessed on regular basis and suitable actions should be taken for their improvement. An extended model for a process-based quality management system is shown in figure 10. This model is based on the model shown in figure 9. Figure 10 visualizes the different clauses that need to be managed, where clause seven is process management.

A measurement and analysis process should be used to monitor the progress in accomplishing results at all levels, in all relevant processes and functions, in the organization. The choice of suitable key performance indicators (KPIs) and monitoring methodology is critical for success of the measurement and analysis process.

<sup>92</sup> Ibid.

<sup>93</sup> The Swedish Standards Institute. (SIS) 2009, "Svensk standard SS-EN ISO 9004:2009".

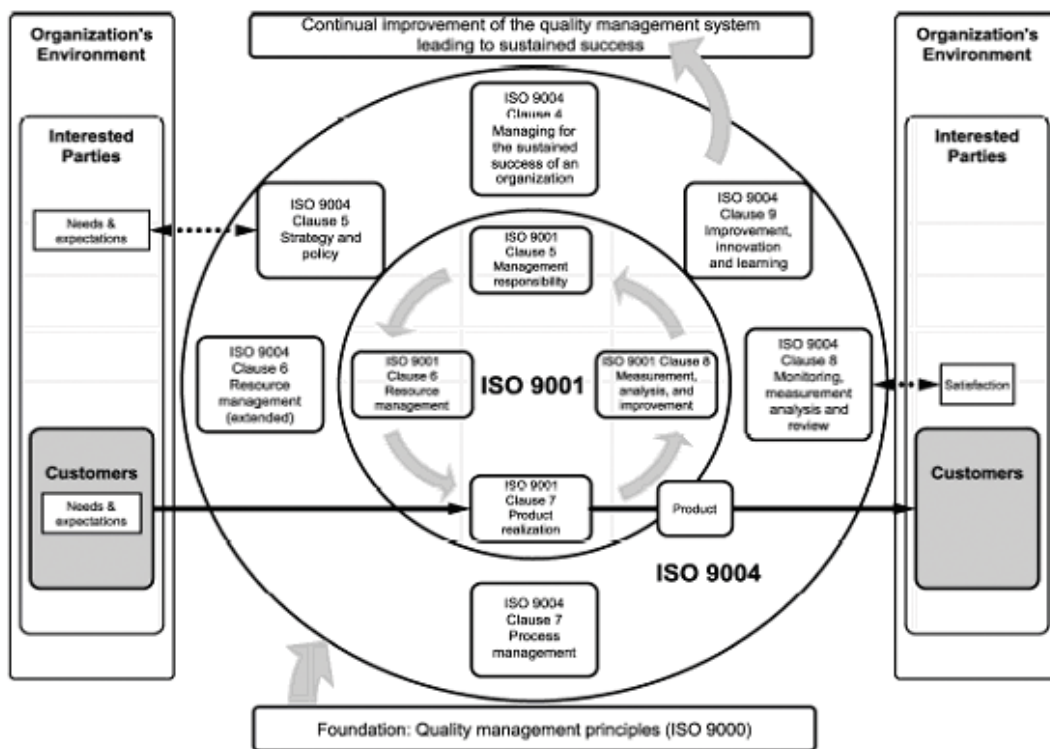


Figure 10. Extended model of a process-based QMS.<sup>94</sup>

### *Key performance indicators*

Factors that are within the control of the organization and critical to its sustained success should be subjected to performance measurement and identified as KPIs. The KPIs should be quantifiable and selected by top management as a basis for making strategic and tactical decisions.

KPIs should be appropriate to the nature and size of the organization and to its products, processes and activities. They need to be consistent with the objectives of the organization, which should, in turn, be consistent with its strategy and policies.

### *Internal audit*

Internal audits should assess the implementation and effectiveness of the management system. It is an effective tool for continually improving the organization's performance. People who are not involved in the activity being examined should conduct the audit in order to give an independent view on what is being performed. The results of internal audits are usually information on compliance against the given criteria, nonconformities, and improvement opportunities. Audits are an essential input for management reviews.

<sup>94</sup> Ibid.

### *Self-assessment*

Self-assessment is a comprehensive and systematic review of the organization's activities and its performance in relation to its degree of maturity. A maturity model is described in ISO 9004:2009, and it can be used for an organization to determine the level of maturity. Self-assessment should be used to find the strengths and weaknesses of the organization in terms of its performance as well as its best practices, both at an overall level and at the level of its individual processes. Self-assessment can assist the organization to prioritize, plan and implement improvements and/or innovations, where necessary. The results of self-assessments should be used to share understanding about the organization and its future direction. The results should be an input to management review.

### *Benchmarking*

Benchmarking is a measurement and analysis methodology that an organization can use to search for the best practices inside and outside the organization, with the aim of improving its own performance. Benchmarking can be applied to strategies and policies, operations, processes, products and organizational structures.

### **3.7.3 The Business Excellence Model**

The European Foundation of Quality Management (EFQM) Business Excellence Model surfaced during the time that “quality” had rose to the highest point of management’s consciousness. Describing a business across a range of features that goes beyond only watching at the internal quality systems is the purpose of the Business Excellence Model. The foundation of the model is a set of eight “core values”, that represent the key management principles and beliefs that will drive the sustainable success of an organization. The model itself is simply a framework to translate these concepts into action.<sup>95</sup> The fundamental concepts can be summarised as follows.<sup>96</sup>

- ***Achieving balanced results***  
*Excellence is about organizations meeting their mission and progress towards their vision through planning and achieving results that meet both the long and short-term need of stakeholders, and where necessary exceeds them.*
- ***Leading with vision, inspiration and integrity***  
*Excellence is about inspirational leadership, and leaders acting as role models for the organizations values and ethics.*

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<sup>95</sup> Hakes, C. 2007, “The EFQM Excellence Model for Assess Organizational Performance – A Management Guide”.

<sup>96</sup> The EFQM Excellence Model, retrieved 3<sup>rd</sup> of November, <http://www.efqm.org/en/Home/TheEFQME ExcellenceModel/FUndamentalConcepts/tabii/169/Default.aspx>

- ***Succeeding through people***  
*Excellence is about maximizing the contribution of employees through their development and involvement.*
- ***Building partnership***  
*Excellence is about developing and maintaining value-adding partnerships and secure mutual success.*
- ***Adding value for customers***  
*Excellence is about creating sustainable customer value by understanding and anticipating their needs and expectations.*
- ***Managing the processes***  
*Excellence is about managing the organization through a set of structured and strategically aligned processes using fact-based decision making to create balanced and sustained results.*
- ***Taking Responsibility for a Sustainable Future***  
*Excellence is about embedding and ethical mind-set, clear values and the highest standards of organizational behaviour into the culture. To enable the organization to strive for economic, social and ecological sustainability.*

These concepts are then translated into action by nine elements, where five of the elements are known as enablers and the remaining four are the results. The enabler criteria cover what an organization does and how it does it and the results cover what an organization achieves. These nine criteria are against which the organization should be graded. It helps organizations to identify strengths and potential gaps in performance. The elements are defined in table 5 on the next page.<sup>97</sup>

### **3.7.4 MBNQA Excellence Model**

Malcolm Baldrige National Quality Award (MBNQA) excellence model is an award and not originally an excellence model, but today it is regularly used as an excellence model. If applying for the award or doing a self-assessment the organization will be evaluated in seven categories, “Criteria for performance excellence”; leadership, strategic planning, customer focus, measurement, analysis, and knowledge management, work force focus, process management and result. These are presented on page 35 in table 6.<sup>98</sup>

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<sup>97</sup> Hakes, C. 2007, “The EFQM Excellence Model for Assess Organizational Performance – A Management Guide”.

<sup>98</sup> Kartha, C.P. 2004, “TQM implementation – A comparison of ISO 9000:2000 quality system standards, QS9000, ISO/TS 16949 and Baldrige criteria”.

**Table 5. The elements of the EFQM Business Excellence Model.** <sup>99</sup>

<b>Elements</b>	<b>Description of elements</b>
<b>Leadership</b>	Excellent leaders facilitate the achievement of the mission and vision. They develop organizational values and systems required for sustainable success and implement these through their actions and behaviours. During periods of change, leaders are able to change the direction of the organization and inspire others to follow.
<b>Policy and strategy</b>	Excellent organizations realize their mission and vision by developing a strategy that focuses on stakeholder and that takes into account the market and sector in which it operates. Policies, plans, objectives and processes are established and implemented to deliver strategy.
<b>People</b>	Excellent organizations manage, develop and release the full potential of their people at an individual, team-based and organizational level. They encourage fairness, and they involve and empower their people. The organization care for, communicate, reward and recognize, employees in a way that motivates them and forms commitment to using their skills and knowledge for the benefit of the organization.
<b>Partnerships and resources</b>	Excellent organizations manage external partnerships, suppliers and internal resources in order to support policy and strategy and the effective operation of processes. While managing partnerships and resources, the organization balances their current and future needs, the community, and the environment.
<b>Processes</b>	Excellent organizations design, manage and improve processes in order to totally satisfy, and generate increasing value for, customers and other stakeholders.
<b>Customer results</b>	Excellent organizations extensively measure and achieve outstanding results with respect to their customers.
<b>People results</b>	Excellent organizations extensively measure and achieve outstanding results with respect to their people.
<b>Society results</b>	Excellent organizations extensively measure and achieve outstanding results with respect to their society.
<b>Key performance results</b>	Excellent organizations extensively measure and achieve outstanding results with respect to the key elements of their policy and strategy.

<sup>99</sup> Hakes, C. 2007, "The EFQM Excellence Model for Assess Organizational Performance – A Management Guide".

**Table 6. The criteria for the MBNQA excellence model.<sup>100</sup>**

<b>Criteria</b>	<b>Description of criteria</b>
<b>Leadership</b>	The leadership category examines executives' personal leadership and participation in creating and sustaining a customer focus and visible quality values. The way in which these quality values are merged into the management system and the way in which the company addresses its public responsibilities are also reviewed.
<b>Strategic planning</b>	This category examines the method in which the company sets strategic directions to define and strengthen its competitive position.
<b>Customer focus</b>	The way in which the company defines requirements and expectations of customers and markets are examined in this category. The process through which customer satisfaction is enhanced and assessed is also of importance.
<b>Management, analysis and knowledge management</b>	This category deals with how the company manages its information and knowledge, which are procedures that help to sustain company performance. The selection, use and management of information affect its process management. Therefore, both financial and non-financial data management techniques are examined.
<b>Workforce focus</b>	This category assesses how the company develops and realizes the full potential of its staff in pursuing the company's quality and performance objectives. The question is if a company maintain an environment for excellence, that encourages full participation and personal and organizational growth.
<b>Process management</b>	Key aspects of process management are inspected in this category; they include customer-focus, product and service delivery, vendor and partnering processes involving all work units. The production and delivery processes should be designed to meet operational performance requirements and the company should also incorporate changing customer requirements and technology into its products and services.
<b>Result</b>	This category grades the company's performance and improvement in such key business areas as customer satisfaction, financial and market-place performance, human resources, vendor and partner performance, and operational performance. Performance levels relative to competitors are also considered. Current levels and trends in key measures of customer satisfaction and dissatisfaction are considered. Financial and marketplace performance include such measures as aggregate return on investment, market share, business growth, and new markets entered. Human resource results include employee well being, satisfaction, development, and work system performance.

<sup>100</sup> Kartha, C.P. 2004, "TQM implementation – A comparison of ISO 9000:2000 quality system standards, QS9000, ISO/TS 16949 and Baldrige criteria".

## **3.8 Literature Review of Process Improvement/Redesign**

In literature different methods for mapping, analysing and improving processes are described. These methods are often very alike and therefore a combination of the most common methods has been created as a frame of reference. The methods chosen are from well-known books and persons that have described mapping and improving processes from a general point of view. The methods that were reviewed but were considered to specific and related to one particular industry or company will not be presented because it was not relevant for this thesis.

### ***3.8.1 Planning for a Process Improvement Effort***

The preparation and planning of a process improvement effort should be thorough. To succeed with the improvements the initial preparations are crucial. The overall goals and objectives should be defined, and it is also important to understand the expectations. How the specific process relates to other company processes, to company customers and suppliers should be documented.<sup>101</sup> Before starting the mapping of the specific process the level of detail of the map should be determined. The map will be clearer if it does not contain too much information, however a process description can complement the map to make it easier to understand. It can be necessary to describe the process in several different maps because of the extent of the process.<sup>102</sup> The purpose of the effort will determine the breadth and depth at which process details must be analysed.<sup>103</sup> A project plan containing information about goals, expectations, level of detail of process map and resources should be completed before the real effort of process improvement will start. The plan should be reviewed in a joint meeting that includes everyone involved in the project. This is a critical meeting, and the outcome should be an agreement on scope and goals of effort to be undertaken.<sup>104</sup>

### ***3.8.2 Mapping Existing Process***

It is important to work in a structured way, the work will be more efficient and the normal mistakes will be avoided. Before it is possible to start the actual process mapping it is important to decide on the scope of the process, which means that the start- and endpoints should be defined. The better the understanding is of the

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<sup>101</sup> Harmon, P. 2003, "Business Process Change: A Manager's Guide to Improving, Redesigning and Automating Processes".

<sup>102</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>103</sup> Savory, P. & Olson, J. 2001, "Guidelines for Using Process Mapping to Aid Improvements Efforts".

<sup>104</sup> Harmon, P. 2003, "Business Process Change: A Manager's Guide to Improving, Redesigning and Automating Processes".



process before the mapping starts the easier the mapping will be. In many cases it can be suitable to create a process specification in this phase.<sup>105</sup>

### ***Information Gathering***<sup>106</sup>

It is important to know what information is needed. To gather information for process mapping there are three different approaches that can be used.

#### *“Walk Through”*

It means that one or more persons are responsible for the realization of a process map and therefore literally walk through the process. During the walk personnel executing the activities are being interviewed. The advantages of this approach are that it is easy and fast. The map will have a homogeneous look and an unambiguous nature. The disadvantage is that only the one mapping the process gets a total understanding of it.

#### *Interviews/Virtual “Walk Through”*

An alternative is to make a virtual “walk through” where you gathered the personnel performing the process and let every one of them describe their part of the process. Interviewing can only succeed with the right preparation and the right approach.

#### *Mapping Team*

A more thorough approach is to create a mapping team that will be responsible for mapping the process. Everybody must know how to map a process and a lot of resources and time will be used. However, everyone in the team will understand the process.

### ***Mapping***

Once the basic information is in hand, the reviewer starts making the map of the existing process, as described below, however this process is not done in isolation. It is an iterative process, the interviewee has input and the interviewer builds together these inputs, in cooperation with the interviewee, until there is a final, real process.<sup>107</sup>

From the information gathering it is easy to identify a large number of activities that probably is in the process and when this is done the rest will come, because it is only when the activities are arranged that the gaps will be visible. The activities should be arranged from start- to endpoint. When this is done it can become obvious that some activities describe the same thing or that some activities are missing.

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<sup>105</sup> Ljungberg, A. & Larsson, E. 2001, “Processbaserad verksamhetsutveckling”.

<sup>106</sup> Ibid.

<sup>107</sup> Jacka, J.M. & Paulette, J.K. 2009, “Business Process Mapping: Improving Customer Satisfaction”.

Therefore merging of some activities is necessary and possible give them new more appropriate names that describes their purposes. The missing activities should be named as well, and also be arranged in the right order.<sup>108</sup> Each activity should now have a name and a description to be sure everyone knows what it entails. The activities can be performed by individuals, be automated by a software system, or performed in combination of a person and a software system, it should be noted how the activities are performed. If specific goals, sub goals, or quality measures are associated with an activity, they should be defined.<sup>109</sup>

When all the activities are defined and arranged it is time to identify the activities object in and object out and to connect these into a process. Defining object in and object out of every activity facilitates the understanding of what is happening and it also enables measurement of the process as a whole. The flow between activities can be products, documents, information (data), or money. The linkage of object out to object in is a good control to see if an activity is missing since the first activity's object out has to be the second activity's object in and so on. If this is not the case an activity is missing or parallel flows have been created. It is time to control the names of the activities and that the level of detail is the same for all the activities so that a coherent description of the process is made. Finally the process map must be studied in whole and corrected until a good description of the process is in place.<sup>110</sup>

#### *Naming the processes, activities and objects*

To avoid falling into the traditional organizational structure it is appropriate to give the processes and activities names that cannot be confused or associated with functions. The name should reflect how value is created and why something is done rather than what is done or in worst case how it is done. The name should preferably have the form of a verb and then a noun. The objects must also have appropriate names and in the form of a noun.<sup>111</sup>

### **3.8.3 Analysis of Existing Process**

The goal of the analysis is to analyse the existing process and create a complete list of weaknesses and potential improvements. The weaknesses should be recorded with the following suitable information: short description, description of potential improvements or solutions, meaning for the company and urgency.<sup>112</sup> They should

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<sup>108</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>109</sup> Harmon, P. 2003, "Business Process Change: A Manager's Guide to Improving, Redesigning and Automating Processes".

