Investigating the Coordination Between Operations and Sales in an Industrial Environment

A Case Study at Tetra Pak

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Investigating the Coordination Between Operations and Sales in an Industrial Environment

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Abstract

Title: Investigating the Coordination Between Operations and Sales in an Industrial Environment - A Case Study at Tetra Pak

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Background: Misaligned strategies, which are developed within different units in a company, are unfortunately a common occurrence. Generally, operations strategy and marketing strategy are difficult to align and it is common that the operations unit and the sales unit have problems understanding each other. In an industrial environment that is characterised by high product customisation, long lead-times, make-to-order and low-volume production, time is an order winner. In order to meet the customers’ demands, the right levels of production capacity are vital. A successful capacity planning system will lead to short and accurate delivery dates and satisfied customer. However, what needs to be taken into consideration is the fact that not only the operations unit is responsible for this activity, but also the sales unit provides input to the capacity planning in terms of their sales forecast. Obviously, the two units need a full understanding for each other to be able to work cooperatively with the capacity planning and make decisions that in the end will benefit the customer.

Issue of Study: The operations unit and the sales unit are often developing strategies that fit their own separate performance. Their strategies are not aligned to support the actual needs of the customer. As a result, the operations unit struggles to make a strategic decision regarding the balancing of capacity levels and costs.
Purpose: To analyse the coordination between operations and sales in an industrial environment.

Objectives: 

Objective A: to develop a theoretical framework that visualises the relationship between the areas that are of importance to understand the relationship between the operations unit and sales unit, and, additionally, takes capacity planning into consideration.

Objective B: to describe a complex industrial situation that represents a suitable environment to investigate the relationship between the operations unit and sales unit.

Objective C: to create a tool for capacity planning that can be used to generate a joint performance measurement in terms of a service level (percentage of customers who get their expectations met), which will support capacity planning decisions and visualise how the decisions taken in the operations unit affect customer satisfaction in the end.

Method: We choose to base our exploratory research on a case study approach that initially was inductive in its nature and later made use of deduction. Both qualitative and quantitative elements were included in this approach.

Conclusions: The operations unit and the sales unit often strive toward increasing their own separate performance and, as a result, customer satisfaction is not taken into consideration in relation to capacity planning. In order to solve the issue, the operations and sales unit need to acquaint themselves with what the market actually demands and aim to achieve more transparency and cooperatively work more proactively with the capacity planning. A joint measurement in terms of a service level (based on actual expectations from customers) could be the first step towards finding a solution to the vague alignment of sales and operations unit. With a capacity tool that generates this measurement, it is easier for the operations unit to make sure that the capacity range is correct by simulating different scenarios. By knowing how the output (service level and costs) is affected by changes in the input (forecast, customers expectations, capacity) it is possible to make conclusions about how the service level will be affected by orders that are placed late, too low/too high capacity,
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customers’ expectations and the length of the process lead-time. Information can also be acquired about how a changed capacity affects the length of the order queue, the waiting time and as well as the closing order stock. This is important information for any manufacturing company and needs to be communicated to whole the organisation.

Key Words: organisational success, strategic alignment, key performance indicators, capacity planning, operations strategy, marketing strategy, make-to-order, low-volume, lead-times, forecasts
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Lund, 2011-05-31

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List of Abbreviations

CE: Central Europe  
CB: Carton Bottle platform (Sweden)  
CV: Carton Value platform (Sweden/Italy)  
EECA: East Europe Central Asia  
ETD: Estimated Time of Dispatch  
ETA: Estimated Time of Arrival  
ICOS: Improving Coordination between Operations and Sales  
KPI: Key Performance Indicator  
M/C: Market Company  
M&PM: Marketing and Product Management  
Mfg: Manufacturing  
MTO: Make-To-Order  
MTS: Make-To-Stock  
NA: North America  
NEAO: Northeast Asia & Oceania  
NE: North Europe  
OtD: Order-to-Dispatch  
S&OP: Sales and Operations Planning  
SCO: Supply Chain Operations  
SCO CE: Supply Chain Operations – Capital Equipment  
SE: South Europe  
SS: Sales Support  
TPA6: Tetra Pak A6 filling machine for Tetra Evero Aspetic packages  
TR/27 & TR/28: Tetra Rex single-line filling machines for chilled products  
TT/3: Tetra Top filling machine
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1 Introduction

The aim of the opening chapter is to give the reader a background of the setting that initiated the need of this master thesis. After the background, a problem discussion follows which ends with a presentation of the problem that will be investigated further. The purpose is then presented together with the three objectives that are to be achieved. In the end, a chapter outline is demonstrated.

1.1 Background

The competitive environment that companies are facing today is tough. In order to survive in a long-term perspective it is vital to have a wide range of functions and capabilities to be able to design, make and sell products at a profit. Hence, the whole organisation has to be aligned towards meeting the needs of the customer. Organisations constantly strive to reach an ideal state, where all business processes run perfect, all strategies are aligned and a high level of customer satisfaction is achieved, always. According to the Institute for Supply Chain Management, US, the reality is unfortunately far from this ideal state:

“... In many firms, business unit strategy is developed as a series of independent statements. Lacking essential integration, the result is a compilation of distinct, functional strategies that sit side by side, layer on layer in the same corporate binder. Integration is not provided if, in fact, it was never intended.” (Hill & Hill, 2009)

Companies must therefore work proactively to avoid this state and to do so, there are a few factors that needs to be taken into consideration. A company’s level of success depends on two factors: effectiveness, i.e. its ability to do the right things; and efficiency, its ability to do things in the right manner (Bruzelius & Skärvad, 2011). How well an organisation reaches effectiveness and efficiency, in turn, depends on the level of differentiation between sub-units and how well these sub-units are integrated with each other. In larger companies it is common that different units emerge to cope with the size and complexity of the company (Taylor, 1911). Therefore, it is natural that different strategies are developed within these functions, strategies that need to be consistent (Lawrence & Lorch, 1967).

Operations strategy and marketing strategy are two types of strategies that are specifically difficult to align and it is common that the operations unit and the sales unit have problems understanding each other (Lawrence & Lorch, 1967). Operations managers are often blamed for focusing only on short-term performance, which comes naturally to them as a result of the pressure on them to meet quantifiable day-to-day targets (Hill & Hill, 2009). The sales unit, on the other hand, is responsible for forecasting future and long-term market potential in relation to current and potential customers, products and competitors (Hill & Hill, 2009). Hence, market
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descriptions generally becomes limited to the long-term views of the sales unit and fail to provide insights that are important from the operations unit’s point of view (Hill & Hill, 2009). Clearly, these two different units’ strategies are not aligned and in order to become a more successful and integrated organisation, the link between the operations unit and the sales unit is critical.

1.2 Problem Discussion

If considering the above-presented issue in an industrial environment, where the production is make-to-order and characterised by low volumes, high product customisation and long lead-times, the link between operations and sales becomes especially critical. In this type of setting, only a few customers stand for a large share of revenue and therefore it is vital to keep these customers satisfied. The sales unit is responsible for satisfying the customer in the sales moment in order to gain the first sale (Hill & Hill, 2009). Thereafter, the operations unit need to meet the need of the customers by fulfilling the order or contract, which makes them directly responsible for securing the second sale (Hill & Hill, 2009).

According to the well-known manufacturing strategy *Time Based Competition*, low cost and high quality are not enough in an increasingly customer oriented market, but short lead-times for products have become essential (Van Mieghem, 2003; Nahmias, 2009). Customers in the time-based environment place a high value on the delivery date, which makes time an order winner (Spearman & Zhang, 1999; Nahmias, 2009). To be able to offer short lead-times to the customers, great pressure is put on the operations unit to perform at their best and their performance is greatly dependent on the capacity available in the production (Chen & Wan, 2001). If the capacity planning system is faultless, it will lead to short delivery dates and highly satisfied customer. Capacity investments, however, are among the largest investments a company can make, and they are also fixed in that it takes a long time to agree upon, implement or perform changes in these investments (Hill & Hill, 2009). Therefore, it is critical that these investments are made correctly. A lack of fit between key investments and the company’s market will surely lead to failure. To avoid this, it is of greatest importance that companies are aware of how their operations can support the marketing strategies (Hill & Hill, 2009). When aiming to find the right level of production capacity it is therefore important to consider the behaviour of external forces such as external demand and external supply markets (Van Mieghem, 2003). Consequently, there is a need to specify the order-winners and the order-qualifiers of the company (Hill & Hill, 2009). As a result of knowing what enables the company to compete in the market, the market knowledge can more easily be passed on from the sales unit to the operations unit and in this way both units become aware of what forces drives the need of capacity (Hill & Hill, 2009).

Furthermore, what needs to be taken into consideration in relation to capacity investments is that the sales unit is also involved in the capacity planning in terms of
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the sales forecast they provide to the operations unit (Nahmias, 2009). Sales forecasts are used to estimate the total revenue and profits of the company and it is often assumed that the sales forecast is equal to the actual outcome of the product mix, order size and order frequency (Hill and Hill, 2009). Due to this, it is also assumed that the operations unit should be able to fulfil the actual outcome of orders (Hill and Hill, 2009). In reality, however, this can be hard since the production is planned according to sales forecasts that have been created on a more overall level and therefore includes assumptions of the actual outcome (Hill and Hill, 2009). In Sales and Operations Planning (S&OP), the act of balancing supply and demand is performed through a meeting between the operations unit and sales unit, and in this meeting the coordination is of crucial importance. The S&OP must be coherent with the manufacturing strategy, which focuses more on the timing of capacity, with other words when capacity should be added; prior to or after the demand appears. Both S&OP and manufacturing strategy are focused on long-term capacity management but involve different parts of the organisation. Since they are threatened in sequence they can easily be uncoordinated (Olhager et al., 2001).

As can be understood, aligning operations and sales is a complex undertaking and the mutual understanding that is needed in between these two units is not always in place. As a result of this, the following two-parted problem formulation is initiated:

1) The operations unit and the sales unit are often developing strategies that fit their own separate performance. Their strategies are not aligned to support the actual needs of the customer.

2) As a result, the operations unit struggles to make a strategic decision regarding the balancing of capacity levels and costs.

Hill and Hill (2009) have developed an extensive framework for linking corporate objectives and operations and marketing strategy development. Their framework is appropriate to use when trying to understand the misalignment between operations and sales on a more strategic level (sub problem 1). When looking at is at a lower level, however, and taking capacity planning into consideration (sub problem 2) there are other aspects that also are of importance, which originated the purpose and objectives below.

1.3 Purpose and Objectives

The main purpose is to analyse the coordination between operations and sales in an industrial environment.

Included in this purpose are three objectives that are to be achieved.

Objective A: to develop a theoretical framework that visualises the relationship between the areas that are of importance to understand the relationship between
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the operations unit and sales unit, and, additionally, takes capacity planning into consideration.

**Objective B:** to describe a complex industrial situation that represents a suitable environment to investigate the relationship between the operations unit and sales unit in.

**Objective C:** to create a tool for capacity planning that can be used to generate a joint performance measurement in terms of a service level (percentage of customers who get their expectations met), which will support capacity planning decisions and visualise how the decisions taken in the operations unit affect customer satisfaction in the end.

### 1.4 Delimitations

This thesis addresses capacity planning issues in organisations characterised by low volume and highly customised production. The problem is viewed upon from an industrial engineering perspective; hence, no other aspects will be taken into consideration. The case company forms the empirical basis of the study, and the unit of analysis is the operations and sales unit in an industrial environment. In addition, the system delimitations that have been made are: Tetra Pak Sweden is considered, not any other parts of the Tetra Pak Group; only the SCO unit and the three sales-related units (Sales Support, M&PM and the Market Companies) at Tetra Pak Sweden are included in the investigation; customer satisfaction is measured in terms of their expectations on order lead-times; due to confidentiality, the customers have not directly been contacted for their opinion on order lead-times, instead the different sales units (primarily the Market Companies) have given their perception of the matter, which might have resulted in slightly distorted information since the sales units provide a captive image that might differ from the customers’ true image. The result was not implemented in case organisation, but further recommendations were given.

### 1.5 Chapter Outline

Figure 1 below outlines the structure of the chapters that will follow. In chapter 1, a background and introduction to the problem was presented. After this chapter, chapter 2 will explain how the purpose and objectives will be met and provide an evaluation of the method approach. Next, chapter 3 will summarise the literature study and present the theoretical framework (ICOS) that visualises the areas of importance to understand the problem. Chapter 4 is an introduction to the case company, which provides a real-life setting related to the problem. In chapter 5, which will be based on chapter 3 and 4, an overall analysis will be made and the tool referred to in Objective C (the capacity tool) will be used to analyse different situations that are of interest in the case study. In chapter 6 the results will be
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Figure 1 Chapter outline in relation to the purpose and objectives
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2 Methodology

This chapter describes the methodology that was used and justifies the choices that have been made to meet the purpose. The chapter starts with an explanation of how the purpose of our study is related to the research method that we conducted and an introduction to our case study. Thereafter, the method used for theoretical data collection, empirical data collection and analysis is presented. In the end of the chapter, the results of the chosen methodology are evaluated.