<sup>110</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>111</sup> Ibid.

<sup>112</sup> Becker, J., Kugeler, M. & Rosemann, M. 2003, "Process Management A Guide for the Design of Business Processes".

also be categorized in type, cause and possible action and then the problem should be investigated.<sup>113</sup> Not all detected weaknesses require comprehensive reorganization efforts. Often, improvements can be achieved with only minor organizational actions.<sup>114</sup> Focus should be put on the most important weaknesses.<sup>115</sup>

A process map can be a starting point for identifying problems in the process. Letting people point out the areas of issues in the existing process map is one way of finding deficiencies, bottlenecks and improvement opportunities. Improvements can be reduction of looping errors, reduction of delays and rework, streamlining of hand-offs and removing unnecessary approvals. Another analysis that can be made when studying the existing process map is a value analysis. Every activity in the process can be classified in one of three categories; the categories are presented below.<sup>116</sup>

- **Value-Adding Activities**  
*Activities that in a direct way contribute to solving the customer's problem, in other words, create what the customer demands. Activities the customer would be willing to pay for. These activities should be developed.*
- **Non Value-Adding Activities**  
*Activities that do not create value for the customer but that are necessary for the organization or for the specific process. It can also be activities that create value, not for the customer, but for another stakeholder. These activities should be minimized.*
- **Waste**  
*Activities that do not create value for the customer, for the organization or for any other stakeholder can be categorized as waste. These activities should be eliminated.*

The classification of activities is built on subjective values. It can be hard to determine in which category an activity belong, however this analysis results in the identification of the major problem activities, where waste is found.<sup>117</sup> Another way of analysing the process is with benchmarking, which means the comparison of parameters between companies in order to be able to judge the competitiveness. The comparison has the objective of identifying performance gaps to other companies that execute perceived best practice in certain processes or procedures. Benchmarking requires first of all a specification of what has to be measured; every

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<sup>113</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>114</sup> Becker, J., Kugeler, M. & Rosemann, M. 2003, "Process Management A Guide for the Design of Business Processes".

<sup>115</sup> Ljungberg, A. & Larsson, E. 2001, "Processbaserad verksamhetsutveckling".

<sup>116</sup> Ibid.

<sup>117</sup> Ibid.

measuring object needs suitable criteria in order to allow comparison of these objects. The measuring of a process has to be analysed, because even a relatively well-designed process that is managed by supervisors who have not established clear measures or who do not reward behaviour that is critical to the success of the process is likely to be inefficient.<sup>118</sup>

At the end of the analysing effort the findings should be summarized in a redesign plan where the general approach of the redesign should be presented. Approval should be obtained of all those who will later have to assure that the new process actually is implemented.<sup>119</sup>

#### ***3.8.4 Design of a New Improved Process***

The goal of this phase is to create a design for a new or improved process. The review the original process should result in a new process, where disconnects and unneeded activities are eliminated and the activities, sub processes and over all process are streamlined. The design of a new management process to support the new process must be designed. The management process should specify who is responsible for each activity and sub process. It should also establish measures for activities and sub processes. New processes will probably require that new and more rationalized reporting relationships be established. A review of the jobs and roles involved in the process should be made. Detailed information of new activities should be provided; the new or modified activities should be documented on activity worksheets. When a fully documented new process is designed, a presentation of the proposal should be made to the senior managers. It is important that they not only understand the process but also approves it.<sup>120</sup>

#### ***3.8.5 Managing the Transition to a New Improved Process***

The objective of this phase is to transition to the new process. Many companies have redesigned processes and then failed to implement them. Manager and employees may resist using the new procedures. A good transition plan calls for meeting that acquaint everyone with the change and reasons for the change. The activities of this phase vary greatly according to the nature of the new process, the amount of change required, management support, and the resistance offered by those currently performing the process. In many cases the work of this phase will be subcontracted to a team of change management specialists. Beyond the transition, managers will need to work to assure that the new process meets its goals and to identify new

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<sup>118</sup> Becker, J., Kugeler, M. & Rosemann, M. 2003, "Process Management A Guide for the Design of Business Processes".

<sup>119</sup> Harmon, P. 2003, "Business Process Change: A Manager's Guide to Improving, Redesigning and Automating Processes".

<sup>120</sup> Ibid.

problems that will require subsequent changes. Maintaining a process is a full-time management job.<sup>121</sup>

### **3.8.6 Process Improvement/Redesign vs. Process Reengineering**

There is a difference between process improvement and process reengineering, and process improvement is the most applicable and relevant method in this thesis. There is not a need for a radical change, however it can be good to have knowledge about process reengineering. Some of the things brought up in this section can be worth having in mind.

Business reengineering means starting over, putting aside old wisdom and decide how work can be done best today and in the future. It is about identifying and abandoning the out-dated rules and fundamental assumptions that underlie current business operations. Thereby identifying actions that are done simply to satisfy the internal demands of the company's own organization and that do not lead to satisfying customer needs.<sup>122</sup>

Reengineering is defined as “the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed.”<sup>123</sup>

The definition contains four keywords: fundamental, radical, dramatic, and process. The first keyword, fundamental, focuses on the basic questions of how a company conduct their business. Reengineering first determines what a company must do, then how to do it. Reengineering takes nothing for granted. It ignores what is and concentrates on what should be. The next word, radical, means getting to the root of things: not making superficial changes or fiddling with what is already in place, but throwing away the old. In reengineering, radical redesign means disregarding all existing procedures and structures and inventing completely new ways of accomplishing work. Reengineering is about business reinvention, not business improvement, enhancement or modification. Dramatic, the third word, states that reengineering is not about making marginal improvements but about achieving large leaps in performance. The forth word in the definition is process, which is the most important word, but also the one that gives most managers the greatest

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<sup>121</sup>Harmon, P. 2003, “Business Process Change: A Manager’s Guide to Improving, Redesigning and Automating Processes”.

<sup>122</sup> Hammer, M & Champy, J. 1995, “Reengineering the Corporation – A Manifesto for Business Revolution”.

<sup>123</sup> Ibid.

difficulty. Most business people are not “process-oriented”; they are focused on tasks, people, structures, but not on processes.<sup>124</sup>

In reengineering processes there are some commonalities, which mean some recurring characteristics that are frequently encountered. These are presented below.<sup>125</sup>

- **Several jobs are combined into one**  
*Many formerly distinct tasks are integrated and compressed into one, resulting in a reduced number of handoffs, and thereby errors, delays and misunderstandings.*
- **Workers make decisions**  
*The company is compressed vertically, which means that at the points in a process where workers used to have to go up the managerial hierarchy for answers, they now make their own decisions. The benefits from compressing the company vertically include fewer delays, lower overhead costs, better customer response and greater empowerment for workers.*
- **The steps in the process are performed in a natural order**  
*In reengineering processes, work is sequenced in terms of what needs to follow what. “De-linearizing” processes speeds them up in two ways. Many tasks get done simultaneously and the amount of time that elapses between the early and late steps of a process reduces, which narrows the window for major change that might make the earlier work obsolete or make the later work inconsistent with the earlier. Organizations thereby encounter less rework.*
- **Processes have multiple versions**  
*Traditional one-size-fits-all processes are very complex since they must incorporate special procedures and exceptions to handle a wide range of situation. A multi-version process is clean and simple, because each version needs to handle only the cases for which it is appropriate. There are no special cases and exceptions.*
- **Work is performed where it makes the most sense**  
*Work is shifted across organizational boundaries to improve overall performance; it eliminates the need for integration.*

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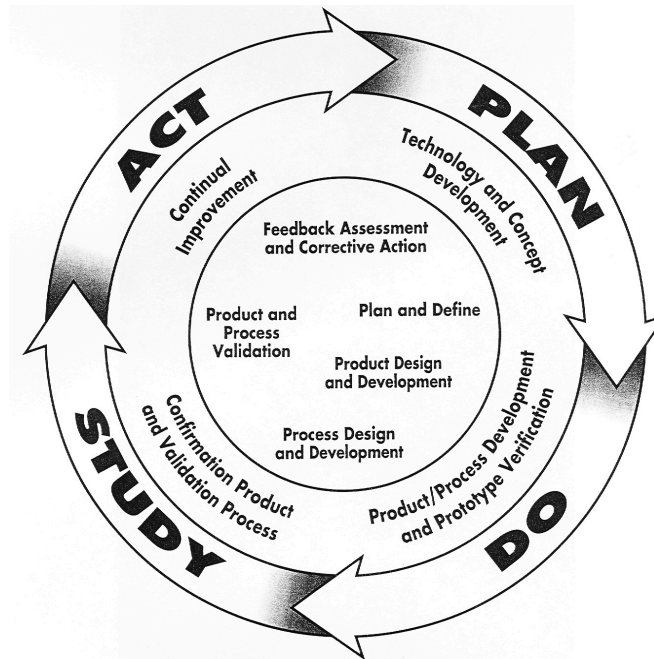
<sup>124</sup> Hammer, M & Champy, J. 1995, “Reengineering the Corporation – A Manifesto for Business Revolution”.

<sup>125</sup> Ibid.

- **Checks and controls are reduced**  
*Another kind of non value-adding works that gets minimized in reengineering processes is checking and control steps, which add no value but are included to ensure that people are not abusing the process. Instead of tightly checking work as it is performed, reengineering processes often have aggregate or deferred controls. These control systems will, by design, tolerate modest and limited abuse, by delaying the point which abuse is detected or by examining aggregate patterns rather than individual instances. The control systems, however, more than compensate for any possible increase in abuse by dramatically lowering the costs and other encumbrances associated with the control itself.*
- **Reconciliation is minimized**  
*By cutting back the number of external contact points of a process the risk that inconsistent data requiring reconciliation will be received is reduced.*
- **A case manager provides a single point of contact**  
*The use of someone called “case manager” is a recurring characteristic found in reengineering processes. This is useful when the steps of a process either are so complex or are dispersed in such a way that integrating them for a single person or even a small team is impossible. The case manager behaves towards the customer as if he or she is responsible for performing the entire process. To be able to answer the questions and solve customer problems this person needs access to all the information systems that the people who are actually performing the process use and the ability to contact those people for further assistance when necessary.*
- **Hybrid centralized/decentralized operations are prevalent**  
*When reengineering processes the advantage of combining decentralization and centralization in the same processes are obtained. The best of two worlds can be utilized.*

### 3.9 Advanced Product Quality Planning

Advanced product quality planning (APQP) is a system for assuring good quality in developed products. Ford, GM and Chrysler developed it and originally it was created for the automotive industry, but it can be applied in any industry. The purpose of the system is “to produce a quality plan which will support development of a product or service that will satisfy the customer”. The plan provides specialised tools to offer the opportunity to get ahead of problems and solve them before the problems affect the customer. The focus is on up-front quality planning as well as evaluating the output to determine if customers are satisfied and also to support continual improvement. The benefits of APQP are that communication is facilitated, with everyone involved in the product development process, and design and product quality problems are avoided.



**Figure 11. The Product Quality Planning Cycle.**<sup>126</sup>

To illustrate this figure 11 above shows the Product Quality Planning Cycle, which includes four steps, where the first three are devoted to up-front product quality planning through product/process validation and the fourth step is the stage where the importance of evaluating the output serves two functions - to determine if customers are satisfied and to support the pursuit of continual improvement.<sup>127</sup>

***The Five Phases of APQP***

The advanced product quality planning process consists of five phases; plan and design program, product design and development verification, process design and development verification, product and process validation, and feedback assessment and corrective action. The phases are shown in figure 12 as a part of the APQP framework.<sup>128</sup>

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<sup>126</sup> Advanced Product Quality Planning (APQP) and Control Plan Reference Manual. Issued June 1994.

<sup>127</sup> Ibid.

<sup>128</sup> New Product Development Solutions. Advanced Product Quality Planning, retrieved 2011-11-16.



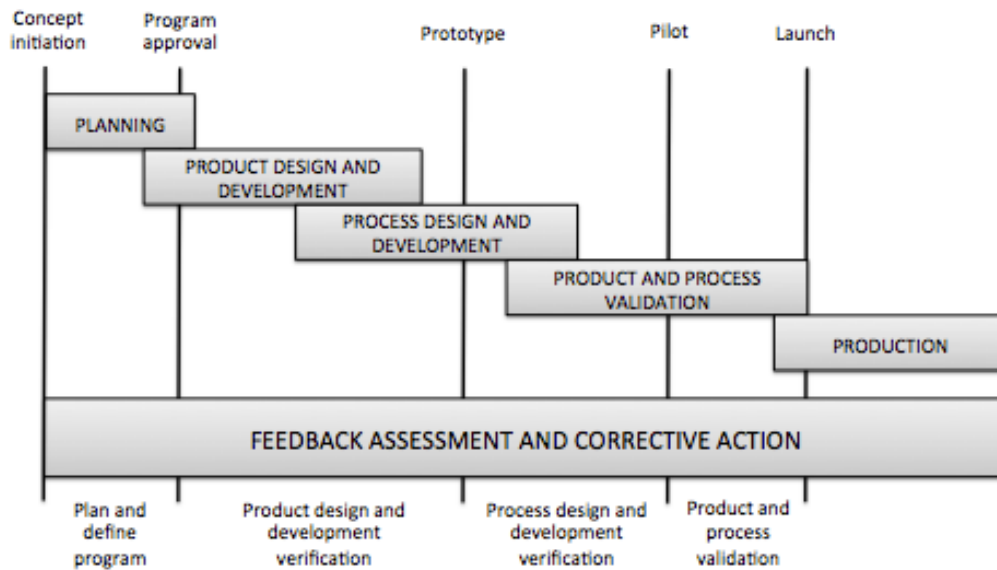


Figure 12. The APQP system.<sup>129</sup>

### *Plan and Define the Program*

Form a cross-functional team to define scope, customer requirements and create formal feasibility assessments. The key deliverables for this phase are:

- *Identify design intent, life and quality goals*
- *Preliminary Bill of Materials (BOM)*
- *Initial process flow chart*
- *Initial critical product and process characteristics*
- *Initial product assurance plan and signed-off management support statement*

### *Product Design and Development*

In this phase a thorough and robust review of engineering/service requirements will be done and also an assessment of all related critical technical information. The key deliverables for this phase are:

- *Design/service Failure Mode Effects Analysis (FMEA)*
- *Design for successful execution of the manufacturing, assembly of service path*
- *Design/service validation*
- *Design/service review*
- *Preliminary control plans for early prototype/service trail phase*
- *Engineering documentation and proofs*
- *Engineering/service specifications*

<sup>129</sup>New Product Development Solutions. Advanced Product Quality Planning, retrieved 2011-11-16.

### *Process Design and Development*

This phase is designed to develop a robust, high-quality manufacturing or service system. It must ensure that the most important customer needs, requirements and expectations are completely satisfied. The key deliverables for this phase are:

- *Process Failure Mode Effect Analyses (PFMEA)*
- *Product/process quality system review*
- *System layout*
- *Characteristics matrix*
- *Process/service flow chart*
- *Beta control plan prior to first run*
- *Packaging and delivery standards*
- *Process/service instructions*

### *Product and Process Validation*

This phase is a full evaluation and confirmation of the manufacturing/service process, which includes trial runs with the quality planning team evaluating control plans, flow charts and checking that customer requirements are met throughout the system. This phase resolves problems prior to the first official production runs. The key deliverables for this phase are:

- *Trial runs*
- *Initial capability analyses*
- *Measurement Systems Analysis (MSA) and validation*
- *Production Part Approval Process (PPAP)*
- *Production control plan*
- *Packaging validation: quality planning sign-off and management presentation*

### *Feedback Assessment and Corrective Action*

The total quality planning system outputs and effects are reviewed for effectiveness and improvement. All customer requirements are reviewed and measured to confirm they are met (or exceeded) and that they are documented. The key deliverables for this phase are

- *Reduce unwanted variation*
- *Confirm customer satisfaction or delight*
- *Delivery and service requirements have been met*

In reality, these phases overlap and many tasks are done in parallel to streamline and maximize resource utilization. This is an excellent business system tool for both manufacturers and service providers. APQP brings a higher level of success in starting new services and/or product offerings.<sup>130</sup> In table 7 on the next page an example of an APQP checklist from Electrolux is provided. The objective of the document is to deliver guidance and to be able to follow every update in the project that is ongoing. Companies can create checklist that are modified to fit their own business and provide as much help and structure as possible.

**Table 7. An example of an APQP checklist at Electrolux.<sup>131</sup>**

Activity number	Activity	Responsible	Done day	Done week	Check point	Customer approved	Comments & status
1	Quality plan for project						
2	Feasibility study						
3	Contract review including						
4	Product FMEA						
5	Environmental assessment						
6	Construction examination						
7	Construction verification						
8	Process FMEA						
9	Material list with supplier						
10	Inspection, test plan						
11	Tools list						
12	Measuring instruments						
13	Work instructions						
14	Test instructions						
15	Handling and storage						
16	Specific processes						
17	Statistical process control						
18	Capability						
19	Prototypes and final test						
20	Zero series						
21	Reliability test						
22	Control of governing						
23	Critical components						
24	Final product review						
25	Competence development						
26	Preventive maintenance						
27	Cost accounting						

<sup>130</sup> The QC Group. Advanced Product Quality Planning, retrieved 2011-11-16.

<sup>131</sup> Advanced Product Quality Planning (APQP) and Control Plan Reference Manual. Issued June 1994.

### 3.10 Lean

Lean production originates from The Toyota Production System, which is a philosophy or even better describes as a set of general principles of organising and managing an enterprise, which can help any organization get on the path of positive learning and improvement. This philosophy is presented because it has a strong connection to processes, making processes lean is a way of making work more efficient. From the beginning the two key concepts of success were: cost reduction through elimination of waste and full utilization of worker's capabilities.<sup>132</sup> Today there are 14 principles to describe The Toyota Production System and they are divided into the four sections presented below. An illustration of the four sections is presented in figure 13.<sup>133</sup>

#### *Long-term Philosophy*

The focus of the entire company is to add value to customers and society, which leads to a long-term approach to building a learning organization. An organization that can adjust to variations in the environment and survive as a productive organization is on the right path. Without this foundation, none of the investments made in continuous improvement and learning will be possible.

#### *The Right Process Will Produce the Right Results*

A process-oriented company and the right flow is the key to achieving the best quality at the lowest cost with high safety and morale. The processes should be de visualized and transparent to easily detect problems. The process focus should be built in to the company's DNA, and managers should believe in their hearts that using the right process will lead to the results they desire.

#### *Add Value to the Organization by Developing the People and Partners*

The Toyota way includes a set of tools that are designed to support people continuously improving and continuously developing. The view of management at Toyota is that they build people, not just cars.

#### *Continuously Solving Root Problems Drives Organizational Learning*

The highest level is organizational learning. Identifying root causes of problems and preventing them from occurring is the focus of the continuous learning system. Analysis, reflection and communication of lesson learned are central to improvement as is the discipline to standardize the best-known practice.

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<sup>132</sup> Liker, J.K. & Lander, E. 2007, "The Toyota Production System and art: making highly customized and creative products the Toyota way", *International Journal of Production Research*.

<sup>133</sup> Liker, J.K. 2009, "The Toyota Way – vägen till världsklass", Liber AB, Malmö, Sweden.

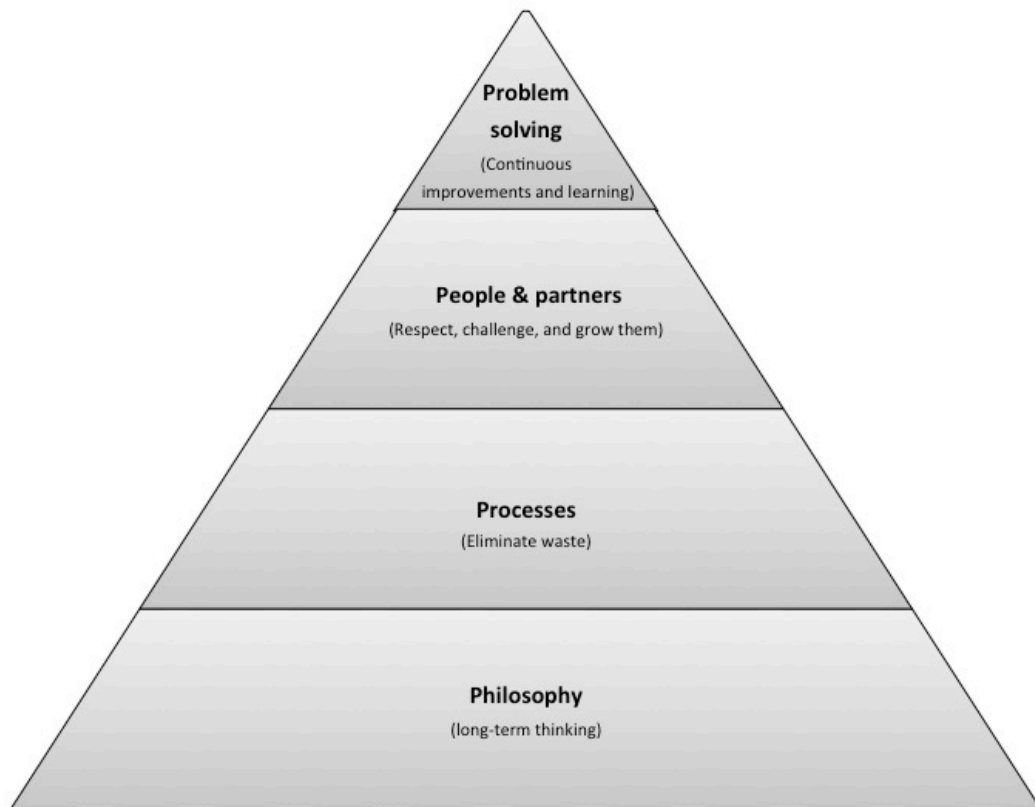


Figure 13. The “4 P” model of the Toyota Way.<sup>134</sup>

### 3.10.1 Eliminate Waste

The most central part of Lean is to eliminate non-value adding waste in business processes. The prescription for the elimination of waste is a five-stage process. First, there is need to specify value. The customer should define value in terms of specific products with specific capabilities at specific prices. Second, the value stream should be identified. The value stream incorporates the all the actions required to bring the product to the customer: including detailed design, engineering, production, order taking, production scheduling and delivery. This stage should identify activities that add value, that do not add value but are unavoidable in current circumstances and those that do not add value and are avoidable. Those activities in the third category should be eliminated. The third stage is to create flow and a radical change is required. Then the fourth stage is to let the customer pull the product as needed. The fifth stage is called perfection.<sup>135</sup>

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<sup>134</sup> Liker, J.K. 2009, “The Toyota Way – vägen till världsklass”, Liber AB, Malmö, Sweden.

<sup>135</sup> Womack, J.P., Jones, D.T. & Rand, G. 1997, “Lean Thinking – Banish Waste and Create Wealth in your Corporation”, *Journal of the Operational Research Society*.

Lean identifies different types of waste; and they can be divided into eight major categories.<sup>136</sup>

- **Over production**  
*Producing items for which there are no orders, which generates such wastes as overstaffing and storage and transportation costs because of excess inventory.*
- **Waiting (time on hand)**  
*Workers merely serving to watch an automated machine or having to stand around waiting for the next processing step, tool, supply, part, etc., or just plain having no work because of stock outs, lot processing delays, equipment downtime, and capacity bottlenecks.*
- **Unnecessary transport or conveyance**  
*Carrying work in process (WIP) long distances, creating inefficient transport, or moving materials, parts, or finished goods into or out of storage or between processes.*
- **Over processing or incorrect processing**  
*Taking unneeded steps to process the parts. Inefficient processing due to poor tool and product design, causing unnecessary motion and producing defects. Waste is generated when providing higher-quality products than is necessary.*
- **Excess inventory**  
*Excess raw material, WIP, or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage costs, and delay. Also, extra inventory hides problems such as production imbalances, late deliveries from suppliers, defects, equipment downtime, and long setup time.*
- **Unnecessary movement**  
*Any wasted motion employees have to perform during the course of their work, such as looking for, reaching for, or stacking parts, tools, etc. Also, walking is waste.*
- **Defects**  
*Production of defective parts or correction. Repair or rework, scrap, replacement production, and inspection mean wasteful handling, time, and effort.*
- **Unused employee creativity**  
*Losing time, ideas, skills, improvements, and learning opportunities by not engaging or listening to your employees.*

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<sup>136</sup> Liker, J.K. 2009, "The Toyota Way – vägen till världsklass", Liber AB, Malmö, Sweden.

## 3.11 Change Management

This section will describe change management and how change is carried out. This is an important part of process management, because if the changes are not accepted there will be no process improvements. If looking back in time, when there was less global competition and a slower-moving business environment the motto was: "If it ain't broken, don't fix it". Change occurred incrementally and infrequently. The challenges today forces firms to make drastic improvements not only to compete and prosper but to merely survive. Two patterns for success of change management are; the success of change tends to be associated with a multistep process that creates power and motivation sufficient to overwhelm all the sources of inertia. Second, this process is never employed effective unless high-quality leadership drives it.<sup>137</sup>

### ***Management vs. Leadership***

Management is a set of processes that can keep a complicated system of people and technology running smoothly. The most important aspects of management include planning, budgeting, organizing, staffing, controlling, and problem solving. Leadership is a set of processes that creates organizations in first place or adapts them to significantly changing circumstances. Leadership defines what the future should look like, aligns people with that vision, and inspires them to make it happen despite the obstacles. The distinction is important to realize since a successful transformation requires 70 to 90 percent of leadership and only 10 to 30 percent of management. With a strong emphasises on management instead of leadership, bureaucracy and inward focus take over.<sup>138</sup>

### ***3.11.1 The Eight-stage Process for Major Change***<sup>139</sup>

A method to alter strategies, reengineer processes, or improve quality, and address barriers effectively is the eight-stage process of creating major change. The first four steps help prepare, warm-up, for the change and they are a necessary base to proceed. Phases five to seven introduces many new practices, and the last stage grounds the changes in the organizational structure and helps them last. The process stages are presented in the coming eight sections and an illustration of the process is shown in figure 14 on page 58.

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<sup>137</sup> Kotter, J.P. 1995, "Leading change: way transformational efforts fail".

<sup>138</sup> Ibid.

<sup>139</sup> Kotter, J.P. 1996, "Leading change".

### ***Establishing a Sense of Urgency***

Establishing a sense of urgency is essential to attaining cooperation. Transformations often go nowhere because few people are motivated to working with the problem, there exist a high complacency. Without a sense of urgency it is difficult to guide the effort or to convince key individuals to spend the time required to create and communicate a change vision. To establish a sense of urgency markets and competitive realities should be examined as well as identifying crises or major opportunities.

### ***Creating the Guiding Coalition***

In fruitful transformations there must be a group standing behind it, a group of people with a shared commitment to excellent performance, through renewal. Support from senior managers is also essential, when putting a guiding coalition together high sense of urgency from management help enormously. This group should have enough power to lead change and they should be able to work as a team.

### ***Developing a Vision and Strategy***

A picture of the future, that is easy to communicate and appeals to customer, stockholders and employees, has to be developed. Eventually a strategy for achieving the vision will be created. Without a sensible vision, a transformation effort can easily dissolve into a list of confusing and incompatible projects that can take the organization in the wrong direction or nowhere at all.

### ***Communicating the Change Vision***

Transformation is impossible unless a large number of people are willing to help, often to the point of making short-term sacrifices. Employees will not make sacrifices unless they believe that useful change is possible. Without credible communication, and a lot of it, the hearts and minds or the personnel are never captured. This phase is particularly challenging if the short-term sacrifice includes job losses. Gaining understanding and support is tough when downsizing is a part of the vision. For this reason, successful visions usually include new growth possibilities and the commitment to treat anyone who is laid off fairly.

### ***Empowering Employees for Broad-based Action***

Changes involve many people when they progress. Employees are encouraged to try new approaches, to develop new ideas, and to provide leadership. The only constraint is that the actions fit within the broad parameters of the overall vision. Big obstacles must be confronted and removed, because it is essential and to empower others to maintain the credibility of the change effort as a whole.



### ***Generating Short-term Wins***

Real transformation takes time, and a renewal effort risks losing drive if there are no short-term goals to meet and celebrate. Creating short-term wins is different from hoping for short-term wins. The latter is passive and the former is active. In successful change managers actively look for ways to obtain clear performance improvements, establish goals in the yearly planning system, achieve the objectives, and reward the people involved. Commitment to produce short-term wins helps keep up the urgency level and to visibly recognizing and rewarding people who made the wins possible helps keep the motivation up.

### ***Consolidating Gains and Producing More Change***

After a few years of hard work, managers may be tempted to declare victory with the first performance improvement. Until changes sink deeply into a company's culture, a process that can take five to ten years, new approaches are fragile and subject to regression. The process should be strengthened with new projects, themes, and change agents and people who can implement the change vision should be hired and developed.

### ***Anchoring New Approaches in the Culture***

In the final analysis, change sticks when it becomes the company culture. Until new behaviours are imbedded in social norms and shared values, they are subject to degradation as soon as the pressure for change is removed. Two factors are particularly important in institutionalising change in corporate culture. The first is a conscious attempt to show people how the new approaches, behaviours, and attitudes have helped improved performance. The second factor is taking sufficient time to make sure that the next generation on top management really does personify the new approach. If the requirements for promotion don't change, renewal rarely lasts.

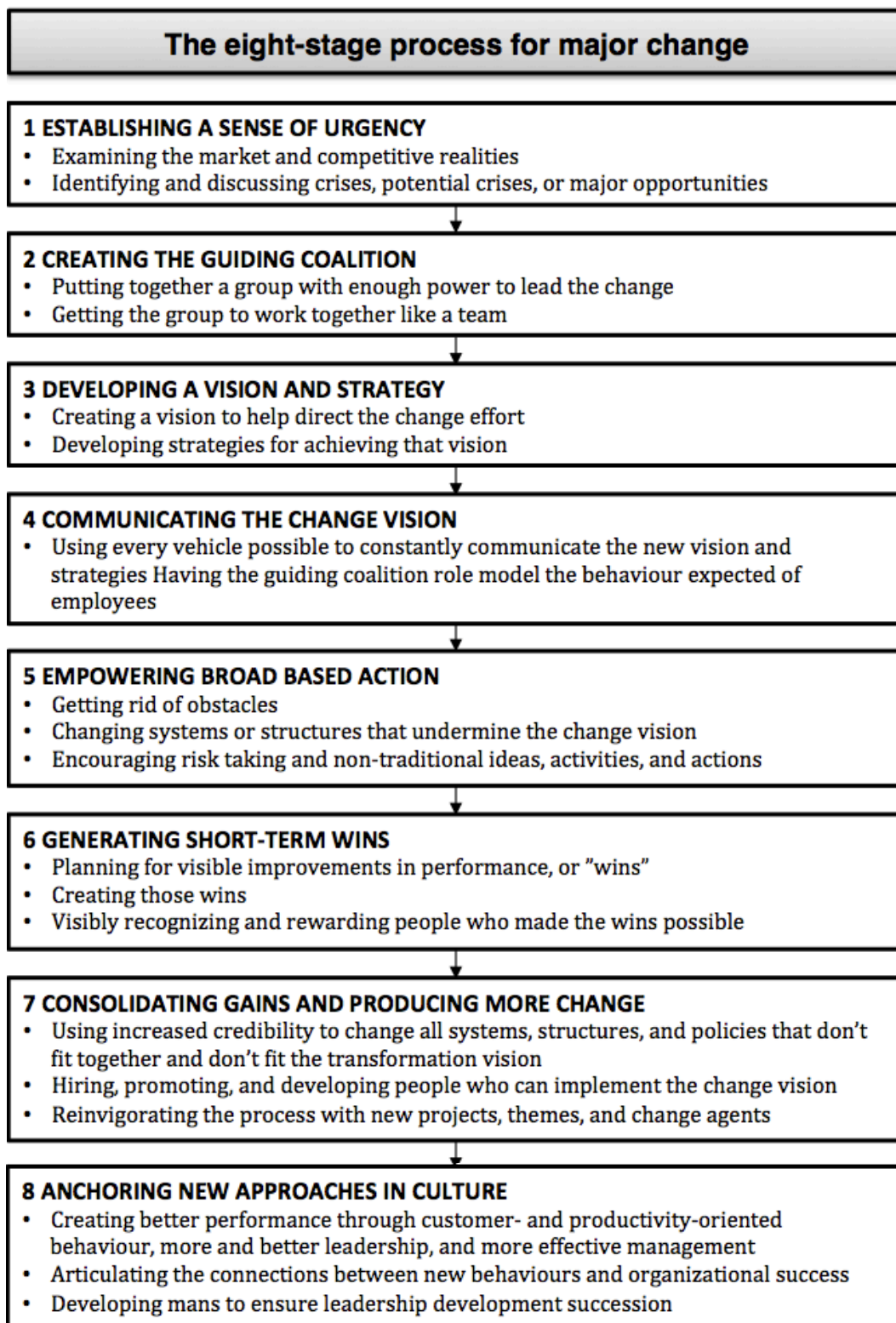


Figure 14. The eight-stage process for major change.<sup>140</sup>

<sup>140</sup> Kotter, J.P. 1996, "Leading change".