2.1 Method Approach

In order to meet the main purpose, i.e. to analyse the coordination between the operations and the sales in an industrial environment (see 1.3), it was important for us to make justifiable decisions about our research approach (Saunders et al., 2009). A well-chosen methodology helped us help creating an understanding for how the research decisions would influence the final result.

Due to the fact that the purpose aims to explain a contemporary phenomenon within a real-life context, it was appropriate for us to use a case study as research method (Yin, 2009). In addition, our purpose required an extensive description of the phenomenon. A case study was therefore suitable since it includes close contact with the persons that are involved in the events that surround the phenomenon; hence, they can provide in-depth input to the matter (Yin, 2009). The case study approach made it possible for us to gather a rich understanding of the background of the problem.

Our research was exploratory, i.e. a model (the capacity tool, explained in section 2.5.1) and theory (the ICOS-framework, explained in section 2.3) were used together with descriptive facts to derive a conclusion (Andersen, 1994). This type of research differs from the explanatory type of research in view of the fact that it predicts the future rather than explaining what has already happened, which becomes clearer in chapter 5 (Analysis) where different scenarios have been generated in order to analyse possible situations that could appear in the future.

Due to the nature of the study, which could be associated with an applied problem-solving study where the purpose was extensive and exploratory, we used a method that touched upon aspects from the deductive as well as the inductive approach (Saunders et al., 2009). For example, in order to get a better understanding for the current situation, there was an initial need to collect empirical data and we moved from qualitative data (interview- and documentary study) to finding suiting theory in a literature review, i.e. an inductive approach (Saunders et al., 2009). However, there was also a need to explain casual relationships between the variables related
In summary, we choose to base our exploratory research on a case study approach that initially was inductive in its nature and later made use of deduction. Both qualitative and quantitative elements were included in this approach.

2.2 Case Introduction

The purpose was addressed through a case study at the processing and packaging solution company Tetra Pak. Naturally, as a result of choosing the case study approach, it was important for us to define the case (Saunders et al., 2009). According to Yin’s definition (2009), Tetra Pak’s organisation became the immediate topic of our case study while the unit of analysis was the operations and sales unit in an industrial environment. We choose to perform a single case study due to the fact that the perceived problem at Tetra Pak is typical and representative for similar organisations in the same setting. In addition, an embedded case study seemed most appropriate since our purpose involved more than one sub-unit at the case company (Saunders et al., 2009).

Our result was aimed at Tetra Pak Sweden, specifically the Carton Bottle-organisation in Lund. This was a suitable case to study since Tetra Pak is a company in an industrial environment where the production is make-to-order and characterised by low volumes, highly customised products and long lead-times. Evidently, it is a setting where the more general problem of misalignment between operations and sales exist. After initial contact with our supervisor we could confirm that Tetra Pak dealt with this typical problem, which mainly manifested itself in their SCO unit in relation to capacity planning activities. In addition, by applying our case study at Tetra Pak in Lund our empirical data collection was facilitated. As a result of being able to move freely within the walls of the case company we were able to collect extensive amounts of qualitative data, in the form of interviews, as well as quantitative data, through a study of internal documents and a smaller survey (see further section 2.4 Method for Empirical Collection). The empirical findings that are presented in chapter 4 are the result of the interview- and documentary study, see References: Internal Sources at Tetra Pak and Oral Sources. The survey can be found in Appendix I.

2.3 Method for Theoretical Data Collection

The empirical data (see section 2.4 Method for Empirical Collection) was collected and comprehended with the help from existing theory in the area. We performed a theoretical literature review to understand what had been said earlier about the subject and to understand how the subject that we were studying at Tetra Pak was meant to work according to theory. Due to the fact that the first part of our study was primarily qualitative, we strived towards finding new dimensions to the matter;
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The areas of importance for our literature study were developed in an iterative matter after discussion with our tutors and our supervisor at Tetra Pak. Our starting point was Bruzelius and Skärvad’s theories of organisational success (2011) and Hill and Hill’s Framework for Linking Corporate Objectives and Operations and Marketing Strategy Development (2009). Another central theory that was taken into consideration because it was appropriate for our purpose was Sales and Operations Planning (Olhager et al., 2001). In relation to the service level measurement we studied Kaplan and Norton’s theories about Key Performance Indicators (2006) as well as articles related to the subject that we searched for in the search engine of Lund University (LibHub). In order to gain more knowledge regarding the two different aspects of operations and sales we studied literature that were relevant to the matter, for example Hill and Hill (2009) and Nahmias (2009). For a more detailed overview, see References.

The factors that were input to the capacity tool were developed iteratively based on the literature review and empirical findings at Tetra Pak, and the final factors were summarised in the ICOS-framework. The five main areas that were included in the final version of the ICOS-framework were: Organisational Success and Strategic Alignment, Key Performance Measurements, Order Winner and Order Qualifiers, Operations Strategy, and Marketing Strategy (see chapter 3, figure 3). In the framework a relationship dimension was also added in between the areas in order to see how they were related to each other. Below follows a deeper motivation for why and how the theoretical areas were modified to specifically suit our purpose, the numbers within brackets refer to the section number in the theoretical chapter (chapter 3).

Corporate objectives in Hill and Hill’s framework for linking corporate objectives and operations and marketing strategy development were divided into two factors in the ICOS-framework: Organisational Success and Strategic Alignment (3.3), and Key Performance Indicators (3.4). KPIs were emphasised in the ICOS-framework since they are central to reach strategic alignment and KPIs are a central part of capacity planning if linking them to a higher level of customer satisfaction. The KPI section also linked the Order-Winner and Order-Qualifiers (3.5) and the Organisational Success and Strategic Alignment (3.3) sections together. Furthermore, the two steps that belong to Operations Strategy in Hill and Hill’s framework (process choice and infrastructure) were merged into one in the ICOS-framework and the Operations Strategy section in the ICOS-framework specifically addressed the production planning aspects of Hill and Hill’s framework. Related to this, Olhager et al.’s theories about Sales and Operations Planning (S&OP) (2001) were also taken into consideration. In Olhager et al.’s mathematical model describing S&OP the following parameters are included: forecasts, inventory/backlog and workforce levels (Olhager et al., 2001). These three parts were the input factors to the capacity tool on a more
Investigating the Coordination Between Operations and Sales in an Industrial Environment detailed level and, therefore, they were included in the ICOS-framework in such a way that forecasts is presented in the Marketing Strategy section (3.7), inventory/backlog (order backlog in specific) is discussed in relation to queueing theory in the Operations Strategy section (3.6) and workforce levels is dealt with in relation to Manufacturing Strategy and Sales and Operations Planning in the Operations Strategy section (3.6). Lean is specifically important with Tetra Pak as a case company, since Tetra Pak apply a takt system in their production. Lean is therefore explained in 3.4.3 Lean Management.

In summary, the ICOS-framework brings up the main parts of the theories mentioned in chapter 3 with modifications made of Hill and Hill’s framework (2009) in order to better support our specific purpose. The literature review was completed when realising that no new insights would be found in the different areas, i.e. when we reached a point of literature saturation.

2.4 Method for Empirical Data Collection

We collected empirical data through an interview study, a smaller survey and by performing a documentary study. The interviews in the empirical collection and the literature review in the theoretical collection were iterated and performed in two rounds each (see figure 2). Thereafter, the result of this process together with the quantitative data collection, which partly was performed through the survey, came to support the creation of the capacity tool (see section 2.5.1).

![Figure 2 Our data collection process](image)

In the early stage of our research, we tried to gain a deeper understanding of a specific subject at Tetra Pak and the data collected was mainly qualitative (Höst et al., 2006). Through the use of this data collection technique we were able to generate non-numerical data through performing numerous face-to-face interviews (Andersen, 1994). One drawback of the qualitative data collection technique was that it was more difficult to generalise the results with qualitative data (Höst et al., 2006). The qualitative study is more of a communicative relationship where the researcher is participating in a two-way communication (Saunders et al., 2009). Therefore, in a later stage of our research, the quantitative approach was also used to complement the qualitative study (Höst et al., 2006). In a quantitative study, surveys, data analysis procedures and mathematical models are used to generate numerical data (Andersen, 1994). This data collection technique allows data to be measured and validated by numbers. For us, the quantitative data collection was suitable in order to gather numerical data for the capacity tool. Since everything
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could not be measured, this approach was also somewhat limited. The quantitative
data collection is done through a one-way-communication, on the researcher’s
conditions (Saunders et al., 2009). However, in our study, the qualitative and
quantitative data collection techniques were suitable complements to each other.
Below follows a further explanation of the different empirical data collection
techniques that we used.

2.4.1 Interview Study

We chose to base most of our empirical research on an interview study because it
was harder, if not even impossible, to get the basic information about the
departments involved, connections in between and the capacity planning of the
different filling machines by only performing observations or a documentary study.
We also needed historical and future information, which, naturally, was hard to
observe in real life. In addition, some information that was required in our research
was not official, which became a reason for not recording the interviews. Already at
an early stage, our supervisor at Tetra Pak indicated that it might be hard to get
people to speak unreservedly with us recording the interviews. Therefore we
decided to take notes on our computer instead and alter the one of us who
interviewed and the one who took notes.

The aim of our interview study was to understand the context and how the different
areas were related to each other. In the beginning, primary data was gathered in the
form of unstructured interviews and later we started to perform semi-structured
interviews (Saunders et al., 2009). The unstructured interviews were performed in
the beginning because there was an initial need to discuss the complex subject with
people who were working within the area and in order to get a deeper
understanding for the perceived problem. During the semi-structured interviews,
which were performed at a later stage, we began to understand the context and
realised the need of direct answers to specific questions in each area.

We chose to do all interviews two-to-one, i.e. two interviewers and one interviewee.
This approach was chosen since we wanted every interviewee to get a chance to
speak freely during the interview and not get affected by another person’s opinions.
In many cases we wanted to talk to more than one person about the same thing
since they handled the same type of tasks but for different machines. We chose to
perform the majority of our interviews face-to-face since we wanted a chance to ask
associated questions that would give us a more extensive understanding. In a couple
of cases, we used electronic interviews (e-mail) because we had problems
scheduling these persons. The electronic interviews had a few, easily interpreted,
questions that we already had an understanding for and therefore did not need to
conduct an oral interview with the respondent regarding the matter.

In our interview study we used categories when organising the notes from
interviews. Since the purpose of our case study at Tetra Pak was to analyse the
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coordination between the operations and sales, we organised our interviews according to these two units as far as it was possible. Our categories were then classified further into the different sub-units. This was done in order to keep track of what units belonged to what side: the operations unit or the sales units (or none of them).

Our interview candidates were carefully chosen according to a network structure where we started to interview candidates within the SCO unit, then candidates that were responsible for driving the overall Global Processes, then people from Marketing and Product Management respectively Sales Support, one supply manager (Purchasing), one manager from Market Introduction and finally people representing the Market Companies (see detailed interview list in references). Below follows a motivation for the different group of candidates that we chose to interview.

Supply Chain Operations
We started interviewing people at different levels within the SCO unit, managers as well as supply chain planners. The first round of interviews with this group of candidates was primarily meant to support our problem formulation and delimitations. During the second round of interviews we asked more directed questions, mostly concerning the input to the capacity tool (for example, internal and external operations lead-times).

Global Processes
The Global Process Director and his subordinate were contacted to give us get a better picture of the process that we were going to investigate further (the Order-to-Dispatch process) and the historical perspective, i.e. what changes Tetra Pak’s supply chain has undergone over time. Also, since Tetra Pak already had initiated an internal project investigating the capacity planning matter, it was important for us to find out what part of that project we were supporting.

Marketing and Product Management
After having a clear view of the process that we were investigating, the next step was to interview Marketing and Product Management. We wanted to collect expected order lead-times from this unit and, in addition, we wanted to get a better understanding of their coordination with the Market Companies and how their interaction with the sales support unit worked. We needed this information to understand the larger perspective of how the sales units’ cooperation with the SCO unit worked.

Sales Support
After having Marketing and Product Management’s view on their relation with Sales Support, it was also interesting for us to find out how Sales Support experienced their interaction with Marketing and Product Management. We were also interested in finding out more about their coordination with the Market Companies and how
they were fulfilling their role as an administrative unit, dealing with the incoming orders they get from the Market Companies (orders that are then forwarded to the SCO unit).