## 4 EMPIRICS - DESCRIPTION

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*Tetra Pak's Global Management System and the Global Processes that Tetra Pak follows will be presented and a description of the Global Process for development, Product Creation, will be found in this chapter. Also, Sealing Technology's process for developing (Sealing) sub systems, the NPI process, will be explained comprehensively as well as what work has been performed and will be performed regarding this process. Tetra Pak's process metrics will be described together with an explanation of how these measurements are decided.*

### 4.1 Tetra Pak's Global Management System

A decade ago, Tetra Pak started the transformation towards process orientation and after much effort and commitment the power and benefits of processes has been recognized. Today they understand that processes are about driving operational performance and to deliver value to customers. Tetra Pak's processes are documented and compiled in a Global Management System. The Global Management System contains relevant policies, forms, templates, procedures and description of roles and responsibilities. Global Management System has decided on a consistent set of process guidelines and frameworks resulting in a unified process look and feel.

At Tetra Pak there is a group called Global Process Office that works with process management and process measurements. They exist to assure good process work, good process knowledge within Tetra Pak, and to manage Business Transformation projects and communicate with other stakeholders.<sup>141</sup>

#### 4.1.1 Tetra Pak's View on Process Orientation and Definition

Tetra Pak process management is based on Dr. Michael Hammer's philosophy and his management theory by organizing work as series of tasks leading to an overall goal instead of organizing the work by specific functions. The company has realized that all work is process work and they organize by functions but manage by processes. A process is defined as "an organized group of relevant activities or tasks that together create customer value, it is a transformation of input(s) into output(s)." The emphasis is on what gets done, rather than what Tetra Pak do. It is about why, and not how. The focus is on time, quality and cost.<sup>142</sup>

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<sup>141</sup> Tetra Pak Internal, Tetra Pak Global Management System, retrieved 2011-12-19.

<sup>142</sup> Ibid.

### **4.1.2 Tetra Pak's Process Levels**

The Global Management System has a structure for the processes at Tetra Pak; they have been divided into different levels. The system was launched in November 2006 to help improve process consistency throughout the company and keep one repository for all official processes, guidelines, procedures and templates. There are seven levels, starting from level 0 to level 6. The first four levels, level 0 to level 3 are globally standardised, the other three levels have the objective of allowing specific additions and adoptions for other parts of the organisation. Level 0 is described as Global Processes, level 1 as Primary Processes, level 2 as Sub-Processes, level 3 as Activity Flows, level 4 as Task Flows/Lists, level 5 as Procedures and Templates and level 6 as Work and Script Instructions, these are shown in Appendix – Tetra Pak's Process Levels.<sup>143</sup>

### **4.1.3 Global Processes**

The Global Management System has defined several Global Processes that explain how work is performed on a high level. The Global Processes are divided into three categories; core processes, enabling processes and governing processes. Tetra Pak defines core process as a process “that realises the Business Idea by converting input into an output that is of greater value for external customers. It provides a comprehensive view of the organization and help focus on what is important.” The enabling process is described as a process “that supports other processes, typically by supporting indirect inputs.” The governing process is labelled as a process “that directs or tunes other processes.”<sup>144</sup> There are seven core processes, but due to secrecy they will not be named. The one that is relevant for this thesis is the Global Process Product Creation and it is described below.

#### **Product Creation**

The Global Process named Product Creation is the process that describes how development and launching of product portfolios are performed. The objectives of the process are to deliver a winning portfolio, to ensure availability of competence and technology, and to bring profitable, quality products to market fast.<sup>145</sup>

### **4.1.4 Primary Processes**

The primary processes are level 1, which means the level that comes under the Global Processes. The Global Process, Product Creation, is divided into two primary processes called Product Development and Technology Development. The Product Development process is the process that the NPI process is a part of.

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<sup>143</sup> Tetra Pak Internal, Tetra Pak Global Management System, retrieved 2011-12-19.

<sup>144</sup> Ibid.

<sup>145</sup> Tetra Pak Internal, Tetra Pak Global Management System, retrieved 2011-12-19.

### ***Product Development***

The Product Development (PD) process contains five Sub-Processes: Project & Concept Definition, Design & Risk Reduction, Prototype Development, Product Validation and Industrial Validation, which in turn consist of an activity-flow describing the Sub-Process. Between the Sub-Processes there are a forum called Toll Gate (TG), a product development project goes from TG 0 to TG 6. The objective of the Toll Gate forum is to make business decisions based on evaluation of total business value. During the PD process there are meetings called System Design Review Meeting (S-DRM), where an assessment of System Level Technical Maturity and Risks are performed and a recommendation of how to continue based on evaluation of System Technical Maturity versus target.<sup>146</sup>

The Product Development process is complex, however, it does not describe product development on a very detailed level. Therefore functions, such as Sealing Technology, needs more detailed activity flows to be able to visualize how work is performed.

#### ***4.1.5 Process Roles***

Tetra Pak has defined a number of Global Process roles, these are the ones driving performance and that is responsible and accountable for the specific Global Process. The Global Process Leader and the Global Process Owner is responsible for the strategic decisions, the Business Process Coach and the Global Business Expert is responsible for the operational decisions. The Global Process Driver is involved in both strategic and operational decisions. The five roles mentioned is the Global roles, correspondingly the same roles exists for every cluster or operational unit. These roles are named Local Process Owner, Local Process Driver, Super User and Process Performer, the Global role Process Driver do not have a corresponding role.

## **4.2 Tetra Pak's Global Measurement system**

The constant improvement of the performance of Tetra Pak's processes is a prerequisite for reaching Tetra Pak's targets and achieving its strategy. To be able to assure that the processes improve a measurement system has been created at Tetra Pak, Tetra Pak's Global Measurement System. It describes the Global Processes measurements and what other measurements tools are used within the organization.

In the Global Process Office that was mentioned in section 4.1 the employees work as facilitators regarding process measures and support the people that are responsible for the processes. It is the persons in the Global and Local Process roles

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<sup>146</sup> Tetra Pak Internal, Tetra Pak Global Management System, retrieved 2011-12-19.

that have the mandate to decide how to measure the process that they are responsible for. The Global Process Office is welcome to suggest improvements and so on, however, they are not able to make any decisions regarding the processes. On global level, the decision to follow the same strategy has been taken, a decision to have Global Process Key Performance Indicators (KPIs).

The measurement, the Global KPIs, at Tetra Pak is developed for the Global Processes and then they go down in the hierarchy. They are divided on the clusters or business units, which means that there is a geographical split. For example, first the measurement is for Tetra Pak Global then it goes down to the different platforms, business units and clusters.

Tetra Pak also measure their business with the Balanced Scorecard, and one of the perspectives it measures is business processes. The Balanced Scorecard at Tetra Pak contains information regarding strategic objectives and therefore no further explanation will be provided. However, a description of the Global Process Key Performance Indicators that is the foundation of the measuring of the Global Processes will be presented in the coming section.<sup>147</sup>

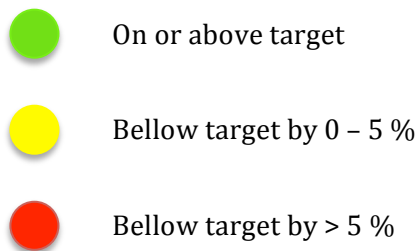
#### ***4.2.1 Global Process Key Performance Indicators (KPIs)***

Without wisely selected and applied Process Key Performance Indicators (KPIs) the tracking of the constant improvement of Tetra Pak's processes is not possible. Process KPIs in this way act as one of the fundamental tools to ensure Tetra Pak's long-term success as a company. The KPIs are defined in the Global Measurement System. For every Global Process three to seven Process KPIs are outlined to be able to measure the performance of each process, due to secrecy examples of the KPIs are limited, only the three KPIs for the Global Process Product Creation is presented in the next section. The measurement unit is percent. The Global Processes are measured four times every year, quarter one (Q1), quarter two (Q2), quarter three (Q3) and quarter four (Q4). The result is collected and presented in a quarterly report. For every KPI there is an indicator that shows how well the KPI meets the target. There are three indicators; green, yellow and red, and what they represent are presented in figure 15 on the following page.<sup>148</sup>

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<sup>147</sup> Tetra Pak Internal, Tetra Pak Global Management System, Global Processes, Process Measures retrieved 2011-12-19.

<sup>148</sup> Tetra Pak Internal, Tetra Pak Global Management System, Global Processes, Process Measures retrieved 2011-12-19.



**Figure 15. Indicator of how well the KPIs meet their target.<sup>149</sup>**

### ***Global KPIs for the Global Process Product Creation***

For the Product Creation process three different Global KPIs exists; time to market, release with quality on time and tollgate with quality on time. For these three measures a definition is outlined, together with the objectives of the measure. These will not be presented in the rapport due to secrecy.

## **4.3 Process Improvement Efforts**

Every Global Process is measured on Global KPIs; they are also being evaluated as a part of the Balanced Scorecard. However, there is no strategy for how to improve processes, the follow up after measuring is the responsibility of the Global Process Owners. They decide what to do with the results from the measurement and the improvement effort is entirely in the hands of this person. Therefore the quality of the efforts varies a lot.

### ***4.3.1 Internal Audit – Process Reviews***

Tetra Pak's Global and Local Process Owners use internal audit as a tool to improve quality of the process. This is an internal revision and it is a requirement for having an ISO Certificate. However, these audits vary a lot from process to process as mentioned before. The employees at Sealing Technology mentioned that there was some kind of audit for the Product Creation process for some years ago, but they never saw the result of it.

## **4.4 The New Product Introduction Process**

Sealing Technology started thinking about the creation of a process for developing sealing sub systems several years ago, but the work has been delayed for the reason that the organization has changed and roles and responsibilities has been under development. However, in the beginning of the summer of 2011 the process for developing sealing sub system went live, a process called New Product Introduction.

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<sup>149</sup>Tetra Pak Internal, Tetra Pak Global Management System, Global Processes, Process Measures retrieved 2011-12-19.

This process has been created and mapped by one person, an employee from Sealing Technology, but with help from other employees at Sealing Technology and other departments that are working with Sealing Technology. During the implementation phase the Local Process Owner have been developing and changing the process, which means that during this thesis the process was updated a few times. Some changes were done to create a more clear and understandable map and some changes were done because activities were missing in the map. The changes have been developed together or at least with support from Sealing Technology management.

From the beginning of the summer of 2011 and until January 2012 the work of implementing the process has been ongoing. The employees has until now been presented to the process during a workshop session, where they were able to get answers to questions and wonderings about the new process. One workshop session was hold in Lund, Sweden and one in Modena, Italy.

#### ***4.4.1 Process Measures and Process Improvement Efforts***

Tetra Pak's high level processes (level 0 - level 1) have defined measurements, as described above and then they go down in the hierarchy geographically. Regarding the other levels, the low level processes, the responsibility lies on the process owner to create a measurement system that supports continuous improvement. The NPI process is under implementation and no process measures have been developed and there is yet no plan of how to create any measures or how to improve the process.

#### ***4.4.2 New Product Introduction and Product Development***

The NPI process is a part of the Product Development process, a part of the last "steps" in the PD process. The NPI process starts at Toll Gate 4 and ends at Toll Gate 6, however this is not illustrated in the process map. The meeting, the S-DRM, and the decisions points that are performed during the PD processes, are not presented as a part of the NPI process. Sealing Technology works towards the platform/project but at the moment there is only a small connection between the NPI process and the PD process. It is only the activities regarding the RfD and the test and verification activities that are being performed together or by the platform/project that are illustrated in the NPI process.

### **4.5 Phases in the NPI Process**

The purpose of the NPI process is to describe and set rules and methods for new product introduction regarding sealing components. The NPI process is divided in five process phases, where each phase describes a sub-procedure. The sub-procedures consist of a set of activities/actions and to each sub-procedure the



stakeholders and documents are presented. A database/website, Product Quality Management (PQM), is used for maintaining and storing of all documentation and data throughout the process, except for the master data that is located and documented in SAP R/3. In the coming five sections and in figure 16 the phases in the NPI process is presented. In Appendix – NPI process, the process map is presented.



**Figure 16. The five phases of the New Product Introduction Process.**

#### **4.5.1 Concept Definition**

The first phase of the NPI process start with a sub-process called RfD alignment, which describes how a project starts. A project comes from inside of Tetra Pak, either from a platform or from the marketing company, when there is a need for a new product or when an existing product changes. The need comes in form of a Request for Delivery (RfD), and an activity description, with information regarding background, objectives, scope, assumptions, limitations, constraints, dependencies, risks and key milestones, is provided. The deliverables, acceptance criteria, resources, in form of time and money, and delivery dates are also presented in the RfD.

The Sealing Integrator Manager in Lund, Sweden or Modena, Italy receives the RfD and assigns a so-called Extended Team Member (ETM) from Sealing Integrator, who will be the link between Sealing Technology and the project. The ETM notifies the manager that is responsible for the technology that the project requires, which is either the Induction Heating Manager or the Ultra Sonic & Impulse Sealing Manager. This manager assigns project leaders and/or component owners to the project, which in turn updates the RfD. A meeting within Sealing Technology is hold to agree on the RfD before it is send to the project for approval. When the RfD is approved there are two ways to go, depending on if the project is development of a single component or if it is development of a complete sealing system? For a single component the component owner creates the activity in PQM and assign project members. For a complete system the project leader created a parent activity in PQM and the assigns child activity owners.

After the RfD alignment process a review of the RfD is done, and the decision whether the project is development of a new concept, development of a known

concept, TD project or if it is a Virtual Engineering project, has to be made. A TD project follows the Product Creation – Technology Development process and the Virtual Engineering project follows the process of Virtual Engineering. These processes will not be discussed further. A known concept project goes straight to the third phase, the verification phase, but a new concept project needs to go through the rest of phase one and phase two.

For a new concept project the child activities/ needs to be created and the parent activity or the single activity needs to be updated in PQM. Following this is the design of a concept model, on which simulations must be performed to finalise the concept design. After the design of concept model an internal Design Review Meeting (DRM) is hold to check the technical aspects of the development project. During this activity master data is updated in SAP R/3, for example the registration of article numbers is very important in this stage, as well as supplier data, drawings and the Bill of Material (BoM). Sealing Technology normally uses the same suppliers but in rare cases they need something these suppliers cannot provide. In these cases Supplier Management has to start a sub-process called Sourcing, and a contract needs to be created and master data needs to be updated. For all suppliers a Request for Quotation (RfQ) is sent so that delivery times can be confirmed, as well as dates for rig tests and filling machine tests. If both Sealing Technology and the platform/project approve the time plan the second phase, the concept phase, can start. If not there is a loop back and the first phase of the process start again.

#### **4.5.2 Concept Phase**

The second phase is only performed if it is a new concept project, as mentioned above. The manufacturing of concept parts/model is performed followed by a technical review and supplier feedback. At the same time Supplier Management starts a discussion about the commercial setup and makes a strategic review. The second DRM is executed before the technical review and supplier feedback to check that the technical requirements are in place. Then Sealing Technology performs an in-house test on the concept parts together with the project. This test results in a validation report. If the validation report is compliant with the RfD, and the strategic review from Supplier Management is in line, the design is frozen and the concept activity is completed in PQM, if not there is a loop back to the first phase.

#### **4.5.3 Verification Phase**

The third phase is performed for new concept projects and for known concept projects. The phase starts with an Engineering Change Meeting (EMC), which is combined with the third internal DRM. After this meeting the release in R/3 is performed, a release with Z2 block. This means that the component is released in the system, but not fully because it is not visible for Technical Service and it is only

Sealing & Creasing, the production, that can see it and order it. It is not commercially released. Then the creation of a new activity in PQM for the prototype, where the concept activity is added as a reference is executed. The design of the tools should be made as well as the drawings for the prototype and the master data in R/3 should be updated. The material for the tools and for the prototypes should be ordered. Then a reference batch should be produced and specification values should be verified, the reference batch is only produced if it is development of inductors because Sealing Technology produces this batch, other components are produced directly in the production, by Sealing & Creasing. After this validation test a TRM is held to control technical aspects and requirements that are set up so far. For other components, a first batch and for inductors a second batch, the validation batch, is produced in the production and specification values are verified, once again for the inductors. At last a batch should also be verified in-house by the project and if this one is approved the final design for commercial production is created. At the second ECM, which is combined with the fourth internal DRM, the Z2 block is removed and a full release, a commercial release, of the component is performed. During this phase some of the steps/activities are not performed, in some cases a validation batch is not created for the inductors, instead the reference batch goes straight to the in-house test.

#### ***4.5.4 Prototype Phase***

In this phase the Zero Series Production (ZSP) starts, the first prototype parts are ready for fieldtest. The fieldtest is performed by the project on customer sites. The test results in a field test rapport. If the fieldtest report is approved the evaluation and documentation of reports are made and the results are uploaded in the PQM and it is complete.

#### ***4.5.5 Deployment Phase***

The deployment phase is the last phase, which only symbolizes that Sealing Technology is a part of the deployment phase as a support for both the production, Sealing & Creasing and for the platform/project. The two activities are Deployment Machines Maintenance, which the platform/project is responsible for, and Manufacturing Ramp Up, which Sealing & Creasing is responsible for. Sealing Technology acts only as a link between the two, receiving orders from the platform/project and forwarding the orders to Sealing & Creasing, receiving the delivery for Sealing & Creasing and delivering it to the platform/project.

### **4.6 Product Quality Management (PQM)**

The database/website called Product Quality Management is a place to store and handle information on. The site is divided into five modules called Drawings, Document System, Activity Planner, Manufacturing and Management, see figure 16.

During this project the implementation of this website is also conducted. A number of employees are already using one or two modules in the system but the purpose is that everyone should use it. There have been two versions of the website already and a third is being developed. However, Sealing Technology does not use all modules. Below there are two sections describing the modules and foremost the Activity Planner, which is the most commonly used module.

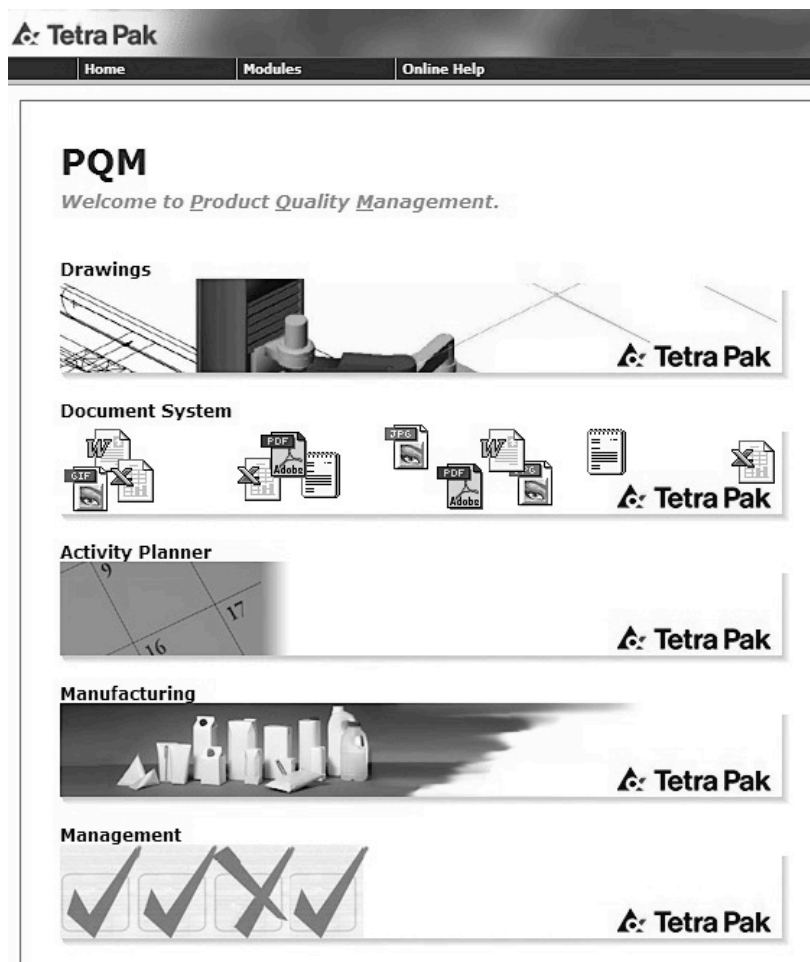


Figure 17. The PQM website with the five different modules.<sup>150</sup>

#### 4.6.1 Activity Planner

The Activity Planner is the module that is most used during the NPI process. This is the place where the RfD is uploaded and where the information regarding all activities exists and is updated throughout the process. In the Activity Planner there is a module called Visual Management, which is used during meetings to see how the

<sup>150</sup> Tetra Pak Internal, PQM, Home, retrieved 2011-12-19.

projects and activities are going. The Visual Management view is presented in figure 17. In the Overview all activities can be found together with the information about them.

Visual Management					
Activity	Concept definition	Concept phase	Verification phase	Prototype phase	Deployment phase
Activity number	●				
Activity number	●	●			
Activity number	●	●	●		
Activity number	●				

**Figure 18. Visual Management view in Activity Planner.<sup>151</sup>**

For every activity some information is required, this information is put into the Activity Planner to make sure it is available for everyone. This information is presented in the list below.

- *Activity number*
- *Article number*
- *Created date & created by*
- *Activity group*
- *Description*
- *Extended team member*
- *Design responsible user*
- *Activity start & end date*
- *Design time schedule start & end*
- *Network number (SAP/R3)*
- *Platform*
- *Machine type & machine volume*
- *Component name*
- *Number of units requested & number of units confirmed*
- *Delivery status*
- *Delivery date requested, estimated, confirmed*
- *Current process step & status*
- *Current tollgate*
- *TG2 price, TG4 price & TG6 price*
- *Planned tollgate advancement*
- *Material*
- *Project members*

#### **4.6.2 Drawings, Document System, Manufacturing, Management**

As described it is the Activity Planner that is mainly being used during the process. However, the drawing module is also being used by Sealing Technology to store drawings, and material related to that. The other three modules in PQM are used by the production, Sealing & Creasing, but not to full extent.

<sup>151</sup> Tetra Pak Internal, PQM, Activity Planner, Visual Management, retrieved 2011-12-19.

## **4.7 Meetings During the NPI Process**

During the NPI process several meetings are hold, they have different focus and objectives and to understand the process it is important to understand what the meetings during the process is about. The four meetings are called Internal Design Review Meeting, Internal Technical Review Meeting, Release Forum and Engineering Change Meeting.

### **4.7.1 Internal Design Review Meeting (DRM)**

This DRM is internal, only for the development function, Sealing Technology, and the production, Sealing & Creasing. The focus of this internal meeting is on engineering and design. The objective is to follow up the design steps needed to get a product/component to meet the requirements. The meeting handles the specifications and drawings for the component. During the NPI process there are four internal DRMs, and for each meeting a check is performed to see if the requirements are met so far in the process. There is a discussion regarding the component to see that everything that should be completed is completed.

### **4.7.2 Internal Technical Review Meeting (TRM)**

The TRM is somewhat alike the DRM, both Sealing Technology and Sealing & Creasing are participating. The objective is to have a technical discussion regarding the transfer from development to production. The focus is on machine settings and limits. As for the Internal Design Meeting there is a checklist of what should be performed and ready so far with regard to the technical aspects. The meeting is held one time during the NPI process. It is in the final part of the process before starting the production of the component.

### **4.7.3 Release Forum**

This is a forum in which Sealing Technology govern the release of Induction Heating (IH) sub systems. The meeting recur monthly and is not only for Sealing Technology but also for other stakeholders in the project. The idea of the RF is to guide projects all the way to a released IH system. The objective of the forum is to review the technical readiness level of the component, such as lifetime and repeatability, to assure quality. However, the objective is not to go into any business decision such as business versus risk decisions. Decisions like that are taken on a higher level, together with the rest of the project team. The information and the decisions from the RF will be relevant and available for Sealing Technology Management, Supply Chain (SC) Sealing and Creasing (S&C) Management and Platform Project Manager and Module Manager.

Criteria for releasing components will be developed during these meetings, and as the meeting “mature” requirements and specifications will be evaluated and

improved. A tool has been created in order to judge the readiness level of components. The tool will help in communication of the technical risk of releasing components before they are actually ready to release according to the NPI process. The Release Forum is also a way to connect to the NPI process by understanding where in the process a component are and what documents and requirements needs to be in place in that stage of the process. This is a way to make sure everybody is following the phases in the process.

The Release Forum meetings started during the period of this thesis. The first meeting was hold in January 2012. Sealing Technology Management realized that it is important to document and assess each component before releasing it to be able to follow up and to understand the risks of the release. The meeting will also highlight the importance of following a process, and not take any short cuts, which will improve quality of components.

#### ***4.7.4 Engineering Change Meeting (ECM)***

The meeting is a planning and review meeting to collect all data and information about the components and a way for development and production to align their work and to plan the releases of the components. During the NPI process there are two releases, one for the production only and one full commercial release. Before theses releases an ECM is hold to make sure everything and everyone is ready for the release.





## 5 EMPIRICS – DISCUSSION

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*In this chapter a reflection regarding Sealing Technology's NPI process will be presented as well as what problems and findings has been revealed during the interviews, observations and content analysis. In Appendix – Interview Guide, a guide that was used during the interviews can be found, to better understand what the interviews have been covering.*

### 5.1 New Product Introduction Process “As-is”

The information and thoughts from several employees at Sealing Technology was gathered during a period of six weeks, with the method described in chapter 2.3 and mainly in section 2.3.1. The employee's thoughts have been a valuable part of understanding the NPI process and the work regarding it. In the following sections these thought and opinions will be presented, they have been divided into four categories; implementation, objectives and goals, people and resources and process/process map. These categories were chosen after having compiled the interviews. It was clear that these subjects were the ones that the employees at Sealing Technology wanted to discuss and therefore became the focus of the interviews.

#### 5.1.1 Implementation

The implementation has been ongoing since the summer of 2011, and the plan is to have successfully implemented the process in the middle of 2012. However, Sealing Technology management wanted to evaluate the NPI process, and understand what the employees thought about working in it so far. The reality was that in December 2011 a substantial group of people who had been presented to the process were not fully comfortable with it; it had only been shown to them during a workshop session and one of the interviewed employees had not seen it at all. This affected the quality of the evaluation that was performed during this thesis. Many employees felt that they could not evaluate the quality of the process, and that they could not do it until the implementation is completed. The process, as it was during the project, mainly directed to people working with inductor and dolly development, these were also the people that had most knowledge about the process so far. Still even they could not fully evaluate the process because they felt it was too early to say how it was working.

The NPI process is a combination of how Sealing Technology management wants work to be performed and how it is being performed. Parts of it was created as a “to-be” map, which means it was how the management wanted the employees to work,

not how they actually work. After the implementation, some employees have adjusted their routines, but not all of them. Therefore there are on one hand people trying to follow the process and on the other hand people performing work as they did before the process was introduced. There is a gap between how work is performed and how the process describes how work should be performed. Also, during the implementation changes in the process map has been made and these changes has not yet been presented to all the employees, therefore there is a gap of knowledge between the employees at Sealing Technology regarding the process.

The PQM that is or should be used during the process was implemented as well, and many activities in the process are performed there. It should be used, but from the interviews with the employees in Modena, the facts showed that they had not acquired adequate education and training, so they were still not using it as they should. Also, the same employees have lacking knowledge about the DRM meetings and the TRM meeting.

### **5.1.2 Objectives and Goals**

The importance of a common objective and goal regarding the process is essential; this is also something that should be communicated to the employees when presenting a new process. It creates a motive for why the following of the process is important. The interviews addressed this subject but the answers showed that no vision or strategy for why implementing the process was clearly presented, neither the objectives nor goals regarding the process was discussed.

The process fits the development of inductors and dollies, but other components have not been included when creating the process map. Questions that are important to answer are whether the process should fit for all components, if it should only fit for inductors and dollies, if it should fit for an entire system or if it should fit for everything being developed at Sealing Technology? To these questions the answers have been contradictory. This is also something that is noticeable in the process, the DRMs and the TRM only handles inductors where on the other hand the RF meetings handles both inductors and dollies.

### **5.1.3 People and Resources**

The organization's view of processes and the organization's view on process orientation are important to succeed with process efforts, there must be a common goal and objective regarding processes and there must be a belief that processes can help develop the business and operations. This is something that Tetra Pak works very hard with, however it takes time. Something that is noticeable at Sealing Technology is that not all employees believe in processes and process orientation;

these people find processes to be administrative and unnecessary. The feeling that everything is easier without processes is not unusual.

The resources that Sealing Technology has at the moment cannot handle everything in the process; there are many activities that should be performed to assure the right quality on the components. Since most development projects are under a time pressure, activities in the process are sometimes skipped. Also for the reason that the process is created as a to-be process, there are at the moment not enough resources to perform all activities. For example the activity simulations, in the process it is illustrated that simulations should be performed for all new concept projects, but it is far from true, employees do not have time for this and there is no way of deciding for what projects it should be done for either.

Since the process is so complex it makes it easy for people to take shortcuts, which sometimes might be justified and sometimes not. Of course this also becomes a problem when there is not enough time, then essential steps will be disregarded and the important thing becomes to deliver on time, even if what is being delivered does not have the right or requested quality. The mentality within Sealing Technology has been described as “we can do it, we can fix it, no problems, whatever you want” and so on. Since there are many times when activities are ignored one can ask if they really are necessary.

#### ***5.1.4 Process and Process Map***

There are parts of the process that are not adequately defined, employees are not sure what should be done and how. Especially the parts of the process that are “new” have not been explained enough during the implementation, and some parts are not even in place. It makes it hard for employees to understand the process, if they are not presented to the prerequisite. There are documents and meetings that are not defined, for example a validation report that is illustrated in the process but it does not exist in reality and a meeting called Release Forum, that now exist in reality but it is not illustrated in the process. The last phase of the process, the Deployment phase, seems to illustrate something that happens earlier in the process before the component is completely released.

The beginning of the process is the part where the interviewees have been able to evaluate and explain that it is too time consuming. The RfDs are not completed and the information coming from platforms/projects in to Sealing Technology is insufficient. This has been a problem for a long time.

Certain employees working with development of inductors have been able to provide some evaluation in terms of comments stating that the process fits for development of inductors. The development of other components have less

directions and not a clear process to follow, therefore it was hard for employees to evaluate the process from that point of view.

The connection to the high level process for Product Development is not illustrated in the NPI process. The knowledge that the NPI process goes from Toll Gate 4 to Toll Gate 6 in the PD process exist but meetings and other activities in the PD process are not illustrated and several interviewees revealed this.

## 6 ANALYSIS

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*In chapter 4 and 5 a description and reflections regarding Sealing Technology's situation and process have been presented. It is time to analyse these facts, the empirics, together with the rest of the information that has been collected during this thesis, the frame of reference.*

### 6.1 State of Science Versus State of Art

To understand what should be done to improve the situation for Sealing Technology one must first understand how the situation looks like at the moment and what has been done to get to the point that they are today. This was one of the objectives of the thesis. Furthermore, to understand what can be improved with the situation today one must compare it with the theory and decide state of art efforts to improve the situation. This is what will be discussed in this chapter. However, the author points out that the state of art is adjusted to fit the situation were Sealing Technology is at the moment and thereby the state of art for what can be done to improve their situation today. It can consequently not be seen as a state of art from a general perspective.

It has however been difficult to establish a progress because of the dynamic situation and during this thesis the conditions have altered, for example the process was improved and changed. Also the implementation of the process had not come as far as Sealing Technology management thought from the beginning and there were struggles when trying to evaluate the process.

#### 6.1.1 Process Orientation at Sealing Technology

First of all the acceptance of process thinking is important before starting to work with processes, and a positive opinion regarding what processes can achieve. At Sealing Technology the communication of the meaning of process thinking has not been enough from the start and therefore the implementation is taking a lot of time. Sealing Technology have missed important steps, such as aligning the objectives and to assure that everybody is positive and willing to work towards process orientation.

Process orientation is of great importance to the success of a business, as well as for Sealing Technology and when the employees realizes this and applies the new way of thinking the benefits will come. The purpose of process orientation is to have a process perspective on systems and structures together with attitudes, values and organization culture.

This process perspective is not completely reached within Sealing Technology, even if there are several employees that are positive towards process orientation. There are still employees that do not see the benefits of working with processes.

### **6.1.2 Developing the NPI Process**

The work that Sealing Technology did when creating the NPI process can be compared to the steps in chapter 6.2 regarding process improvement/process redesign. From the start there was no documentation of the process for developing components, but a process map was created and then improved. The development of process documentation and an improved process at Sealing Technology almost followed the steps:

- *Planning for a process improvement effort*
- *Mapping existing process*
- *Analysis of existing process*
- *Design of a new improved process*
- *Managing the transition to a new improved process*

The author however feels that some central aspects were missing. The work with the process map and improving the process were well performed, but the parts regarding the first step, the planning and the last step, the change were lacking in execution. The objectives and goals were not communicated throughout the organization from the start. What kind of components should be covered and included in the development process was not clear. The level of detail of the created map is high and this was the plan but some connections to other processes that the NPI process connects to, for example the Product Development process, is missing. An employee at Sealing Technology performed the mapping. Walk through and interviews were used, and of course the experience he possessed from before. The existing process was mapped and then it was analysed and a new improved design of the process was created. The names and symbols of the process are in line with Tetra Pak's Management System. However, Sealing Technology did not develop measurements, and activities and roles, especially new activities, have not been properly described. The transition to the new process has not involved enough change management. Employees were not satisfactory acquainted with the change and reasons for the change.