**Purchasing**
We interviewed one purchaser, i.e. supply manager, in order to get a better understanding for the cost aspect that was to be included in the capacity tool. What we wanted to achieve with this interview was a view of how changes in capacity were related to costs surrounding a filling machine, in the internal as well as the external production.

**Market Introduction**
The Market Introduction Manager was interviewed in order for us to get a more certain number of the minimum expected lead-time (in days) before it is possible for a customer to install a filling machine in their factory. It is not always the delivery of the machine itself that is the bottleneck, but there might be other factors limiting the lead-time.

**Market Companies**
The Market Companies were a vital group of candidates to interview since they have the closest relation to Tetra Pak’s customers; hence, they have the most correct point of view on the customers’ expected order lead-times. For the Market Companies, we contacted candidates for each separate filling machine and within each system we made sure to clarify what markets/clusters that were most relevant for us to contact. For example when it comes to the TT/3 filling machine, the Nordics, Germany and Japan were the most relevant markets to contact and within these markets three representatives were contacted. The majority of the Market Companies were not interviewed directly, but instead we sent them the survey in which they got to answer specific questions regarding expected lead-times. This type of quantitative data collection method will be clarified in the section below (2.4.2).

**2.4.2 Survey**
Most of the numerical data that would be used as input in the capacity tool could be collected through the interviews. However, due to the geographic dispersion, the Market Companies were to fill out their perceptions on the customers’ expected order lead-times in a smaller survey (see Appendix I).

The survey could be distributed in different ways, for example as a computer-based survey where a link is sent to the respondents through e-mail with information such as: the purpose of the study, why the respondent has specifically been chosen, the fact that the survey is optional, response routines and time limit, confidentiality and details about the contact person (Höst et al., 2006). Our survey was created as a computer-based survey with a link that was sent to eight different Market Company-representatives by e-mail with additional information written in the e-mail. The
Survey included fixed questions, with predefined response alternatives (Höst et al., 2006). The disadvantage with using the survey as a data collection method was that it made it harder to get a clear view of the respondent’s answers and there was a larger risk that misunderstanding would arise (Björklund & Paulsson, 2003). Therefore, the questions in our survey were stated in a clear and comprehensive manner regarding what cluster the market company representative belonged to, minimum lead-times, maximum lead-times and the expected lead-times for their customers. The questions were formulated in such a way that misunderstandings could not arise, i.e. according to a predefined response schedule (Holme & Solvang, 1997). The survey was also overlooked by our supervisor at Tetra Pak, to make sure that the questions were understandable. Out of eight Market-Company representatives, we received an answer from seven (87.5% respond rate). The answer that did not occur did not make a larger difference to the result since we already had received the answers for that specific filling machine type.

### 2.4.3 Documentary Study

The documentary study was performed by reviewing Tetra Pak’s intranet (Orbis) and studying internal documents received by Tetra Pak employees. The initial purpose of the documentary study was to get an understanding of Tetra Pak’s development through time as well as to find information about the people we were planning on interviewing. Later, internal documents were also used to derive quantitative data concerning capacity consequences (i.e. changes in the number of personnel and test bays needed depending on what capacity is applied in production) and shipping information, which included the shipping times from Sweden to different geographical destinations needed to calculate the customers’ expected lead-times. We also looked at documents to receive an understanding of the input to the capacity tool, like forecasts (annual and monthly) and the sales units’ KPIs. The internal documents can be found in References.

### 2.5 Method for Analysis

The theoretical and empirical data that was collected was analysed to generalise from case study to theory. We analysed the data that had been collected through analytic generalisation, which according to Yin (2009) is the most suitable way of generalising the data collected in an empirical case study. This method implies that the theoretical framework that had been developed (ICOS) was used as a template that we compared the empirical results of the case study with. The purpose of our analysis was to find relationships between the variables that we had identified as important to our overall purpose as well as visualise changes in these variables over time, i.e. visualise how the different decisions in each unit may affect capacity planning and customer satisfaction in the end. For this, we used a data analysis method called modelling/simulation (Björklund & Paulsson, 2003) where the data processing program Excel was utilised to design the capacity tool, which then was
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used to develop different scenarios that formed a basis for analysis (see section The Capacity Tool below).

Initially, we analysed the data along the way, which gave us guidelines for the future data collection. In parallel, we started to design the capacity tool in Excel and modified the input variables as we did important theoretical and empirical insights. After the theoretical and empirical data had been collected, we performed an overall analysis in two steps:

1) We compared the theoretical findings, derived from the ICOS-framework, with the empirical findings at Tetra Pak, and

2) We made use of the capacity tool to replicate different scenarios that supported our analysis of theoretical and empirical data.

The next section will deal with the modelling method that supported the design of the capacity tool.

2.5.1 Modelling

Models are normally constructed in order to be better able to analyse a complex situation. A model is an abstraction of a phenomenon, were the most important aspects of the matter that are to analyse have been taken into consideration. Models clarify what kind of information one should concentrate on and what kind of comparison that needs to be made. A model should not be too complicated, but rather “a compromise between what is real and what is manageable” (Holme & Solvang, 1997). If the model is too complex the overview is lost. A model with very few characteristics, on the other hand, might be to simple and differ a lot from the reality it is meant to portray. (Höst et al., 2006; Holme & Solvang, 1997)

Depending on what type of model that is chosen, the analysis of the model goes in different directions. Conceptual models are dependent of empirical knowledge in order to be derived. Interaction models explain how certain variables interacts with each other and how their interaction affects the result. (Holme & Solvang, 1997)

Independent of what type of model that is used, there are three important steps that should be followed: 1) model design, 2) model implementation, and 3) model validation (Höst et al., 2006). Model design involves decisions on three key areas, all of which are determined according to the model’s purpose: scope, input and output, and the level of abstraction. It is possible to include new factors or exclude old factors along the way as they prove to be important or unimportant to the purpose of the model (Holme & Solvang, 1997). The scope should be extensive enough to capture the most important aspects, but narrow enough to make the model manageable. The output of the model is the parameters to be analysed through simulation and the input are the factors that can be varied. Regarding level of
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Abstraction, it is important that the detail of the model is at a level that can be validated. The model implementation is done in different ways depending on the purpose of the model. For a simulation model the implementation involves turning the design of the model into an executable simulation program. For this, there are plenty of computer programs that could be used, for example Excel. (Höst et al., 2006)

The Capacity Tool

The capacity tool that supported the second step of our analysis is a conceptual model that visualises interactive relationships between different variables (the conceptual version is displayed in chapter 5 and the Excel-version is visualised in Appendix II). The purpose of the capacity tool is to generate a service level measurement (based on customer expectations on order lead-times), which will support capacity planning decisions and visualise how the decisions taken in the operations unit affect customer satisfaction in the end. The tool is structured in such way that to input data is inserted and altered to visualised how the output is affected by these alternations.

The output of the tool is:

1) A service level based on customer expectations on order lead-times (in percentage)

2) Production cost per machine

3) The difference in production costs depending on different capacity ranges, and

4) Closing order stock (number of orders that have been postponed from one year to the upcoming year)

The input to the tool is divided into fixed input such as machine type, year, forecasted number of orders per month, levelling time and postponed order from the previous year, as well as variable input such as the production capacity and the targeted service level (based on customer expectations on order lead-times, in percentage).

As mentioned, the capacity tool was implemented in Excel and when designing the tool the initial scope was decided early on with a lot of involvement from Tetra Pak. However, the scope of the tool was not totally set and we were permitted to alter it if gaining new insights that were of importance to the tool but not yet known to Tetra Pak. As a result of our data collection procedure, during which we alternated the collection of theoretical and empirical data, and due to the fact that we analysed data along the way, we were able to add and remove factors to the scope as we got new insight in the matter. The reason for adding factors was to make sure the final factors really served the purpose of the tool. And the reason for removing factors
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from the tool mostly depended on that we wanted the tool to be simple enough for any person at Tetra Pak to use it; hence, not all factors were of relevance. When all input and output factors where in place, the design of the capacity tool was completed and it was supported by the ICOS-framework that includes the same factors but on a higher and more general level.

2.6 Method Evaluation

2.6.1 Ensuring Overall Validity and Reliability

When performing case studies it is important to maximize their quality. According to Yin (2009) this can be done through meeting four critical conditions: construct validity, internal validity, external validity and reliability.

In order to construct validity we made sure to use multiple sources of evidence. For example, we posed the same interview questions to different interviewees in the same interview group to get a composed perception of the matter, not only the view of a single individual. In this way, the insights gained from the interviews could be validated by more than one interviewee. Moreover, we made sure to have key informants that objectively could review the drafts of our report during different phases of the project. With the help from our supervisor and key persons involved at Tetra Pak, as well as our tutors at the University, our case study could be reviewed several times before the final version was handed in. Internal validity was reached through pattern matching and by addressing rival explanations. As a result of collecting the empirical data at Tetra Pak, we did not only get access to large amounts of internal information but also great support from the employees involved in the matter. Unfortunately, since our problem formulation focuses on the interface between different units, many people at Tetra Pak had many things to say regarding the matter and sometimes the information we got was distorted and slightly contradicting. Instead of getting affected by this, we constantly tried to turn it to our advantage. Due to the fact that we came from outside the company’s walls we had a more objective perspective on the matter and could therefore bring objectivity to the collected data, analysis and results. External validity was reached through using theory to draw comparative conclusions and generalise the findings beyond the case study at Tetra Pak, which according to Yin (2009) is suitable in single-case studies.

Reliability was manifested primarily in the data collection phase, in line with Yin (2009). We made sure to document all procedures taken that made a difference to the result.

In general, the nature of our study is a qualitative case approach, which results in the fact that it is impossible to draw completely general conclusions regarding the investigated matter. However, our aim is that the conclusions made can be handled as valuable insights regarding the coordination between operations and sales in an industrial environment.
2.6.2 Model Validation

To validate a model the model needs be tried on the original phenomenon in order to investigate if the model is a correct description of the reality and if the most important factors are included (Landry et al., 1983). It is also important to validate if the concepts are explained in unison (Holme & Solvang, 1997). In order to make the capacity tool valid, it was tested theoretically against the ICOS-framework during the design phase as well as empirically at Tetra Pak when implementing it in Excel. Several times, we confirmed the functions of the capacity tool with the SCO unit’s employees to get their input on missing or redundant variables; they work with capacity planning every day and were therefore assumed to be experts in the area. By having regular steering group meetings, were the most relevant empirical findings were brought up to discussion, it gave us a way of testing the capacity tool during different stages of the process, which made the end result more reliable. Our tutor at LTH also gave us valuable input to the capacity tool.

Since the model is a simplification of reality it will never be completely correct (Landry et al., 1983). For a computerised model, the validation implies execution of the model with input from the reality with known output (Landry et al., 1983). This was made in our case since the output from the model is a completely new measurement, and has therefore never been calculated before. However, the results have been presented for the case company, which confirmed that the results seemed likely. There is also a strong correlation between the results from the model and the conclusions from the theory.
3 Theoretical Foundation

This chapter is meant to present the theoretical areas that formed the frame of reference for our research. The chapter starts with an explanation of Hill and Hill’s framework (2009) and how their framework is related to the ICOS-framework that was specifically developed to suit the purpose of this study. Thereafter, each part in the ICOS-framework will be presented in detail and in the end a theoretical summary is made.

3.1 Hill and Hill’s Framework For Linking Corporate Objectives And Operations- And Marketing Strategy Development

Hill and Hill (2009) have developed a framework for linking corporate objectives and operations and marketing strategy development. Their framework involves the following five steps:

1. Corporate objectives
2. Marketing strategy
3. How do products qualify and win orders in the marketplace?
4. Operations strategy: Process choice
5. Operations strategy: Infrastructure

The first step in the framework emphasis that corporate strategy needs to be carefully thought through and uniform. Related to this is the marketing strategy, the second step, which brings up the importance of a company to know their customers, products and competitors. This information shall be included in the sales forecast, which is used to estimate the total revenue and profits of the company. It is often assumed that the sales forecast is equal to the actual outcome, in terms of product mix, order size and order frequency and the operations unit is therefore assumed to be able to fulfil the actual outcome of orders. In reality, however, this can be hard since the production is planned according to sales forecasts that have been created on a more general level and therefore includes assumptions of the actual outcome. The success factor for being able to create a strategy that provides the operations unit with information about customer needs is to perform a detailed market analysis. When analysing the market it is crucial to define the order-winners and order-qualifiers of a company, which is summarised in step three. The operation unit’s task is then to meet the order-qualifiers, which is the criterion that gives the company an opportunity to compete on the market but not to win actual orders. The operations task is also to supply the order-winners better than the competitors, which is the criterion that enables the company to win orders. The choice of processes in the production should reflect on the order-winners as well as the volume of products being produced (step four and five). (Hill & Hill, 2009)
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3.2 The ICOS-Framework: A Conceptual Framework Used to Structure The Theoretical Foundation

The areas described in the framework developed by Hill and Hill (2009) are important for linking corporate objectives to operations and marketing strategy on a strategic level. However, when developing a tool for capacity planning on a more detailed level certain factors in their framework are more relevant to focus on than others. Therefore, the framework entitled the ICOS-framework (Improving Coordination Operations Sales) has been created to explain and link together the most important parts of Hill and Hill’s theories (2009) that should be taken into consideration when it comes to capacity planning and in relation to our purpose, see figure 3. A motivation of the modification of Hill and Hill’s framework (2009) was given in 2.3 Method for Theoretical Data Collection.