The development of the process was good, however activities that facilitate the implementation of a new process were infringed. More time should have been spent on the objectives and the description of the new NPI process. Also measurements or improvements efforts should have been created or at least a plan for how to create them should have been developed.

### **6.1.3 Process Versus Reality**

The NPI process was developed to create structure and to be able to visualize the development process and thereby be able to track deficiencies, mistakes and errors. The objective was to improve the quality of components; having a clear process from customer need to customer satisfaction should make this possible. The NPI process matches the reality in some ways, but there are parts and activities in the process that describes how the management want the employees to work, and thereby an improvement of how work was done before the process. The NPI process “as-is” was developed and improved to a “to-be” process. This is good; the process was in a way created to encourage the employees to work in a more efficient way than before. However, as described in the previous section the information about the objectives and the changes was not enough communicated.

The ideas and intentions of Sealing Technology were all well thought and suitable. The challenge to get employees to adjust to the new way of working and to implementing the process however is very difficult. During the period of this thesis the author noticed that the employees had not yet adapted to the process in full. The main part of the employees is describing their work as it was performed before, and not in line with the NPI process. The problem is also that people perform activities differently. A small part of the employees expressed that they did not believe in process thinking.

Employees, and especially the ones that communicated an optimistic view regarding process orientation, did also express that the new process describes a better and more efficient way of working than how the work was performed before. The NPI process contains the necessary activities to develop an inductor and other sealing components that Sealing Technology produces in-house. Nevertheless, a good process is useless if people are not acknowledging and following it.

In the beginning of 2012 the Release Forum meeting was introduced as a way to make sure the process is being followed and to assure quality of released components. The meeting will act as a checkpoint for the projects to see how far in the process the project is and also make sure that deliverables up to that point has been performed. The Release Forum is a great initiative, and it encourages employees to acknowledge the process. This will improve the implementation of the process and also the quality of released components.

In a perfect process oriented setting the process is describing work from customer need to customer satisfaction. The employees have knowledge and understanding of the process and especially their part in the process and how that part contribute to the result. The objectives of the process should be clearly stated and aligned with

strategy. The objective should also be known and communicated to everyone in the organization. Processes should not be perceived as something bothersome, but rather as a facilitator to efficient work.

The conclusion that there is still a gap between reality and process after a period of six months of implementation can be drawn. Everyone in the organization does not believe in process orientation and a big part of the employees are not fully comfortable with the new way of working and some do not understand the NPI process. This can be linked to the missed steps and activities during the development of the NPI process.

#### **6.1.4 Process Measurement**

Sealing Technology has not developed any measures for the NPI process, which should preferably have been done in combination with the development of the process, see chapter 3.6. There is no initiative or plan for how to measure the process in the future either. Sealing Technology management has stated that they see the need to develop an improvement system for the process, which contains measurements and evaluation efforts.

Sealing Technology has during the period of this thesis started the Release Forum meetings. This is a good initiative and together with the internal DRM and TRM and their checklists it can be compared to Advanced Product Quality Planning checklists. There are similarities, and the author found that Sealing Technology has developed a good way to assure quality of components. It is now only the challenge of making sure that the new initiative is working and being performed correctly. As mentioned it is a good way of assuring quality of products, but when it comes to assuring quality of the process there are yet no initiatives.

Measuring a process is one of the most important things if striving for process and quality excellence. It allows the management and other stakeholders to understand how well the process is working and where improvements can be made. Measurements help steer an organization in the right direction, it facilitates benchmarking and it creates a common language for everyone involved. These are benefits that Sealing Technology could really take advantage from; important are also that problems can be identified and change can be motivated.

The decision of what kind of measurement system to choose is difficult. Sealing Technology is foremost a development function and most work is performed under time pressure. Therefore the measurement system should be easy and understandable and not exceedingly time consuming. In chapter 3.6 a description of how to develop a measurement system is provided. There are steps in that model that has already been performed by Sealing Technology. The process has been



mapped and Sealing Technology has touched upon the manager's trust and engagement as well as development of competence. The author feels that there is still some work to be done regarding people involvement, their competence and their view on processes. Sealing Technology has a good view and knowledge of their customer's requirements, and together with the strategy and goals of the function they should be able to develop measures. They should then perform a measurement and based on the result set goals for improvement.

Tetra Pak's Global Measurement system has set up KPIs for the Global Processes Product Creation and this is something that Sealing Technology should take advantage from. Since the NPI process is a part of the Product Creation process on a lower level the goals and measures should be the same. The NPI process can be measured on the same, but slightly adjusted, KPIs as the Product Creation process:

- **Time to market**  
*This KPI cannot be fully transferred to Sealing Technology, since it is time to market and Sealing Technology develops their components to platforms/projects and not to market. However, this KPI could be express as time to release component/sub system.*
- **Release with quality on time**  
*Quality is in the end one of the most important things for the final customer, and this KPI should be very important for Sealing Technology. They should strive for always releasing their components with the right quality.*
- **Tollgate with quality on time**  
*The NPI process goes from tollgate 4-6 and the fifth tollgate is not completely defined for any projects at Tetra Pak. Therefore there would only be one measure and it would be the same as release with quality on time. Therefore this KPI can be transferred to Process phase with quality on time.*

Sealing Technology could benefit from measuring the three measures described above, which are all easy and understandable. A measurement regarding resources, such as time and cost, could be introduced because the three measures above do not take it into account. A complementing measure is necessary, a measure such as:

- **Use of resources**  
*This measure should be compared to budget and resource plans to be able to show how well the organization is performing regarding resource planning.*

As the process mature more measurements and KPIs can be developed according to the model discussed above and explained in chapter 3.6. In ISO 9004:2009 measuring processes should be done on a regular basis. One of the measurements

that are suggested in ISO is KPI, together with three other process improvement efforts.

It is important to understand why to measure but it is as important to follow up the measures. Measurements provide an organization with a view of how performance is at the time and this is good. Still, if the measures are not analysed issues and improvement efforts will not be found, and the development of the organization will be slow.

### ***6.1.5 Process Evaluation and Continuous Improvement***

Sealing Technology has no metrics for the process and no plan for how to evaluate the process either. This thesis had the objective to evaluate the NPI process, but since it was difficult to evaluate it after only six months of implementation the need for a plan of how to evaluate it in the future is of importance for Sealing Technology.

The method the author used during this process is described in chapter 2 and the efforts made had the objective of understanding the process and having it evaluated by the employees and by studying other sources of information. This thesis was very comprehensive and time consuming, but parts of the evaluation process can be used for Sealing Technology in the future, combined with other evaluation activities. It is important to understand the Lean concept when improving processes; the reduction of waste is necessary for creating an efficient process. The author noticed that activities in the process sometimes were skipped even though the management said that they were necessary, and whether all activities are essential for the outcome should be assessed.

According to ISO 9004:2009 processes and their interrelationship should be assessed on regular basis and actions for improvement should be taken. The suggestion to use KPIs, Internal Audit, Self Assessment as well as Benchmarking is presented. KPIs were discussed in the previous chapter. The other the improvement efforts will be handled in the following sections.

#### ***Internal Audit***

Internal audits provide valuable information for understanding, analysing and continually improving the organization's performance. It can be used to assess the effectiveness and implementation of process management or any other management system. People who are not involved in the activity being examined should conduct an internal audit.

This thesis has been an internal audit of the process management at Sealing Technology, with focus on the NPI process. Therefore the method used in this thesis can be used in the future as discussed in the previous section. An internal audit often

results in the form of report containing information on compliance against given criteria, nonconformities, and improvement opportunities. This is the objective of this thesis, to provide Sealing Technology with information about the existing situation and what can be done to improve the same. Internal audits are time consuming and hard to perform since there is a need for someone from outside the organization to perform it. Therefore it is understandable that internal audits cannot be performed as frequently as other process measurement and evaluation efforts. They are however very beneficial when being performed, and they act as input to management.

### ***Self-assessment***

Self-assessment provides an overall view of the performance of an organization and it can help identify areas for improvement and to determine priorities for the main concerns. The self-assessment helps determine the strengths and weaknesses and the maturity level of the organization.

There are already defined steps for how to perform a self-assessment, these steps are presented in ISO 9004:2009, and the author think this is a good way for Sealing Technology to work with assessment of processes. The self-assessment tool can be defined and adjusted for an organization. Additional criteria matching an organization's specific need can be added. The scope and the person responsible for the assessment should be determined, and then an assessment can be performed and hopefully result in an action plan for improvements.

### ***Benchmarking***

Benchmarking a process towards other processes, both inside and outside of the organization can help to understand best practice. The organization that is chosen to benchmark against should be facing the same challenges and have similar strategy and goal.

Sealing Technology could surely benefit from a benchmarking towards both internal and external functions. However a benchmarking that would be performed at this stage would act more as a review of how another function work with processes. It will be hard to make a comparison since Sealing Technology have not developed any measures for the NPI process. A benchmarking should therefore have the objective to understand how other functions work with processes, and therefore the most benefit would come by looking at a function that has come a long way with process management. In the future when measures are defined for the NPI process Sealing Technology should be able to perform benchmarking as a comparison to their own performance.



## 7 RESULT AND RECOMMENDATIONS

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*In this chapter the conclusions of the thesis is presented. These conclusions were drawn from the analysis. The objective of this chapter is also to give Sealing Technology recommendations regarding the NPI process. The chapter will be concluded with a description of benefits that will come from the improvement proposals.*

The first part of this thesis was aimed to understand how development of components and (sealing) sub systems is done and if that is compliant with the NPI process. The NPI process describes an efficient developing process and it is an improvement of how the development was performed before the process was created. The interviewed employees that expressed a positive view regarding process orientation and process management did also express that the new process portrays a better and more efficient way of working. However, a conclusion that the main part of the interviewed employees does not follow the new process that has been created can be drawn, and this for different reasons.

The problem is not the process, but as stated in the reflections regarding the NPI process there are small improvements that can be performed to create an even clearer and understandable process map. These improvements will be presented to Sealing Technology, however they are not of interest for this thesis.

The reason for developing a new process and a process map describing the process at Sealing Technology was to create knowledge of how work is performed and thereby detect and then improve quality issues. Process documentation is essential when working with quality. Sealing Technology has succeeded to develop an efficient process but this is not enough. The implementation must be successful and also there is a need for further work regarding process evaluation and process measurement. This is just as important as having a good process.

The second focus of the thesis was just this; evaluate the process and find ways to assure the quality of it. This was done by looking at the current situation, the empirics and comparing to theory to understand the best way for Sealing Technology to continue with process management and especially regarding the NPI process. The author found that process measurements and process evaluation efforts must be implemented.

There is a gap between where Sealing Technology stands at the moment and where they wish to be. The situation is as it is, and the situation is not bad, but there are definitely improvements to make. In figure 18 one of Tetra Pak's internal

illustrations is presented, it visualizes what performance is created by. Processes, people and tools are some of the areas the Sealing Technology has to improve/develop further.

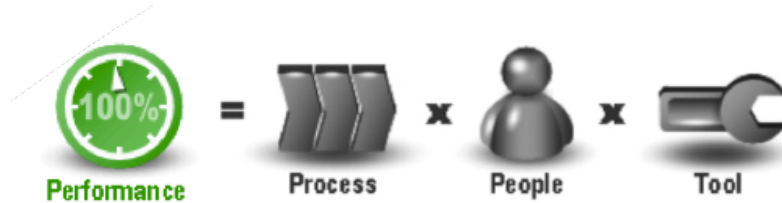


Figure 19. Tetra Pak's internal illustration of performance.<sup>152</sup>

## 7.1 Improvement Proposals

Areas of focus have been chosen to help Sealing Technology on their way to process excellence. These areas are presented in the figure below and an explanation of the areas follows. The areas of focus are arranged in the order in which they should be performed.



Figure 20. The areas of focus for Sealing Technology.

### **Process Orientation**

- *Involve employees and help them understand the benefits of process orientation*

<sup>152</sup> Tetra Pak Internal, Tetra Pak Global Management System, retrieved 2011-12-19.

The acknowledgment of process thinking is essential when working with process management. The process perspective is not entirely reached within Sealing Technology, even if there are several employees that are positive towards process orientation. Employees must understand the benefits that come and understand why working with processes will help an organization to excel. This is the first step in getting an organization ready for process management. Sealing Technology should use change management to make sure the employees are ready and also communicate the advantages that will come. Also, the NPI process is a different way of working; the changes that have been made must be explained.

### ***Objective and Goal***

*- Create a common objective and goal for the NPI process that supports strategy*

Sealing Technology lost one important step when developing the NPI process. The objective and goal was not enough communicated and/or it was not aligned. Employees have different view of what kind of components should be covered and included in the development process. This is something that Sealing Technology management must state, and then make sure everyone understands.

### ***Implementation***

*- Close the gap between reality and process*

Sealing Technology has already taken some initiatives to make sure the process is being followed, such as the Release Forum meeting, the internal DRM and TRM meetings. The author is hopeful and sure that these meetings will develop and become good ways of assuring that the gap between reality and process is closed. However, to speed up this, specifications for new activities should be created describing what should be done, how it should be done and who should do it.

### ***Process Measurement***

*- Establish process measurement, assign responsible person and perform measurement*

There is a need to develop an improvement system for the process, which contains measurements and evaluation efforts. The first suggestion is to take advantage of the KPIs that have been developed for the Product Creation process, since the NPI process is a part of it. The KPIs can be adjusted to fit the NPI process, and thereby three measurements can be performed, and these can be complemented with a fourth to assure that resources are included in the measurements. The four measures are:

- ***Time to release component/sub system***

- ***Release with quality on time***
- ***Process phase with quality on time***
- ***Use of resources (compared to budget)***

Sealing Technology could start measuring these four measures and as the process mature further measures can be developed according to the model described in chapter 3.6.

The measures should be performed regularly, but how often this means is not clearly described in theory, it depends on the situation. However, since most processes at Tetra Pak are measured four times a year this is what the author suggest that Sealing Technology starts with. If this is too time-consuming Sealing Technology can in the future adjust the regularity of performing the measurement to better suit the situation. The follow-up of the measures are very important and the results should be presented for employees and a discussion and analysis regarding the measurements should be conducted. To assure that the measurement efforts will be accomplished Sealing Technology should select a person who is responsible for the measures. The Process Owner is usually the one responsible for measurements. At Sealing Technology the Process Owner is the Manager over the function and the author believes this person is too busy and already have too many responsibilities to perform this task. Therefore an employee with knowledge about processes should be chosen instead.

### ***Process Evaluation and Continuous Improvements***

*- Establish a plan for process evaluation, assign responsible person and perform evaluation*

Three methods for evaluating the NPI process have been selected. When performing the evaluations for the first time the author suggests that it would be wise discuss whether all activities in the process really are necessary to create good quality on the delivered product. These three are presented below.

- ***Self-assessment***  
*Self-assessment should be performed on regular basis, and this should be done according to the tool provided in the ISO 9004:2009. This is a good way to understand strengths and weaknesses of the process, and a person or team inside of Sealing Technology can perform it.*
- ***Benchmarking***  
*The author recommends that the first benchmarking is perform towards a function within Tetra Pak, a function that has been working with process*



*management for some time and therefore have more experience. In the future benchmarking towards other companies can also be interesting.*

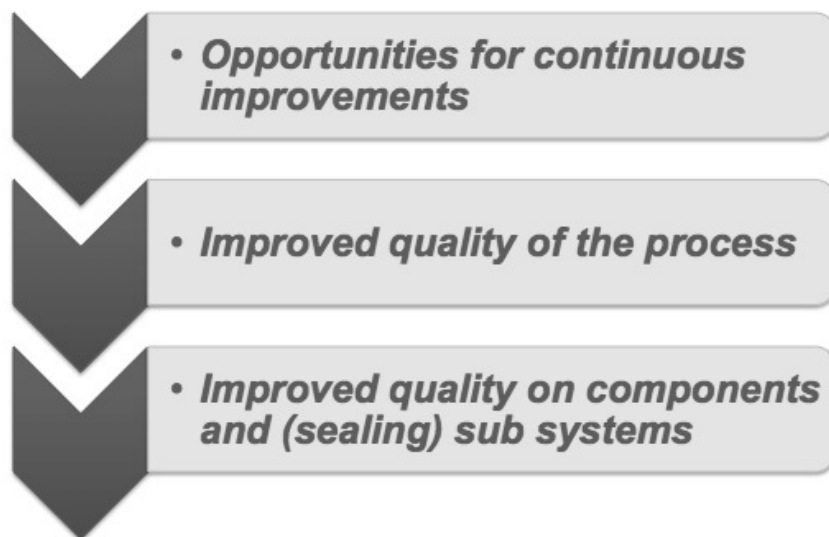
- **Internal audit**

*An internal audit is in some way what this thesis has been all about, even though the focus of this thesis has not only been to evaluate the process. Internal audits can be time consuming and difficult to perform since a person that is not involved in the process has to perform it. Internal audits can be performed when there is a need and when the self-assessments are not resulting in any suggestions for improvements.*

As for process measurements, process evaluation needs an employee that is responsible for making sure that they are performed, at the right time and in the right way.