![Figure 3 The ICOS-framework – a framework for Improving the Coordination between Operations and Sales](image)

The purpose of the ICOS-framework is to illustrate how the theoretical concepts are related to each other. The arrows demonstrate what area(s) that need to be in place before the next area can be reached; i.e. in order for an organisation to reach long-term success there needs to be a high level of strategic alignment within the company, and in order to achieve strategic alignment it is important to have the right measurement system in place which should be based on the order-winners and qualifiers of a company. Finally, in order for the measurement system to work properly, the areas that are most vital for the firm to succeed need to be measured.
Since the overall purpose is to analyse the coordination between sales an operations in an industrial environment, the focus will lie on the strategies that are of high importance to companies specifically in this setting: the operations strategies and the marketing strategies.

The upcoming sections will present each of the areas in the ICOS-framework in depth and in section 3.8 Theoretical Summary, a more detailed overview of the framework will be presented as a summary.

3.3 Organisational Success & Strategic Alignment

3.3.1 Effectiveness and Efficiency

For decades, it has been known that a company’s level of success depends on two factors: its ability to do the right things (effectiveness) and its ability to do things in the right manner (efficiency) (see figure 4). Organisational effectiveness means creating the most value with optimal levels of input and output, and it all comes down to producing goods or services that corresponds to the demand of the customers. Organisational efficiency, on the contrary, relates to financial measures and productivity, i.e. how well a company uses its money through getting the maximum output with minimum input. Effectiveness takes long-term strategies into consideration while efficiency focuses on the “status quo”. Working only with effectiveness will most likely lead to success but at an expected high cost, and focusing only on efficiency will probably not satisfy customer demand or stakeholder requirements. In order for companies to stay successful it is necessary for them to work with both of these factors. This requires coordination and an optimal design of the organisation, which will be further discussed below. (Bruzelius & Skärvad, 2011)

![Effectiveness and Efficiency Diagram](Source: Bruzelius & Skärvad, 2011, pp. 101)

3.3.2 Differentiation and Integration

The two basic elements of organisational design are differentiation and integration. Differentiation implies that the organisation should be designed so that each activity is performed in an efficient matter. Integration, in turn, is required to be able to coordinate the organisation so that the overall objectives are achieved. As a result of
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differentiation, unit specialists emerge and these specialists have important knowledge that needs to be integrated between units in order to benefit the whole organisation. (Bruzelius & Skärvad, 2011)

As a result of today’s increasing turbulence and uncertainty, companies are becoming more and more differentiated. Today, there is a need of more knowledge intensive organisations and through differentiation each organizational unit can develop its own knowledge, aspirations and attitudes. This, however, leads to internal conflicts and a risk of organisational sub-optimisation. For the company to effectively achieve its overall goals, the coordination between within the units must be increased. The creation of Strategic Business Units (SBUs) within companies tend to create independent managers who share more about their own business than the company as a whole. It is suggested companies should be organised so that the organisational units add up to more than the sum of them. In conclusion, to be successful, organisations must balance differentiation and integration and the desired stage is a high level of both elements. (Lawrence & Lorch, 1967; Bruzelius & Skärvad, 2011)

3.3.3 Structural and Functional Systems

The systems and subsystems that emerge as result of differentiation can be divided into structural and functional systems. A structural system is defined by its components, for example organisational units. A functional system, on the other hand, is defined by the system’s performance, e.g. a production system is the system that produces the company’s products. If organising the organisation according to a structural system, it might be difficult to understand the functions and the output of the system. Vice versa, if organising it according to a functional system, it might be difficult to identify the components and the overall structure. To overcome this dilemma, it is effective to cross the two systems in a table (see table 1). In this way, it is possible to see what structural system is related to what function and the other way around. (Bruzelius & Skärvad, 2011)

<table>
<thead>
<tr>
<th>Structural System</th>
<th>Functional System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market unit</td>
<td>Idea generation</td>
</tr>
<tr>
<td>Operations unit</td>
<td>X</td>
</tr>
<tr>
<td>R&amp;D unit</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 1 Functional versus structural system. Example: The Product Development Process (Source: Bruzelius & Skärvad, 2011, pp. 93)
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It is common to name the combination of the structural and functional systems in an organisation after a mutual name: business processes. This name refers to the flow of related activities that together create value for an organisation’s customers. Business processes are cross functional and aims to create a collective effort among employees working in the different units, rather than allowing the employees to solely care about the development of the own unit, or of their own activity. (Bruzelius & Skärvad, 2011)

3.3.4 Strategic Alignment

As mentioned above, in companies of great size it is common that sub-units are created in order to cope with the size and complexity of the company. As a result, different levels of strategy and different strategies are easily developed within these sub-units (see figure 5) and these strategies need to be consistent (see figure 6). For example, operations strategy and market strategy, that constitute a particularly critical link in a company, often have difficulties in understanding each other (Hill & Hill, 2009). Research has shown that the required integration is especially high between the two units (Lawrence & Lorch, 1967). Unfortunately, there are many differences between them when it comes to structure, interpersonal orientation and time-/goal orientation, which makes the integration complicated (Lawrence & Lorch, 1967). Clearly, the more differentiated sub-systems there are in an organisation, the more difficulties there will be when trying to integrate them.

Figure 5 Real-life business strategy making process (Source: Hill & Hill, 2009, pp. 28)

The marketing strategy is aimed to create a fit with the market; hence, this strategy needs to be well conceived since the degree to which a company succeeds is strongly connected to their overall growth in sales and profits, which, in turn, is dependent on market activities. To increase sales and profits, it is important for a company to understand what the customer requires for example in terms of lead-
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time or quality. Hence, it is essential that every function in a company have extensive knowledge of the market needs. (Hill & Hill, 2009)

Operations strategy, on the other hand, is vital because except knowing what the market demands it is also important to consider the company’s ability to meet these demands. In a manufacturing company, for example, it is especially essential for the survival of the company that it is able to deliver products that the customers are expecting at the right volume and at the right point in time. (Hill & Hill, 2009)

Due to the above reasoning, it is obvious that the sales unit and the operations unit need to cooperate in order to satisfy the customers. Both units have a responsibility to achieve a high level of customer satisfaction. For example, the first order placement done by a customer is often the sales and marketing departments’ responsibility while whether or not the customer returns is depending on the operations department’s performance. If the customer’s requirements have been met, then there is higher chance that the customer will return. To be able to have the same view of the market and work towards the same goal, the functions need to discuss their different views on the market and decide upon a common strategy that would benefit the business as a whole. This will create a business unit strategy that is coherent between all parts of the organisation and only then it is possible to know the degree of fit between the market strategy and the operational ability to meet this strategy (see figure 6). If the top management does not understand the importance of an integrated strategy than the functions themselves have to handle trade-offs in the organisation. (Hill & Hill, 2009)

Figure 6 Ideal business unit strategy-making process (Source: Hill & Hill, 2009, pp. 27)
3.3.5 Concluding Remarks: Organisational Success & Strategic Alignment

- In order for companies to stay successful it is necessary for them to be effective (long-term strategies) as well as efficient (current situation), and balance the level of differentiation and integration within the company.
- If organising the organisation according to a structural system, it might be difficult to understand the functions and the output of the system. If organising it according to a functional system, it might be difficult to identify the components and the overall structure.
- A business process refers to the flow of related activities that together create value for an organisation’s customers, i.e. it is a mix of the structural and functional system.
- A business unit strategy that is coherent between all parts of the organisation needs to exist.
- The need of strategic alignment and integration is especially high between sales and operations. These units often have difficulties to understand each other.

3.4 Key Performance Indicators

“You don’t manage what you don’t measure” (Kaplan & Norton, 2006)

In order to maintain a successful business it is important that the activities that are vital for the firm to succeed in the future are measured. This does not only include financial measures, but also measurements from the on-going operations. (Bruzelius & Skärvad, 2011)

Hence, if organisations wish to achieve more alignment, they need aligned measurements (Kaplan & Norton, 2006). In the previous section, the importance of alignment between operations and sales was stressed and one process that involves both departments is the delivery of products to the customers and the customers’ satisfaction. Below is therefore an explanation of a service level measurement as KPI and the importance of speed of service as a competitive factor.

3.4.1 The Service Level Measurement

Service-level management is the monitoring of a customer’s pre-defined expectations in relation to the actual performance of the company. It includes the management of service quality compared to different key performance indicators (KPIs). If measuring how many percentage of the total amount of arriving customers that receive a good or service within their expected waiting time, a service level is generated. This service level is affected by the capacity of a system; the more capacity and the higher number of operating units that are active when a good or service is requested, the higher the service level will be. (Wankel, 2009)
Deciding on an appropriate service level is highly relevant in various management tasks. Service level measurements enable organisations to identify operational deviations, which decrease the risk of system failure and unsatisfied customers. However, finding optimal policies for choosing service rates is not an easy undertaking. These problems are generally classified as *optimal design problems* and fall within the area of design and control of queuing system. (Kalai et al., 1992)

### 3.4.2 Service Level: A Decision Variable for Customers

An important goal of having a service level measurement is to keep lead-times under control, i.e. keep lead-times as short as possible while at the same time satisfying a certain customer service requirements. A service level consists of two different measures: *tardiness* and *serviceability*. The tardiness of a job is the positive difference between completion time and the due date, while the serviceability indicates to what probability a job finishes on time or before its due date. The tardiness measure is to prefer when quoting lead-times, since the serviceability can lead to unethical practices if seeking to optimise this measurement. The suggested service policy says: “Quote lead-times according to the congestion level, so that every job is guaranteed the same serviceability level”. (Spearman & Zhang, 1999)

A service requirement is in most cases a decision variable of the customer. More specifically, time delay is an important attribute of customers’ perceived quality of service. Due to this, it is crucial for a facility manager to utilise the facility in an optimal way in order to totally avoid delay or maintain an acceptable level of delay. It is also important to truly know the customers in order to determine if any customer should be prioritised, and if so, which customer should be prioritised in front of another. Related to this decision there are two aspects: first, different customers have different service requirements and only those who truly value the speed of service should be admitted to the system; secondly, the size of the service requirement need to be taken into consideration and if it is large, more capacity is needed to satisfy the requirement. (Ha, 2001)

There is a problem of coordinating service rates when the facility manager does not know the customers’ identities and service requirements, i.e. when there is information asymmetry. Customers have different demand patterns and are more or less sensitive to delay costs. If the facility manager can observe their identities, suitable actions for different customer can be applied while at the same time trying to optimise the total net value of the system. (Ha, 2001)

### 3.4.3 Competing on Service Levels

Speed of service as a way to capture a larger market share is an important competitive factor. The faster a firm can offer a good or service to its customer, the larger market share will be captured. However, an important effect of having fast
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service is higher operating costs. Hence, there is a trade-off between speed of service and operating costs. For a monopoly firm, alone in the market, the optimisation problem is quite simple: to offer a mean service time that is never below the mean time of incoming customer requests, i.e. one in one out. If competitors are present, however, the situation is somewhat different. The customer left waiting might be lost. (Kalai et al., 1992)

According to Wankel (2009) there are a few deficiencies if considering previous literature on the concept of competing on service levels. The customers’ expected waiting time might not be the same as the accepted waiting time, because some time might be added to the expected time depending on production delays or queues. Therefore, the waiting time used when calculating the service level should instead be referred to as an actual waiting time. (Wankel, 2009)

3.4.4 Concluding Remarks: Key Performance Indicators

- The activities that are vital for the firm to succeed in the future need to be measured, both financial and operational measurements.
- The service level is the percentage of total amount of arriving customers that receive a good or service within their expected waiting time.
- The service level is affected by the capacity of a system; the more capacity and the higher number of operating units that are active when a good or service is requested, the higher the service level will be.
- An important effect of having fast service is higher operating costs.

3.5 Order-Winners and Order-Qualifiers

As already mentioned, it is important for a company to understand its market since it is the actual reason for a company’s existence. Unfortunately, it is common that the significant link between what the market needs and the functional strategy is missing in companies. Most often, the knowledge and view of the market is limited to the marketing department and not passed on to the operations unit. It is therefore important to specify the order-winners and the order-qualifiers of the company. The qualifiers are, as stated before, criteria that invite the company to compete in the market but they do not let the company win orders. For this, the company needs other factors to compete with. If a company fail to succeed with their order-qualifiers, it will lead to loss of orders, which posses a great risk for the company to loose an order to its competitors. It is therefore important to remember that qualifiers are not less important to address than the order-winners. Order-winners and order-qualifiers are also different in different markets, which means that it is important to find the most important criteria for the company’s specific market. In the section below, we will discuss the criterion lead-time, which is identified to be an important factor in the competitive environment of today’s manufacturing companies. (Hill & Hill, 2009)
3.5.1 Lead-Times

Today, many companies are moving towards becoming more customer-oriented, low cost and high quality is not longer enough to compete against competitors. Companies with customised products are instead competing with lead-times since the customers are already assuming the quality of the product to be good and the cost to be low (Spearman & Zhang, 1999). Companies with the fastest processing rates, or that are best at meeting the required date, will win orders against competitors (Li & Lee, 1994). However, to succeed with this an operations process that is adapted to high delivery speeds needs to exist. Thus, a company need to quote short lead-times but in addition a high rate of customer service is also needed. (Chen & Wan, 2001; Hill, 2009; Spearman & Zhang, 1999)

Time-Based Competition

Time Based Competition (TBC) is a manufacturing strategy that became important in the 1990s and still today contributes to the success of many companies in various industries. According to studies, customers assess delivery reliability and responsiveness as the most important attributes of service in many industries (Li & Lee, 1994). It implies that time management, time to market and on-time delivery performance are important factors for staying competitive in the coming years; low cost and high quality are not enough in an increasingly customer oriented marketplace, but short lead-times for products have become essential (Van Mieghem, 2003; Nahmias, 2009). This suggest that time has become an order-winner. Low cost and quality, on the contrary, are viewed upon as order qualifiers (Nahmias, 2009).

Time-based companies compete by satisfying customers’ needs as soon as possible. This is done through flexible manufacturing, rapid response, expanding variety and increased innovation (Li & Lee, 1994). Compared to non-time based companies, time-based competitors can normally charge a higher price and capture a larger market share since they, in addition to low cost and high quality, provide products with shorter delivery times. This applies especially to make-to-order (MTO) firms, who start to work on an order as soon as it is placed. (Chen & Wan, 2001)

Related to time competition, it is interesting to look at the queue aspect (section 3.5.4). In the literature of operations research and operations management, not much has been written on how queue decisions interacts with other strategic decisions on price and quality. However, in the case of time competition queues are inevitable whenever there is variability in demand and production. At some point in time, customers will hesitate to join the queue and, therefore, in a time-competitive environment the customers’ choice is not totally determined by the customer but also affected by the nature of the queue system (Chen & Wan, 2001).
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Where time, i.e. delivery speed, is an order-winner, it is important to consider reducing the operations lead-time, which is the time it takes for the company to produce the products. This is explained below, as well as the lead-time reduction problem. (Hill & Hill, 2009)

**Different Types of Lead-Times**

A customer’s lead-time consists of the time between the order is placed and the required delivery date. This lead-time is often compared to the operations lead-time, which is a combination of the material lead-time (the time it takes for a supplier to deliver, MLT) and the order backlog (the number of orders already accepted and waiting to be made, OBL) plus the process lead-time (the length of time it takes to make the order, PLT) (see figure 7). It is also possible to include a last element of the lead-time, which would be to deliver an order to the customer’s location, i.e. the transportation lead-time. (Hill and Hill, 2009)

![Figure 7 The components of operations lead-time (Source: Hill and Hill, 2009, pp. 81)](figure7.png)

When comparing the customer lead-time with the operations lead-time, two scenarios are common (figure 8).

**Scenario 1**

```
Customer lead-time
```

```
Operations lead-time
```

**Scenario 2**

```
Customer lead-time
```

```
Operations lead-time
```

![Figure 8 Customer lead-time and operations lead-time comparison (Source: Hill and Hill, 2009, pp. 82)](figure8.png)
In scenario 1, the operations lead-time is longer than the customer lead-time. Hence, to meet the required due date, operations need to shorten their lead-time. This can be done in two different ways: either by increasing the short-term capacity by applying overtime in production, or through changing the prioritisation of the orders in the order backlog queue. However, these short-term strategies are unsustainable and a more strategic solution needs to be found in order to have scenario 2 as the norm. This could, for example, be done through:

- Increasing capacity on a permanent or semi-permanent basis (reduce PLT)
- Hold selected material in stock (reduce MLT)
- Moving from make-to-order to assemble-to-order or make-to-stock (reduce PLT)
- Contracting with suppliers to ensure they provide a certain number of orders at all times (reduce OBL)
- Making sure suppliers hold a selected material inventory, with guarantee of usage or compensation if not utilised (reduce MLT)

In scenario 1, the customer lead-time is longer than the operations lead-time. Therefore, the only undertaking in operations is to schedule orders to meet the promised due dates. (Hill and Hill, 2009)

**Lead-Time Reduction**

As mentioned above, short lead-times can be offered to customers by for example holding excess capacity, keeping low or zero order backlogs or holding inventory at different stages in the production process. Whether or not companies are able to reduce their lead-times depend on different factors such as the nature of their markets (design-and-manufacturing or manufacturing-only), the type of products sold (standard products or special products) and their decision to hold different levels of raw materials or components, work-in-progress and finished goods inventory. (Hill and Hill, 2009)

The strategy of how to reduce lead-times can be either reactive or proactive. This implies that there are different modes from which a company can choose to apply in their production, which all will have different implications on their lead-times (figure 9). These modes are: design-to-order, engineer-to-order, make-to-order, assemble-to-order or make-to-stock. (Hill and Hill, 2009)

![Figure 9 Modes and their implications on lead-times](Source: Hill, 2009, pp. 84)
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The choice of what lead-time reducing strategy to apply falls within the responsibility of the business-strategy making group. Operations role is only to implement and maintain the chosen strategy. From the point in time when the order reaches the factory, an operational aim to reduce all elements of lead-time, i.e. each component’s lead-time that is involved in the total process, needs to exist. Important to consider related to this is that often the lead-time related to activities before and after the actual manufacturing activity takes up most of the total lead-time. (Hill and Hill, 2009)

**Delivery Reliability / On-Time Delivery**

A major task of the operations function is not only to offer short lead-times but also to ensure delivery reliability, or on-time delivery, which means supplying the ordered products on the agreed due date in full quantities. Therefore, a need has developed to identify different delivery expectations. (Kalai et al., 1992)

Quoting short lead-times can be a risky game if not being able to live up to the resulting customer expectations as stated above and therefore it is important to look over the time it takes for the production to produce an order versus what the customers’ expect (Spearman & Zhang, 1999; Hill and Hill, 2009)

### 3.5.2 Concluding remarks: Order-Winners and Order-Qualifiers

- It is important to specify what the *order-winners* and the *order-qualifiers* are and most often, the knowledge and view of the market is limited to the marketing department and not passes on to the operations unit.
- *Order-winners* win orders and *order-qualifiers* qualify the company to compete in the market.
- An important decisions variable for customers in a *time-based environment* is the *lead-time* between their order placement and the point in time in which they receive the good.
- The *customer’s lead-time* is often compared to the *operations lead-time*, two scenarios are common: Customer lead-time > Operations lead-time, Customer lead-time < Operations lead-time.
- *Time-Based Competition* implies that time to market is an important factor for staying competitive; low cost and high quality are not enough.
- In order to reduce waiting lines (queues), extra capacity investments are required and when deciding whether or not to invest, it is of importance to know what the effect of the investment will be.

### 3.6 Operations Strategy

For manufacturing companies, operational strategies are fundamental to succeed. Operational investments are among the largest investments a company can make, and they are also fixed in that it takes a long time to agree upon, implement or perform changes in these investments. Therefore, it is critical that these investments
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are made correctly. A lack of fit between key investments, such as investments in processes or infrastructure, and the company’s market will surely lead to failure. To avoid this, it is of greatest importance that companies are aware of how their operations can support the market strategies. (Hill & Hill, 2009)

This part will raise the issue of long-term capacity management and will bring up important perspectives within long-term capacity management, which are Manufacturing Strategy as well as Sales and Operations planning (S&OP). This section will also explain the concept Lean in more detail as well as Queuing Theory.

3.6.1 Manufacturing Strategy

Finding the right level of production capacity (timing) is a complex part of operations strategy. Capacity decisions are affected by variation in demand as well as the level of quality; depending on if the quality of a product is high, the customer will demand more of that product, and if the demand increases the production capacity needs to be expanded. When capacity is expanded, fewer customers will hesitate to place an order due to shorter waiting times and the product quality will most likely improve because the rate of utilisation of capacity declines. Due to the fact that demand is random, there will be times when the capacity is high but there are no customers available to be served. At other times, the capacity might be fully utilised and a queue forms. Generally, firms carry excess capacity, i.e. the mean output capability exceeds the mean demand. (De Vany, 1976)

The capacity-investment problem incorporates decisions on the size and timing of capacity changes given a probable distribution of demand per time unit. External forces such as customer demand or external supply markets affect these types of decisions since both of these actors have the possibility to turn to other firms if complications appear. Therefore, it is important to consider the behaviour of the external forces when making capacity investments. (Van Mieghem, 2003)

The capacity level decision mentioned above can be divided into two parts: the type of capacity needed and the amount of capacity that should be added/reduced. Capacity can often be added in steps and with a significant lead-time, which means that with added resources a large capacity expansion often comes as a result. It is hard to take small steps when adding/removing capacity and it often takes a while to do it. (Olhager et al., 2001)

The second decision is the timing of capacity changes, which concerns the balance between the sales forecast and capacity available. The capacity strategy can be expressed as a trade-off between high utilisation (low capacity) and high flexibility (high capacity) and two strategies for this has been identified:

1. Leading Strategy
2. Lagging Strategy
A third strategy also exists, which aims to find a trade-off between the two other strategies. This strategy is called tracking strategy or match strategy (Olhager et al., 2001; Van Mieghem, 2003). The different strategies are further discussed further below.

**Capacity-Leading and Capacity-Lagging Strategy**

It is strategically important to decide if a company should decide about capacity in the production prior to changes in demand or if the company should do the other way around. The different strategies that support the decisions regarding the timing of capacity adjustments are capacity-leading strategies, capacity-lagging strategies and match strategies. A *capacity-leading strategy* implies that capacity is added/removed prior to knowing anything about the future demand. A *capacity-lagging strategy*, on the other hand, indicates the opposite, that the capacity is changes after knowing the demand which indicates that there is never underutilized capacity in production. The *tracking/match strategy* means that capacity is added in response to changing market demands and the difference between demand and capacity is kept at a minimum. This strategy is used when it is hard to use one of the other due to difficulties to forecast demand. When using the tracking/match strategy, the sizing problem described above, gets more significant and more emphasis is put on reducing the step sizes but a tracking strategy often means that the capacity can be available in smaller steps. A tracking strategy also implies that sub-contracting or overtime will be use some time and over-capacity will exist at some times, which is typical in MTO situations. (Van Mieghem, 2003; Olhager et al., 2001)

The advantage of using a capacity-lagging strategy is that the risk of having too much capacity is eliminated, which makes the production less dependent on accurate forecasting and it delays capital expenditures. This strategy is often used when price is an order winning and low cost is important. However, it results in lost sales if demand increases and, in addition, customers will be dissatisfied and might go to a competitor. It is also difficult to handle this strategy when demand is decreasing, to be able to not having too much capacity, the decision to reduce capacity must come prior to the decreased demand. For new product introductions, a capacity-leading strategy is required. The aim with using a leading strategy is to be flexible and offer reliable lead-times. (Van Mieghem, 2003; Olhager et al., 2001)

**3.6.2 Sales and Operations Planning (S&OP)**

Sales and Operations Planning (S&OP) is seen as the central function that balances the supply and demand (rate of production) and can be divided into two parts: *the sales plan* (based on forecasts) and *the production plan*. S&OP is seen as the process where different functional units meet to create a production plan. To be able to balance the sales- and production plan, either the demand or the supply needs to be
In an industrial environment, the coordination between operations and sales is often related to discussions regarding the materials requirements planning (MRP) system and similar systems. In these cases, S&OP is referred to as aggregate- or production planning. Olhager et al. (2001), however, claims instead that aggregate planning is a part of S&OP. Some of the different systems and plans used in S&OP will be explained below but in this part S&OP will be referred to as production planning.