## **7.2 Benefits Deriving from the Improvement Proposals**

The author believes that Sealing Technology has started a journey towards process excellence, and a journey that is necessary to adapt to the competitive setting that they are a part of. During this thesis improvements regarding the NPI process have been many at Sealing Technology. The, by the author, suggested areas of focus are a recommendation of how Sealing Technology can continue to improve. The proposals will, if right performed, end up in the major benefits that are presented below.



**Figure 21. Benefits for Sealing Technology.**

- **Opportunities for continuous improvements**

*When the process is in place and the employees are comfortable in it, the measuring of the process will begin. The measurements and the evaluation of the process will identify areas where improvements can be made.*

- ***Improved quality of the process***

*The improvements that are found during the measuring and evaluation of the process will lead to an enhanced quality of the process, if actions are taken.*

- ***Improved quality on components and (sealing) sub systems***

*As the quality of the process improves so will the quality of the delivered solution. The process will be more efficient and mistakes and shortcomings will be reduced due to the control that is created with successful process management.*

The three benefits above will be obtained by focusing on the action plan that was created for Sealing Technology. A positive view regarding process orientation and to close the gap between reality and process is the first steps. Then the knowledge and understanding that will be attained when performing measurements and improvement efforts will create opportunities for further improving the NPI process, and the quality of the process will increase. When the process quality increase and continuous improvements are performed the quality of the developed products will be enhanced as well.

## 8 CONCLUSION

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*The discussion chapter concludes the master thesis. The trustworthiness and authenticity of the thesis is discussed. This chapter also provides Sealing Technology with proposals for further work and areas for further improvement.*

### 8.1 Discussion Regarding the Research

As stated in chapter 2.6 the evaluation of research is of great importance and in qualitative research there are two major criteria that should be considered. The criteria are trustworthiness and authenticity. The master thesis has followed the methodology described in chapter 2 and for this reason the thesis is trustworthy and authentic, a discussion regarding this follows.

The use of multiple sources of data and information, which was described in chapter 2.3, provides credibility. Even though the master thesis focuses on a process within Sealing Technology there is transferability because the empirical description is comprehensive and thereby others can use the findings in this master thesis for other purposes as long as they understand the prerequisite for this thesis. Dependability is assured by saving all gathered data in a structured manner, interviews have been recorded and Tetra Pak's internal documents have been stored throughout the thesis. However, after this project the internal documents will only exist at Tetra Pak for reasons regarding secrecy. The author has had an open mind when performing this project and personal values has been put aside. The thesis describes the situation today and findings regarding the situation, both deficiencies and efficiencies. This was done with the objective to create better understanding for the members of the social environment as well as inspire them to participate in creating a better environment.

The Systems approach combined with qualitative research provides results that are subjective, but the author argues that the chosen methodology was right since a process management problem cannot be completely objective and quantitative analysed.

### 8.2 Proposal for Future Work

The thesis has focused on the NPI process and the delimitations and time frame of the project made it impossible to analyse issues that was outside of the purpose of the thesis. Therefore three proposals for future work will be provided.

### ***Information Management***

It is clear for the author that there are many locations for storage of information. This is confusing and time consuming, information should be easy to find. The PQM tool is new and in the future it would be good if everyone in the organization learned and used it during all the phases of the process. Sealing Technology can benefit from reorganizing and reducing their locations for storage of information.

### ***Connection to Other Processes***

The collaboration among employees from different functions is often difficult, uncertain, and suffers from too little mutual understanding in organizations. Therefore the author thinks it is important to not only acknowledge the process within the function but other processes that are connected to it. Sealing Technology can advantage from understanding functions that they cooperate with and thereby prevent sub optimization. Also, the connection to other functions and processes could be more clearly stated in the NPI process, the external S-DRM should for example be visible in the process map.

### ***Business Excellence Model***

Sealing Technology has to assure that their processes are working, and there is some work to be performed regarding the NPI process. However, in the future the author suggests that they implement a Business Excellence model. It can be compared to a self-assessment tool that reviews different parts of the organization; focus is not only on processes. This will help to create an even better organization and thereby components and (sealing) sub systems with quality. Two Business Excellence models are described in chapter 3.

## **8.3 Conclusion**

Process management and process orientation is a long-term project that never ends, areas for improvement appears continuously. It is no different for Sealing Technology. Many good initiatives towards process orientation have been taken. During the thesis the author has come to realize further improvements that Sealing Technology can do to make sure that their goal with processes and especially the NPI process will be accomplished. Hopefully, Sealing Technology sees the potential in the suggested improvements efforts and continues to develop their business.

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Andersson, Christer

(2011-11-07) (2012-01-12) Development Engineer A, Tetra Pak Sweden

Andersson, Håkan

(2011-12-19) Development Engineer B, Tetra Pak Sweden

Andrea Babini

(2011-12-06) Technology Specialist A, Tetra Pak Italy

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(2011-12-07) Manager Sealing Technology, Tetra Pak Sweden

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(2012-01-18) Business Transformation Analyst, Tetra Pak Sweden

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(2011-11-22) Development Engineer A, Tetra Pak Sweden

Rosander, Jenny

(2011-11-30) Manager Sealing Systems, Tetra Pak Sweden

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(2011-11-10) Manager Inductors, Tetra Pak Sweden

Sandberg, Torbjörn

(2011-11-22) Development Engineer A, Tetra Pak Sweden

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(2011-11-17) Technology Specialist B, Tetra Pak Sweden

Sighinolfi, Fabrizio

(2011-11-28) Technology Specialist B, Tetra Pak Italy

Ståhl, Jonas

(2011-11-09) Development Engineer A, Tetra Pak Sweden

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(2011-12-19) Manager Sealing Integration, Tetra Pak Italy

Widestadh, Henrik

(2011-11-08) (2011-12-07) Manager Induction Heating, Tetra Pak Sweden



# APPENDIX

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## Interview guide

### Introduction

Presentation of the project

### *Formalities*

- Length of the interview – verify
- Answers – how they will be used
- Record – will be deleted
- Notes – meeting notes will be sent to the respondent for verification
- Purpose – the interview’s objectives

### *Personal*

- Title and responsibilities
- Tetra Pak – for how long?

### NPI process

Knowledge about existing process

### *Activities*

- Performed activities
- Duration of activities – minimum time/maximum time
- Object in/object out

### *Decisions*

- Decision-making
  - Information necessary for decision-making

### *Performance measurement*

- Measures of the process – if there are any?
  - What is measured? When is it measured?

### *Inefficiencies*

- Delays – where, cause?
- Bottlenecks – where, cause?
- Lack of resources – where?

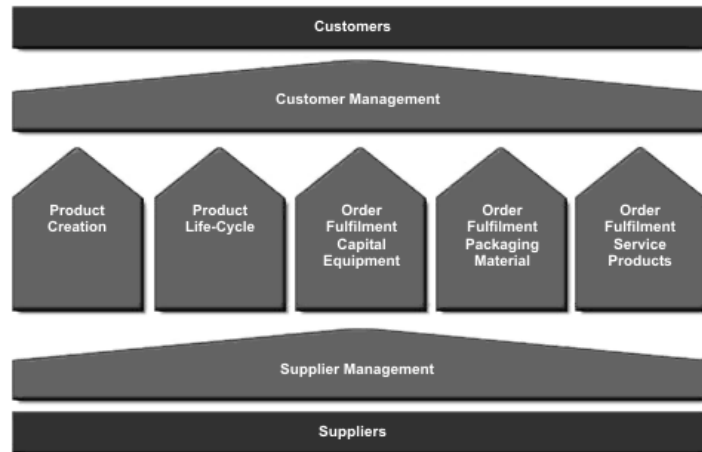
### *Improvements*

- Decrease duration of process – how?
- Improve in other ways – how?
- Unnecessary activities, decisions or hand offs – where?

## Tetra Pak's Process Levels<sup>153</sup>

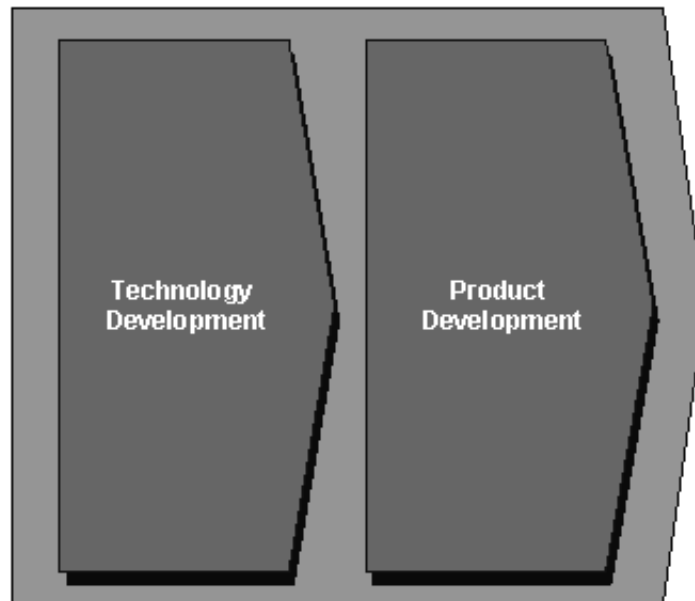
### Level 0

Global Processes



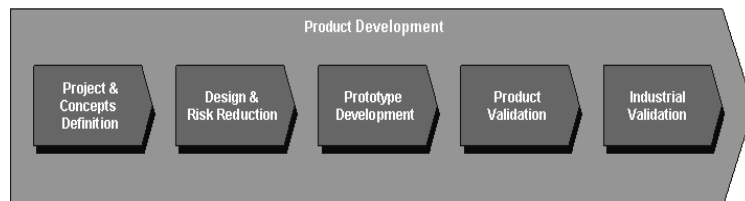
### Level 1

Primary Processes



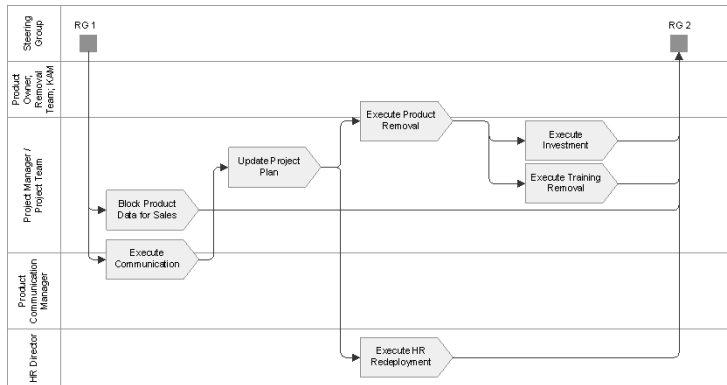
### Level 2

Sub-Processes



<sup>153</sup> Tetra Pak Internal, About Tetra Pak, Global Processes, Processes Explained, retrieved 2011-12-19.

### Level 3 Activity Flow



### Level 4 Task Flows or Task Lists

#### Description:

To secure that the project use correct information. Verify and refine the production solutions based on input information. Elaborate assessment. Verify with the customer.

Input	Tasks	Output
<ul style="list-style-type: none"> <li>▶ Contract:</li> <li>▶ Design Criteria</li> <li>▶ Spec of Equipment &amp; Services</li> <li>▶ Technical Description &amp; Drawings:               <ul style="list-style-type: none"> <li>- Machinery Layout</li> <li>- Item list</li> <li>- Consumptionlist</li> <li>- Process Flowchart</li> <li>- Function Description</li> <li>- Process Functional Diagram</li> <li>- Control System Specification</li> <li>- Control System Block Diagram</li> <li>- Production Time Schedule</li> </ul> </li> <li>▶ Commissioning &amp; Performance Criteria</li> <li>▶ Project Time schedule</li> <li>▶ Pre contractual documents:               <ul style="list-style-type: none"> <li>- Production Simulation</li> <li>- Process Block diagram</li> <li>- Technology diagrams</li> <li>- Project Requirements document</li> <li>- Utility Block diagram</li> <li>- Customer Building drawing</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>■ Verify &amp; Refine Plant Production:               <ul style="list-style-type: none"> <li>- Verify Technological solution</li> <li>- Verify Production Time Schedule</li> <li>- Verify Functional Description</li> <li>- Verify Process Functional Diagram</li> <li>- Verify Control System Block Diagram</li> <li>- Verify Machinery Layout</li> <li>- Verify Process Flowchart</li> <li>- Verify preliminary consumptions</li> <li>- Design, size and position of Control and MCC rooms</li> <li>- Verify Equipment Safety Risk Assessment</li> <li>- Customer verification</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▶ Production Time Schedule, version 1</li> <li>▶ Control System Block Diagram, version 1</li> <li>▶ Machinery layout, version 1</li> <li>▶ Item List, version 1</li> <li>▶ Consumption list, version 1</li> <li>▶ Updated Equipment Safety Risk Assessment form</li> <li>▶ Internal review protocol</li> <li>▶ MoM Customer verification</li> <li>▶ Functional Description, version 1</li> <li>▶ Process Functional Diagram, version 1</li> </ul>

### Level 5 Procedures & Templates

#### 5 DATA CONTENT OWNERSHIP

The commercial owner is the contract owner, which is maintained in the Contract Object data "responsible person" for the contract is identified.

#### 6 ROLES AND RESPONSIBILITIES

Table 1

Business Roles	Responsibilities
<b>Global Process owner</b>	Supplier Management Process is responsible for defining the rules, knowledge and the authority to make decisions on how the master data is maintained, what it contains, how long it is kept and how changes are authorized and audited.
<b>Data Requestor</b>	Supplier/contract commercial owner is the provider of contract master data source for contract data maintenance
	Supplier/contract commercial owner is the content owner of Contract Master Data, accountable for contract data quality.  Contract Data Content Owner is defined in the field "Head Note" Text where "responsible person" data is entered.

**Level 6**  
Work &  
Script Instructions

Characteristic PM\_TETRA\_PAK\_L060  
Change Number  
Valid From 2010-04-12 Validity

Basic data Descriptions Values Addnl data Restrictions

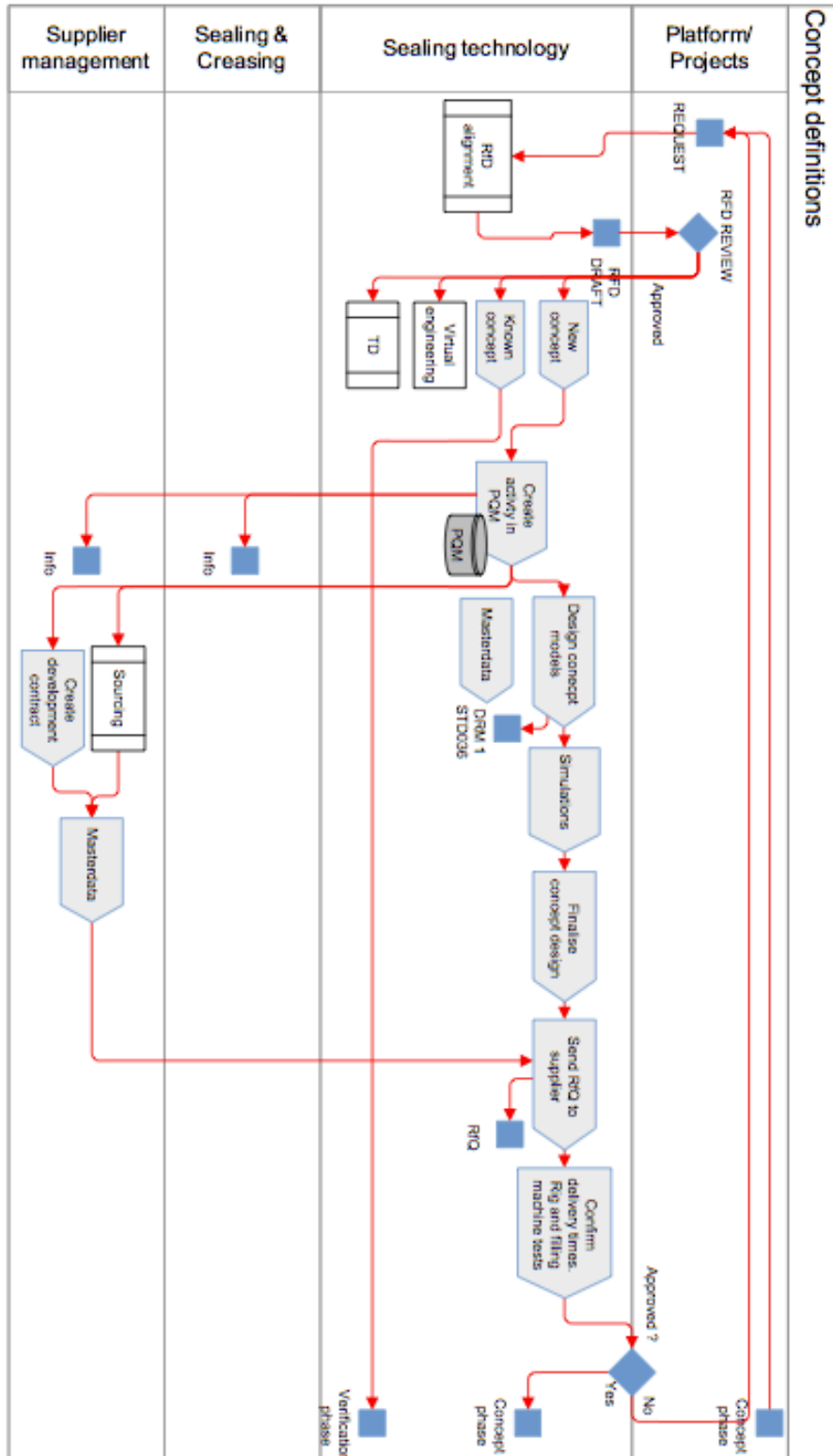
Additional Values Other Value Check

Char. Value	Description	D	O	S
BW	Black&White	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Y	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
N	No	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Environmental message	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Both Logo and Environmental	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	TP Logo + FSC label	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	TP Logo+Envim mess+FSC Label	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	Environm message + FSC label	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	FSC Label	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