**The Production Planning System**

A production plan includes a full description of the amounts of both final- and subassembly items produced, the exact timing of the lot sizes in production, and the final completion schedule. The plan can be broken down into three sub plans: the master production schedule (MPS), the materials requirements planning system (MRP), and the detailed job shop schedule. The most vital input to the production plan are the sales forecasts for final items (shipped products) produced over the planning horizon. (Nahmias, 2009)

The master productions schedule (MPS) is a specification of the production plan with the exact amounts and timing of each of the final items. Forecasts for future demand by item are the main input to this schedule. The MPS, in turn, is broken down into an even more detailed production schedule for each components that add up to a final item, i.e. the material requirements planning (MRP) system. At the lowest level, the MRP is broken down into shop floor schedules and requirements for raw materials. (Nahmias, 2009)

In order for the MRP to work, the data that is the input to the plan needs to arrive on time. The operations unit, the sales unit as well as the finance department are mutually responsible for generating this data on time and the coordination in
between these three units is therefore essential for the production planning system to work. (Nahmias, 2009)

**Capacity Requirements Planning**

The capacity of the production facility is a factor not included in the MRP. The Capacity Requirements Planning (CRP) process links the production planning and the MRP process by computing the capacity requirements placed on a work centre or group of centres by using the output of the MRP planned order releases. (Nahmias, 2009)

If it is noticed that the CRP does not match the planned order releases, it is possible to take action by an iterative trial-and-error process between the CRP and MRP; either it is possible to schedule overtime at the bottleneck locations, or to modify the MRP so that the current capacity match up to the planned order releases. (Nahmias, 2009; Van Mieghem, 2003)

**Different Capacity Plans**

The input to the MRP and CRP systems is normally a *deterministic* or *sales-plan driven capacity plan*. This plan presents a first-hand estimate of the capacity requirements and leads to a balanced capacity outline although it fully ignores uncertainty. The sales-plan driven plan is attractive from a cost-perspective. Another type of capacity plan is the *total coverage plan*, which is a plan that minimizes lost sales and, hence, is attractive from a revenue perspective. (Van Mieghem, 2003)

**3.6.3 Interaction of Manufacturing Strategy and S&OP**

As stated above, manufacturing strategy mainly focuses on the timing of capacity changes while S&OP focuses on the rate of production. Both of these decisions are related to long-term capacity management but they involve different sub-decisions, which is the reason to why they often are treated in sequence where manufacturing strategy (timing) is decided prior to S&OP (rate). The manufacturing strategy determines whether the capacity is changed before or after a change in demand. The planning of the rate of production must after that work within the determined capacity levels. The result from linking the two perspectives is shown in table 2. The upper left corner and lower right corner are two situations where the strategies support each other. The lower left corner indicates that the situation is neither supportive nor conflicting. It is here possible to move towards “mix” or “chase” strategy and thus change the production rate since the flexible perspective of “lead” is used. The level strategy also implies that the capacity is kept at a minimum and new capacity acquisitions can be delayed. In the upper right corner, however, the perspectives are conflicting. With a lagging strategy it is difficult to perform a chase strategy and the company must rely on external sources of capacity. The positions of “mix” and “track” are seen as an intermediate of the other positions. (Olhager et al., 2001)
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<table>
<thead>
<tr>
<th>Lead (capacity supply surplus)</th>
<th>Track</th>
<th>Lag (capacity demand surplus)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chase</strong></td>
<td></td>
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<tr>
<td>Combined strong focus on</td>
<td></td>
<td>Limited opportunities to</td>
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<tr>
<td>resource availability and</td>
<td></td>
<td>execute chase. Relying on</td>
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<tr>
<td>flexibility</td>
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<td>sub-contractors. Frequent</td>
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<td></td>
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<td>overload and delivery</td>
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<td></td>
<td></td>
<td>problems</td>
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<tr>
<td><strong>Mix</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Level</strong></td>
<td></td>
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</tr>
<tr>
<td>Possibility to change the</td>
<td></td>
<td>Combined strong focus on</td>
</tr>
<tr>
<td>production rate if needed.</td>
<td></td>
<td>resource utilisation</td>
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<tr>
<td>Delay new capacity</td>
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<tr>
<td>acquisitions</td>
<td></td>
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</tbody>
</table>

Table 2 Illustration of the effects of combining manufacturing strategy and S&OP. (Olhager, 2001, pp. 224)

### 3.6.4 Lean Management

*Lean* is a philosophy that concentrates on eliminating all activities that do not add customer value and to shorten the overall process in order to lower costs but also to improve quality and shorten the delivery time. Examples of activities that do not add value to the product are over-production, waiting time, unnecessary transports, excess inventory, and defects. It is important that the lean thinking is not only implemented in the operative work. For maximal effect, it should influence the entire culture in a company. Everyone should constantly strive to improve the system. To be classified as a lean manufacturer, a company needs to have a certain way of thinking that influences the entire organisation and that focuses on the product flow with value-adding processes in a one-piece flow. A one-piece flow is defined as a closed arrangement where the resources needed are put in workstations with a logical order where it is possible to produce one piece at a time. The customer’s needs decide the pace of production; hence, the system should be a *pull* system or a make-to-order system, which the situation is called above (logistik.com). The lean philosophy implies that the right process will produce the right results. (Liker, 2004)

Toyota Production System (TPS) have founded 14 principles that they have entitled the Toyota way. These principles are further divided into four sections, displayed below. (Liker, 2004)

**Section I: Long-Term philosophy**

- *Principle 1*: Base your management decisions on a long-term philosophy, even at the expense of short-term goals.
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Section II: The right process will produce the right results

- **Principle 2**: Create continuous process flow to bring problems to the surface.
- **Principle 3**: Use “pull” systems to avoid overproduction.
- **Principle 4**: Level out the workload.
- **Principle 5**: Build a culture of stopping to fix problems, to get quality right the first time.
- **Principle 6**: Standardize tasks are the foundation for continuous improvement and employee empowerment.
- **Principle 7**: Use visual control so no problems are hidden.
- **Principle 8**: Use only reliable, thoroughly tested technology that serves your people and process.

Section III: Add value to the organisation by developing your people and partners

- **Principle 9**: Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.
- **Principle 10**: Develop exceptional people and teams who follow your company’s philosophy.
- **Principle 11**: Respect your extended network of partners and suppliers by challenging them and helping them improve.

Section IV: Continuously solving root problems drives organisational learning

- **Principle 12**: Go and see for yourself to thoroughly understand the situation.
- **Principle 13**: Make Decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly.
- **Principle 14**: Become a learning organisation through relentless reflection and continuous improvement.

The principles that are of most relevance to understand the relationship between operations and sales specifically at Tetra Pak will be described further below: principle 1) **long-term philosophy**, principle 2) **continuous flow (takt)**, principle 3) **the pull system**, and principle 4) **levelling**.

### Long-Term Philosophy

In a lean organisation it is important to look at the long-term philosophy when making management decisions, even if it means to prioritise them over short-term financial goals, which is described in the first principle. By looking at the long-term philosophy the entire industry can profit from decisions instead of increasing profits for one company from year to year. For a while now, many individuals and companies have tried to optimise their profits and to pursue their self-interests in a short-term view. (Liker, 2004)

### Takt

Takt is about creating a continuous process flow, which reveals defects in the production. The flow is a continuous process where the purchase of raw material, production of an order and the next coming steps are triggered by the placement of an order by the customer. The *takt* time is defined as *the rhythm in the production*
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that depends on the rate of customer demand. Hence, takt can be used to set the pace in the production. The takt is calculated by dividing the available amount of working hours in production during a specified time with the amount of products the customer is demanding during the same time.

\[
Takt = \frac{\text{Amount of working hours in production per year}}{\text{Amount of products the customer is demanding per year}}
\]

If the production is working faster than the decided takt, then they will overproduce and if they are going in a slower pace, then bottlenecks are created somewhere in the production. Takt is easiest applied in high-volume production sites where the demand is somewhat continuous. (Liker, 2004)

**The Pull System**

The third principle of Toyota is that a pull system should be used to avoid overproduction. The difference between a push-system versus a pull-system is that in the case of a push-system the products are pushed in the production without considering customer demands. In a push system the products are stored in an inventory or pushed onto the customers instead of the customers receiving the right products when they need it and in the right quantity. The pull system is described as the perfect state of JIT (just-in-time) manufacturing. (Liker, 2004)

**Levelling**

Working according to a levelling system in the production means to even out incoming orders so that the production level stays constant. When levelling the production the incoming orders might be postponed or moved forward to keep the production level constant, which implies that some customers might have to wait a bit for their order. The reason for doing this is because it is difficult to predict incoming orders and the amount of orders can vary from month to month. Without applying levelling in the production, demand fluctuations would imply problems with staffing, problems with keeping suppliers satisfied and the equipment would be underutilized for some periods and over strained for some periods. This could cause large inventory, hidden problems, quality problems and even longer lead-times. (Liker, 2004)

**3.6.5 Queuing Theory**

Queuing theory is a branch of operations research that is viewed upon as the mathematical study of waiting lines, or queues. In order to reduce waiting lines, extra capacity investments are required and when deciding whether or not to invest, it is of importance to know what the effect of the investment will be. For that, the models and techniques included in queuing theory are applicable. As a result of applying these calculation techniques, different performance measures can be generated such as: the expected number of customers waiting for service, the
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Probability of the system having an available server, or the time a customer has to wait to be served. (Nahmias, 2009)

There are different structural aspects of queues:

- **Capacity of the queue:** the size-limitation of a queue
- **Service discipline:** the rule by which customers in the queue are served (first-come-first-served or according to priority service disciplines)
- **Arrival process:** number of arrivals to the system, characterised by the distribution of interarrival times
- **Service process:** the distribution of the time required to serve a customer
- **Number of servers:** single-server or multi-server (see section below)
- **Network structure:** when the output of one queue forms the input of another

There are also different types of queues. The most common queue is the single-server queue. In an industrial environment, this type of queue is comparable with a production line or a production system in a factory. When designing the layout and capacity of such a production system, queueing models are especially useful. For example, if considering a machine that produces different types of products, queueing models might help sorting out questions such as: What is the production lead-time for an order? What is the reduction in the lead-time when adding extra capacity? Should orders be prioritised? (Chen & Wan, 2001). In queueing literature, the control of service rates in a single queue is well investigated. (Weber & Stidham, 1987)

A distinction that can be made between different single queueing systems is if the queue length is observable or unobservable. The system utilisation is the highest when the queue length is observable. (Chen & Wan, 2001)

**Joining Behaviour in a Queue**

Whenever the length of a queue is longer than the expected length, customers will hesitate to join the queue. However, if the cost of waiting is less than the search cost of looking for another supplier customers will join the queue. Also, if the price of the good is low, if the alternative supplier’s price is high, if the switching cost is high, or the service level of the alternative supplier is lower, a longer queue will of course be more tolerated by the customer. (De Vany, 1976; Li & Lee, 1994)

According to the above reasoning, all customers become discouraged to join the queue at some point and turn to other options on the market. If a firm is losing customers to other firms because of long queues, there are two options: either the firm can increase the price of its products or service, which reduces the customer arrival rate and the average waiting time will be reduced; or the capacity can be altered, which will increase the firm’s ability to serve more customer. (De Vany, 1976; Chen & Wan, 2001)
3.6.6 Concluding Remarks: Operations Strategy

- It is of great importance that companies are aware of how their operations can support the market strategies.
- In a lean organisation it is important to look at the long-term philosophy when making management decisions, even if it means to prioritise them over short-term financial goals.
- Working according to a takt system implies that the customer should decide the pace (takt) of production (a pull system).
- Working according to a levelling system in the operations unit means to even out incoming orders so that the production level stays constant.
- Finding the right level of production capacity is a complex part of operations strategy. It is important to consider the behaviour of the external forces when making capacity investments.
- To be able to balance the sales- and production plan, either the demand or the supply needs to be modified to match the other constraint.
- Queuing models might help sorting out questions such as: What is the production lead-time for an order? What is the reduction in the lead-time when adding extra capacity?
- A distinction that can be made between different single queueing systems is if the queue length is observable or unobservable. The system utilisation is the highest when the queue length is observable.
- Whenever the length of a queue is longer than expected lengths, customers will hesitate to join the queue.

3.7 Marketing Strategy

Although operational strategies are fundamental for manufacturing companies to succeed, they, as every other company, also need to have solid marketing strategies in place to retain existing customers and attract new customers. In order for the important operational investments to be made correctly there needs to be a fit with the marketing strategy, i.e. a company need to be fully aware of the market and its customers, products and competitors in order to transfer that information to the operations unit so that it make the investments needed to meet the market’s demand. (Hill & Hill, 2009)

A vital link between the marketing unit’s understanding of the market and the operations unit’s understanding of operational investments is the sales forecast. Hence, forecasts will be explained further below. Also a short overview of market expectations will follow, which, naturally, is an area that needs to be met in order to create satisfied customers. Theories on market expectations are discussed continuously throughout the theoretical chapter and will therefore not be discussed in detail but only commented upon in the section after sales forecasts.
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In similarity to Hill and Hill’s framework, marketing strategy will not be treated in depth but on a more general level. The reason to this is that marketing strategy is an important part for understanding the overall requirements for acquiring organisational success but only the two factors sales forecasts and market expectations needs to be explained further to understand the capacity planning aspect, as these two parts are obvious factors in calculating a service level measurement that will support capacity planning decisions.