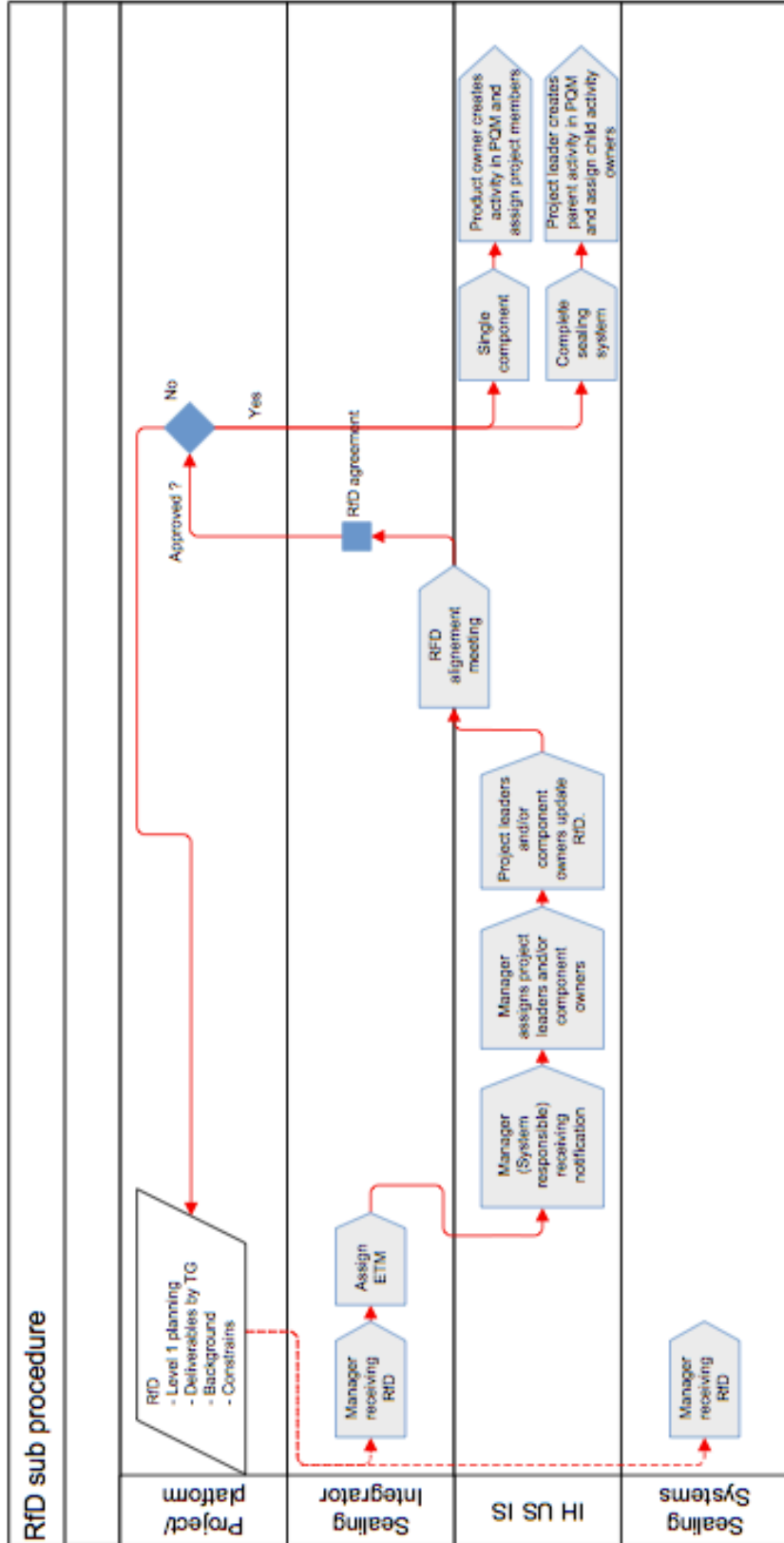
Entry 1 of 9

# The NPI process map

## Concept definitions phase

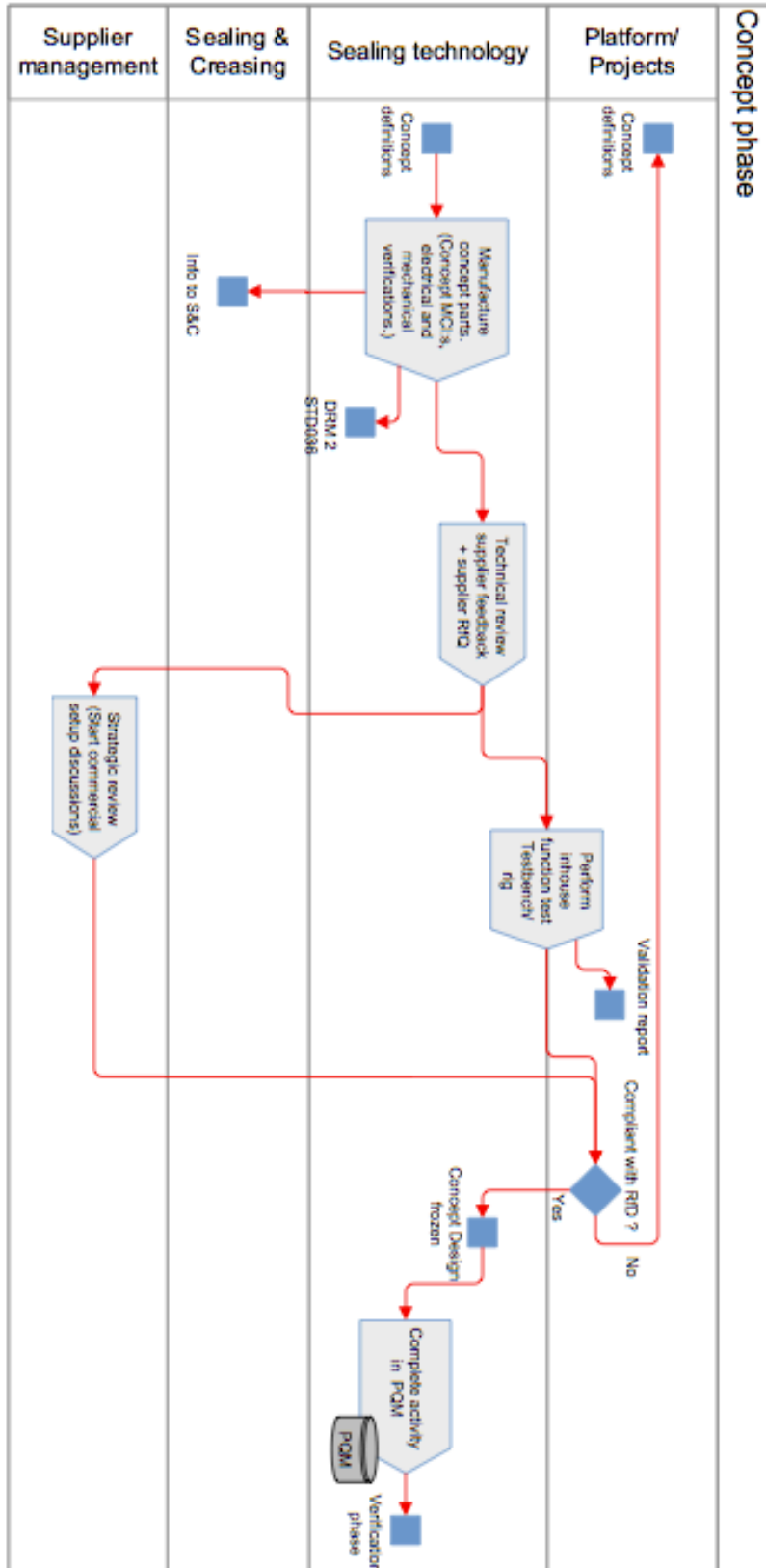


## RfD Sub Procedure (sub-process)

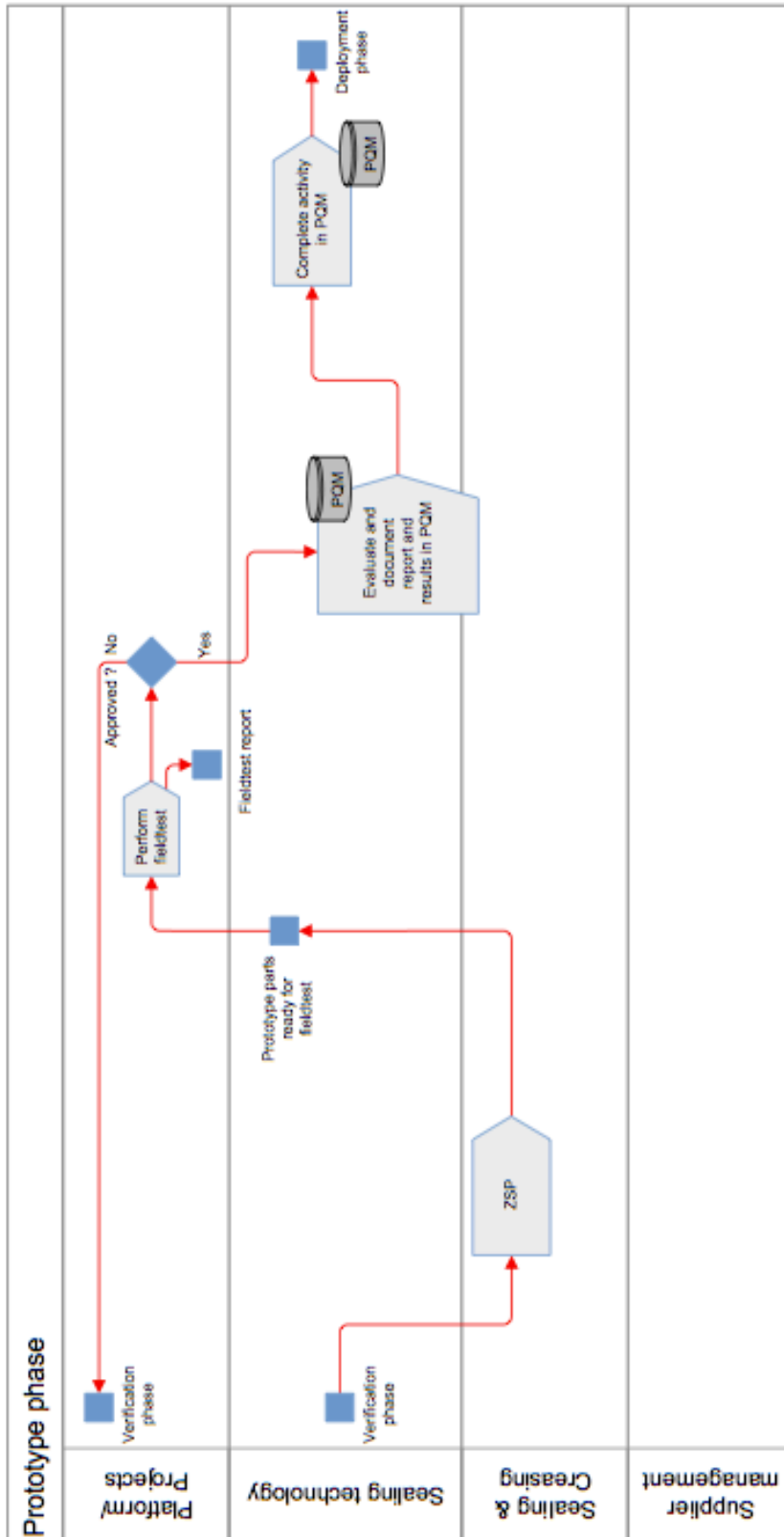




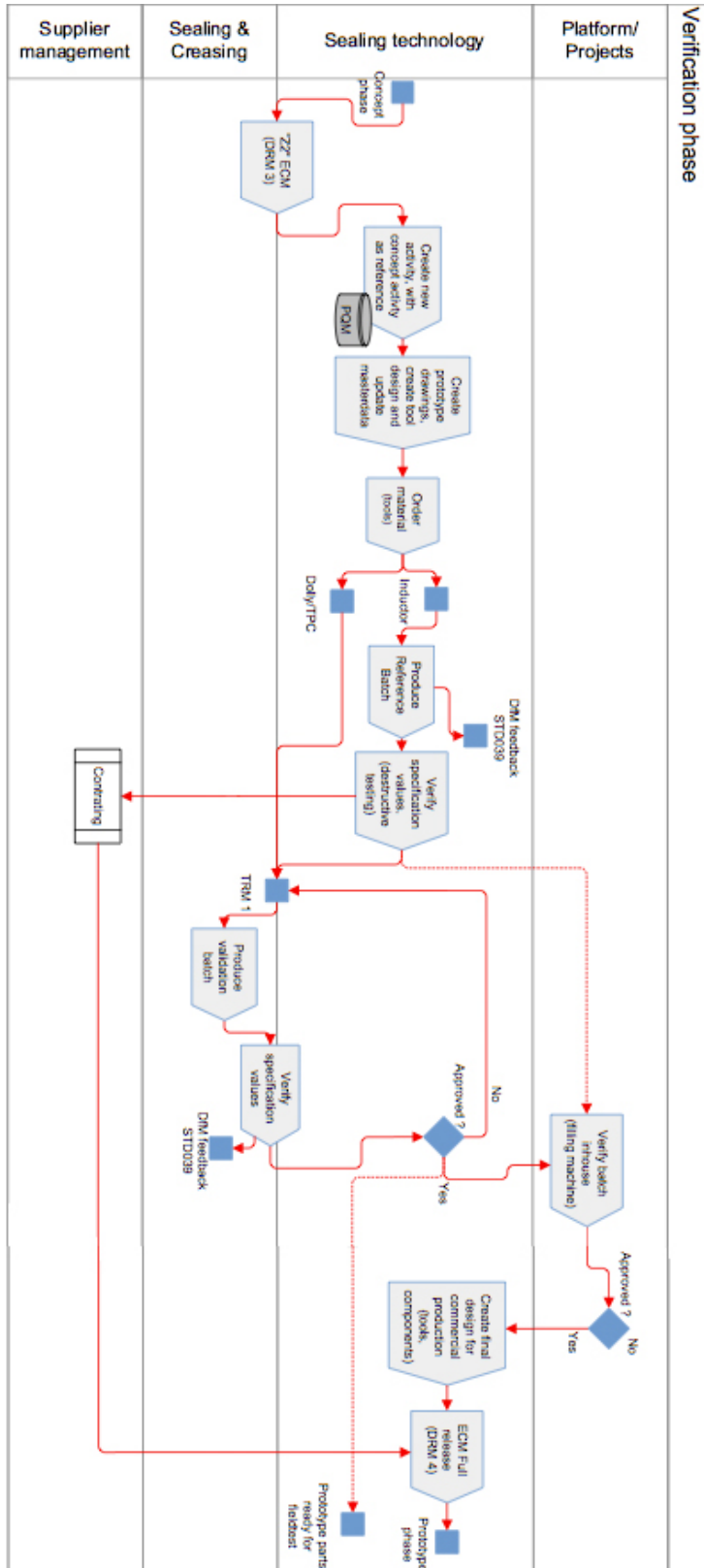
## Concept Phase



## Prototype Phase



# Verification Phase



## Deployment Phase