3.7.1 Sales Forecasts

Forecasts support a company’s operations function. They are used for all business planning, and to support the planning of the sales of existing as well as new products, capacity requirements, availability of raw material, and the changes in the skills of the work force. All of these factors affect the future success of the firm; hence, forecasts are of great importance. (Nahmias, 2009)

Two units in a company especially use forecasting as a tool: the sales unit and the operations unit. Marketing use forecasting to predict sales, while operations use the sales forecasts prepared by the sales unit for their operations planning. The “demand-planning” cycle begins with the sales unit trying to combine historical and future knowledge in order to estimate sales for the upcoming 12 or 24 months (Mieghem, 2003). Normally, marketing prefer to create forecasts of a group of items rather than single items, while operations might require single item forecasts for their planning. The sales estimates are typically set to increase the chance to meet the numbers, so estimates closer in the future are more reliable than others. Understandably, there are occasions when the sales forecasts do not meet the needs of the operations unit. (Nahmias, 2009)

Forecasting Characteristics

According to Nahmias (2009) there are some characteristics of forecasts worth knowing:

- They are almost always going to be wrong
- A good forecast is more than a single number
- Aggregate forecasts are more accurate
- The longer the forecasting horizon, the less accurate the forecast will be
- A forecasting technique should not be used to the exclusion of known information

To begin with, Nahmias (2009) implies that sales forecasts are most often treated as known information although they might be inaccurate. The production planning system needs to be adapted to this and respond quickly to forecasting errors. Secondly, a forecast needs to include some measure of this forecasting error. It could for example be an error measure showing the variance of the distribution of the forecasting error. Third, it is generally known that “point forecasts”, i.e. forecasts
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of individual items, are typically wrong and forecasts of a mass of units, for example an entire product line, are more often correct. However, these aggregate forecasts are not easy to make. Aggregate planning is aimed at a lower level with short planning horizons. It deals with the determination of the level of resources used in the process over time. These resources are often limited to: workforce size, inventory planning, subcontracting and overtime scheduling (Van Mieghem, 2003). Finally, it is important not to base forecasts on a single source of information. There may be information regarding future demand, as for example a promotional sale, which is not included in the historical information that is normally used to design forecasts. (Nahmias, 2009)

**Time Horizons**

Forecasts may be classified according to different time horizons (figure 10). There are three time horizons usually referred to: short-term (days/weeks), intermediate (weeks/months) and long-term (months/years). (Nahmias, 2009)

![Decision/forecasting horizon](image)

**Figure 10 Decision/forecasting horizons and their related decisions/issues (Source: Nahmias 2009, pp. 10 & pp. 55)**

Most associated with a company’s overall manufacturing strategy are the long-term production decisions. For example, the long-term forecasting of capacity needs. Capacity planning concerns extensive questions such as facility investments or downsizing, and this is where the long-term forecasts come in as a support. (Nahmias, 2009)
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**Subjective and Objective Forecasting**

There are two different methods to use when creating a forecast: subjective or objective forecasting. Subjective forecasting is based on human judgement and measures either individual or group opinions. This could for example be the sales force combined knowledge or customer surveys. Objective forecasting, on the other hand, is based on analysis of data and is when forecasts are created based on past history. For example, time series methods or regression analysis could be used. If using time series analysis, the idea is that information gathered from patterns of past observations can be used to forecast future series. The patterns that most often are discovered are trends, seasonality and different types of cycles. (Nahmias, 2009)

3.7.2 **Market Expectations**

It is difficult to know how customers value different product attributes such as cost, time and quality. The issue of time is not as simple as ‘the shorter the lead-time the better’, since a customer might place an order before there is an actual need of the product. They might know that there will be queues and delays, which complicates the production planning of orders since the best time to start the production is not always directly when the order have been received. (Li & Lee, 1994)

3.7.3 **Concluding Remarks: Marketing Strategies**

- Two units in a company especially use forecasting as a tool: the marketing unit and the operations unit.
- The “demand-planning cycle” begins with the sales unit trying to combine historical and future knowledge in order to estimate sales for the upcoming 12 or 24 months.
- *Sales forecasts* are most often treated as known information although they might be inaccurate. The production planning system needs to be adapted to this and respond quickly to forecasting errors.
- It is generally known that “*point forecasts*, i.e. forecasts of individual items, are typically wrong and forecasts of a mass of units, for example an entire product line, are more often correct.
- It is important not to base forecasts on a single source of information.
- Forecasts may be classified according to different time horizons: *short-term* (days/weeks), *intermediate* (weeks/months) and *long-term* (months/years).
- Most associated with a company’s overall manufacturing strategy are the long-term production decisions.
- When it comes to *customer expectations*, the issue of time is not as simple as a shorter lead-time is better since a customer might place an order before actually needing the product.
3.8 Theoretical Summary

After having gone through the above explained areas and concepts, the ICOS-framework is now completed (figure 11). The sub-headings summarise the aspects of each theoretical area in the framework that are most important to the purpose and these aspects will be referred to further on in relation to the empirical section as well as the analysis.

![Diagram of ICOS-framework](image)

Figure 11 The ICOS-framework, detailed overview
In this chapter, the case company Tetra Pak will be introduced and focus will lie on how their SCO unit and the sales unit(s) are managed. Starting this chapter is a description of Tetra Pak; the structure of the company, its competitors and core values. After the introducing part, Tetra Pak’s measurement system will be discussed before going more into detail in the two different aspects of our case study: the operations strategies and the marketing strategies of Tetra Pak.

4.1 Tetra Pak Group

Tetra Pak is a supplier of food processing and packaging systems. The company produces and sells filling machines as well as packaging material to customers situated all over the world. The machines are manufactured in Sweden as well as internationally and approximately 9100 filling machines that have been manufactured by Tetra Pak are currently in operation, most of them in China. Continuous sale of packaging material is a great source of revenue for Tetra Pak. During 2010, a total of 158 billion packages reached the consumers and in 2011 the company delivered 491 filling machines. (tetrapak.com, 2012)

Tetra Pak Group is divided into Packaging Solutions, Processing Solutions and Corporate Functions (figure 12) and consists of eight different machine platforms that are not visualised in the figure. The issue of study was initiated in the SCO unit within Tetra Pak Packaging Solutions, with focus on the Carton Bottle (CB) platform in Lund. The CB platform is characterised by low volumes and a high level of customisation. The other machine platforms have other characteristics; Carton Value (CV), for example, handles much larger volumes with respect to incoming orders per year.

The three filling machines that belong to the CB platform are:

- TPA6 that manufactures Tetra Evero Aseptic packages
- TT/3 that manufactures Tetra Top packages
- TR/27 and TR/28 that manufactures Tetra Rex packages

To obtain the overall representation of the coordination issue, an investigation of only the SCO unit is not enough. Also the marketing aspects are of importance. Therefore, the Market Companies (M/C) that belong to the Clusters, the Sales Support unit (SS) that is an administrative part of Supply Chain Operations, and the Marketing and Product Management unit (M&PM) that is included in Tetra Pak Commercial Operations, are investigated. Further on, these three units will be referred to as Tetra Pak’s sales units and the SCO unit will be referred to as the
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operations unit. The organisational units that are of most relevance are highlighted in grey in figure 12.

![Diagram showing the organisational structure of Tetra Pak Group with highlighted key units.]

**Figure 12 Tetra Pak Group (tetrapak.com)**

**Competitors**

Depending on which filling machine that is considered, Tetra Pak have various types of competitors in the market for food processing and packaging systems. TT/3 has no direct competitor since the Tetra Top package is still quite unique in the market. TR/27 and TR/28, on the other hand, have a wide range of competitors. One of them is Elopak, which is a company based in Norway that sells machines that produces packages similar to Tetra Rex packages but in other sizes and shapes. TPA6 is currently competing against aseptic plastic packages (bottles), which is generally a more flexible type of machine. However, TPA6 and the aseptic plastic filling machines have approximately the same order lead-time. Even so, Tetra Pak prefers to compare the TPA6 with their type of aseptic filling machines, not the competing plastic filling machines.

**Long-Term Thinking and Customer Focus**

One of Tetra Pak’s core values is to apply long-term thinking and have a customer focus. Tetra Pak’s customers often have their own deadlines and slots that must be kept; hence, order lead-time is an important factor for the customer when choosing whether or not to invest in a filling machine. If the operations unit does not manage to meet the requirements of the sales units, the customers’ expectations of order lead-time cannot be met. This leads to the fact that a deal might be cancelled as a result of the customer deciding either to wait to order a machine until their next deadline or, even worse, choosing not to invest in a machine at all. Not often do
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Tetra Pak’s customers switch to a competitor, but if doing so, a cancelled order is a lost sales opportunity for Tetra Pak. This means that short lead-times is a qualifying factor for Tetra Pak’s customer. Tetra Pak claims that the factor that makes them win orders against competitors is primarily their service package, i.e. that they offer continuous service on the machine after the purchase. Tetra Pak also win orders because of their quality and brand name.

Today, sub-units like the sales units and the operations unit are struggling to find common goals that support their long-term thinking. In addition, the different goals that the units are working towards do not take the customers’ interest into mind to a greater extent (see section 4.2).

4.1.1 Tetra Pak Supply Chain Operations

Tetra Pak operations unit manages the sourcing, production, installation and commissioning of Tetra Pak filling machines until final acceptance by the customer. Within the eight machine platforms, different types of machines are produced depending on the characteristics of the geographical market. The filling machines are made out of modules that are manufactured in northern, central and south Europe, India and China. In-house machine assembly and final testing is carried out in Shanghai, Modena (Italy) and Lund and the part of the machine assembly that is outsourced is run by system suppliers in Sweden and China.

The TPA6 and TT/3 filling machines are assembled and tested in Lund while TR/27 and TR/28 are assembled and tested by a system supplier in Eskilstuna. If comparing TT/3 and TR/27/28, the first machine is more complex from a technical point of view but more mature from a process point of view, and takes shorter time to produce. Regarding TPA6, few filling machines of this type have been launched and this new machine type is the result of a development project that started in 2007.

The operations unit at Tetra Pak is currently operating according to a pull system, i.e. their production is make-to-order. This implies that the filling machines are made-to-order and the customers receive the right products, in the right quantity at the right point in time. It also means that Tetra Pak does not order machines modules from their module suppliers until they receive an actual order from the customer. The module suppliers, in turn, order the components to the modules partly from Tetra Pak’s dedicated component suppliers and partly from their own component suppliers. Some module supplier shares the same component suppliers. The supply chain network is shown in figure 13.
Historical Development of the Supply Chain

Tetra Pak’s supply chain has undergone a lot of changes over the years. In short, their production has gone from push to pull, their overall focus have become more customer-driven rather than focusing only on internal costs, and they are now working more according to lean principles and process management. As a result, their overall vision have become more lean inspired rather than having a pure cost focus. Today, Tetra Pak aspires to manage quality, costs and lead-times simultaneously, which is a clear contrast compared to the way the production and supply chain was run in the 1980s.

During the 1980s and most of the 1990s, when the production was push-based, Tetra Pak ordered in batches and aimed to outsource as much as possible of the sub-assembly to external players, keeping only the final assembly in-house. This system put a lot of pressure on the suppliers, who had to keep capacity high at all times to be prepared for an increase in incoming orders. Today, Tetra Pak puts extensive work in managing the fluctuations in the demand by applying takt through all stages in the supply chain, which is explained in section Takt Management. This approach makes it easier for the suppliers, first-tier module suppliers as well as second-tier component suppliers, to keep their capacity levels more balanced.

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4.1.2  Tetra Pak Sales Units

The sales units at Tetra Pak include the Market Companies, Marketing and Product Management (M&PM) and Sales Support. The Market Companies are arranged according to an international cluster structure and they are the ones initiating the sales opportunities, i.e. they have a direct contact with the customers. Sales Support is the unit that receives customer orders from the Market Companies and forwards the orders to the operations unit. M&PM, in turn, owns the product portfolio and coordinates the sales, which makes them involved in some of the orders and have the authority to switch place on orders to satisfy important customers.

There is a perceived need of more alignment between the sales units at Tetra Pak. Today, their communication flow have no set structure, which results in different involvement from different units at different points in time, most often depending on the importance of the customer. If an important customer has placed an order, there is a lot of involvement from M&PM’s side and this interrupts the daily work of the Sales Support unit. It is vital that this communication flow runs smoothly for the Order-to-Dispatch process (further explained in section 4.4.2) to work.

4.2  The Measurement System at Tetra Pak

Before, Tetra Pak had one manager that was in charge of the overall performance of all units: the operations unit as well as the sales units. Today, each separate unit has their own manager who is responsible for how well that unit’s performance correlates to the expected performance of that unit. Below, the measurement system is discussed separately for the operations unit and the sales units. Not all measurements are considered, but only the ones that are relevant to visualise the different goals that the units have today and the fact that they do not take the customers’ interest into mind to a greater extent.

4.2.1  Measurement System of the Operations Unit

Overall, the operations unit’s performance is measured on the relationship between total expenses through net sales. Hence, their goal is to keep costs as low as possible. If shorter lead-times are requested, the capacity needs to expand to increase the speed of production; naturally, this results in higher production costs. Also, on the contrary, if not utilising the capacity that already exist due to too few incoming orders, the unutilised capacity will result in higher costs. To keep costs low it is therefore vital for the operations unit to balance the flow of incoming orders.

A more detailed measure of the operations unit is the dispatch accuracy. This refers to how often their orders are delivered within the confirmed delivery date. Another measure is the order confirmation accuracy, which measures how often the operations unit confirms an order dispatch date within two weeks from the customers’ expected delivery date.
4.2.2 Measurement System of the Sales Units

The Market Companies’ performance is measured on how well they manage to predict sales; with other words, how consistent their yearly forecast is with the actual outcome. This implies that from their point of view it is not always optimal to register orders that are not 100 % certain, since these orders will lower their performance if they are not carried through (further explained in section 4.5.1).

Sales Support is, similar to the operations unit, measured on the order confirmation accuracy. In this case it means how fast they are at confirming the dispatch date and forwarding it to the Market Companies. Since Sales Support represents a coordinative unit, the order confirmation accuracy measurement in their case is a combined performance measurement that is influenced by the performance of the Market Companies, M&PM as well as the operations unit.

M&PM’s goals are related to sales per machine or sales per volume of packaging material, i.e. profitability per system. In order to deal with the fluctuations in demand, M&PM has recently agreed upon a KPI that is in common with the operations unit. This KPI implies that the processing cost, which is the total cost of manufacturing a machine, should be kept as low as possible. Hence, the whole manufacturing process needs to be effective and plenty of effort is put on coming up with alternative ways to produce a machine in order to level out fluctuations.

4.3 Order-Winners and Order-Qualifiers at Tetra Pak

For Tetra Pak customers, it is often important that the ordered machine is delivered in time for a specific campaign. For example, a customer might plan to release a new type of milk package by a certain date and this new package must be available in the store by a certain date since the store is re-arranging the store design. It is then very important that Tetra Pak is able to deliver the filling machine in time for the package release. Therefore, it is crucial that Tetra Pak is able to manage their lead-times and take this into consideration when making decisions about takt and costs. According to the sales units at Tetra Pak, lead-time is not a factor that is important for winning orders, but rather a factor that qualifies them to compete in the market. Without an appropriate delivery date (lead-time), Tetra Pak would not be considered as an option and the deal will not be carried through. The next section will therefore concentrate on lead-times at Tetra Pak, which will affect the delivery time to customers.

4.3.1 Total Production Lead-Time

The production lead-time starts when Tetra Pak sends an order to the first tier suppliers, i.e. the module suppliers, who in turn contact the second tier suppliers, i.e. the component suppliers. The modules are manufactured externally, and this lead-time is fixed, which means that the suppliers have a pre-determined time to...
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produce the modules. When the modules arrive at Tetra Pak, the filling machine is assembled and tested, which also is done according to a fixed lead-time. The production lead-time differs between the three filling machines investigated, especially for TT/3 that has the shortest production lead-time. Due to confidentiality, the production lead-time will not be displayed; however, it can be mentioned that a couple of buffer days are included in the production lead-time. Hence, in a long-term perspective, there are always ways to shorten the internal production lead-time if needed. Tetra Pak is continuously working with continuous improvement to shorten their internal lead-time, and, in addition, there also exist on/off solutions to shorten the lead-time in rare cases.

Tetra Pak is aiming to have a production lead-time that is shorter than the customers’ expected order-to-dispatch lead-time (Real Expected OtD lead-time, REOtD, see explanation in 4.3.2). In figure 14 different scenarios and consequences are explained.

![Diagram](image)

**Figure 14 Production time vs. expected OtD lead-time (REOtD)**

### 4.3.2 Real Expected Order-To-Dispatch Lead-Time

Before there is a point in delivering a filling machine to a customer, there exist a minimum pre-installation time needed at the customer’s factory, which makes it unnecessary to stress the production too much. I.e. it is not always the actual filling machine that is the bottleneck. The Market Companies and M&PM have a good communication with the customer regarding this matter and thereby know when
the customers are ready to receive the filling machine. If the filling machine is produced too early it is put in the inventory for finished goods.

The total installation time at customers consists of three steps: 1) *mechanical completion*, which is the physical assembly of the parts that have to be in place before the machine, 2) *commissioning*, which is when the machine is up and running, and 3) *performance evaluation*, which is when Tetra Pak investigates whether or not the machine is running as it is supposed to and that it reaches its performance targets. Hence, step 1 needs to be finished before any machine delivery is of relevance. In addition to the pre-installation time, as in all cases where a product or service is delivered, there is also a maximum lead-time after which the customers get unsatisfied with Tetra Pak’s service.

Tetra Pak must therefore aim to deliver filling machines at the right point in time; i.e. after the customers have completed the pre-installation and before the waiting time have become unacceptable from a customer’s point of view. This lead-time is called the real expected order-to-dispatch lead-time (REOtD) and will be discussed further in section 4.3.3.

As described earlier, Tetra Pak is quite controlled by the timing of their sales. However, at the present, Tetra Pak’s operations unit is not entirely confident with what lead-times their customers expect and the fact that different filling machines have different production lead-times makes it more complicated. In table 3, table 4, table 5 below, it is possible to see the sales units’ perception of what Tetra Pak’s customers expect in terms of delivery times, i.e. the *minimum-, maximum- and expected order lead-times* (expressed in calendar days, CD) for different market clusters. The different market clusters are described in the *List of Abbreviations*. In some cases, more than one representative per sales unit is included. This was done in order to base the mean value on as many representatives’ perceptions as possible; representatives from the same unit may have different views on the matter since they handle different customers.

Noticably, customers in different market clusters have different expectations on lead-times depending on such a complex matter as cultural differences as well as differences in geographical distances. The geographical distance is handled in the tables below by adding a column called transportation time.

<table>
<thead>
<tr>
<th>TR/28 &amp; TR/27</th>
<th>Min lead-time (CD)</th>
<th>Max lead-time (CD)</th>
<th>Expected lead-time (CD)</th>
<th>Transportation time (CD)</th>
<th>REOtD (CD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&amp;PM</td>
<td>120</td>
<td>300</td>
<td>150</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
<td>M/C NEAO</td>
<td>90</td>
<td>180</td>
<td>180</td>
<td>55</td>
<td>125</td>
</tr>
<tr>
<td>M/C CE</td>
<td>120</td>
<td>240</td>
<td>150</td>
<td>7</td>
<td>143</td>
</tr>
<tr>
<td>M/C NE</td>
<td>84</td>
<td>112</td>
<td>84</td>
<td>0</td>
<td>84</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>M/C</th>
<th>Min Value</th>
<th>Max Value</th>
<th>Possible levelling time</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEAO</td>
<td>180</td>
<td>240</td>
<td>negative</td>
</tr>
<tr>
<td>NA</td>
<td>60</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Mean Value</td>
<td>119</td>
<td>214</td>
<td>155</td>
</tr>
</tbody>
</table>

Table 3 REOtD and possible levelling time for TR/27 & TR/28

<table>
<thead>
<tr>
<th>TT/3</th>
<th>M&amp;PM</th>
<th>M&amp;PM</th>
<th>M/C EECA</th>
<th>M/C CE</th>
<th>M/C NE</th>
<th>M/C NEAO</th>
<th>M/C NA</th>
<th>Mean Value</th>
<th>Possible levelling time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
<td>180</td>
<td>45</td>
<td>120</td>
<td>84</td>
<td>240</td>
<td>90</td>
<td>112</td>
<td>positive</td>
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<td>90</td>
<td>180</td>
<td>90</td>
<td>14</td>
<td>0</td>
<td>270</td>
<td>0</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>90-120</td>
<td>7</td>
<td>84</td>
<td>55</td>
<td>38</td>
<td>82</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90-120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 REOtD and possible levelling time for TT/3

<table>
<thead>
<tr>
<th>TPA6</th>
<th>Market introduction manager</th>
<th>M&amp;PM</th>
<th>M/C EECA</th>
<th>M/C SE</th>
<th>Mean Value</th>
<th>Possible levelling time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60-90</td>
<td>180</td>
<td>180</td>
<td>84</td>
<td>70</td>
<td>negative</td>
</tr>
<tr>
<td></td>
<td>90-120</td>
<td>0</td>
<td>120</td>
<td>84</td>
<td>160</td>
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</tr>
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<td></td>
<td></td>
<td>0</td>
<td>14</td>
<td>7</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>140</td>
<td></td>
<td>98</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 REOtD and possible levelling time for TPA6

As shown in the tables, the expected lead-times differ a lot depending on market cluster. The calculated mean value of the different expected order lead-times, together with the total production lead-time is the input to the possible levelling time.

Possible Levelling Time

\[
= \text{Expected Lead Times} \times (\bar{X}) - \text{Total Production Lead Time}
\]
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The possible levelling time is the time Tetra Pak have left to move the orders back and forth, which is called to level out the demand at Tetra Pak language. This is explained further in the section 4.3.3.

**Real Expected versus Wanted Expected OtD Lead-Times**

There is a difference between what customers really expect (according to the Market Companies’ and M&PM’s perceptions) in terms of delivery times, which is the real expected OtD lead-time (REOtD), and what Tetra Pak wants their customer to expect, the wanted expected OtD lead-time (WEOtD), which is coherent with the levelling time they want to use.

In the tables described above, it is possible to see that the expectations expressed by M&PM and Market Companies includes the shipping time. However, the shipping time fluctuates very much depending on market cluster and the customer should not need to take into consideration where (geographically) the production of their requested product is situated. Consequently, they should not need to take shipping lead-time into consideration in their expectations on the total lead-time. In tables 3-5 the estimated shipping lead-times from the different market clusters are subtracted from the customers’ expectations, and left is the REOtD. In Orbis, which is Tetra Pak’s intranet, it is possible for the Market Companies to see the expected lead-times on certain filling machines, but not for the filling machines included in the CB. This service can help Tetra Pak to navigate customers’ expectations.

**4.3.3 Possible Levelling Time**

To be able to manage the fluctuations in demand when producing in takt, a *levelling time* needs to exist that will allow for orders to be moved back and forth as illustrated above. The levelling time will be expressed either in the form of queue time (4.4.4) or time in inventory of finished goods (see figure 19), and can therefore be placed both before and after the actual production (see figure 15). Thus, the levelling time is the time Tetra Pak can use to move orders to match appropriate free slots. The customer has certain expectations on lead-time as explained above, which can be both longer and shorter than the actual production lead-time. If the expected order lead-time is longer than the production lead-time, then it exists a levelling time (see figure 15). As long as the machine is delivered in time for the customers’ expectations, the customer does not matter if the order waits in a queue or if it is kept in inventory for finished goods.
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Figure 15 Levelling time

Initially, the customer indirectly chooses the levelling time if their expectations are known. It is therefore important to make sure that the levelling time plus production time is equal to or less than what the customer expects in order to meet the customers’ demand. Due to this, it is of importance to manage the levelling time so it is coherent with customers’ expectations. This is illustrated in figure 16, which is the same figure as figure 15 but where the levelling time is added to the production time and the consequences is connected to customers’ expectations. REOtD stands for what customers really expect in terms of delivery times, which is the real expected OtD lead-time, and WEOtD stands for what Tetra Pak wants their customer to expect, the wanted expected OtD lead-time.

Figure 16 WEOtD vs. REOtD and effect on customers’ expectations
4.4 Operations Strategies at Tetra Pak

4.4.1 Production Capacity

Tetra Pak’s production capacity is measured in terms of people, area and material, which means that a specified number of blue collar workers is required to perform within a specific capacity, as well as a certain number of test bases and material. The production is very resource consuming, hence, it becomes inflexible and fluctuations in demand are not easily managed. Through the supply chain, the assembling and testing of the filling machines is executed in a one piece continuous flow, which means that each process only handles one machine and this process is separate from any other processes.

All activities at Tetra Pak are driven by real customer orders; hence, a pull system should be applied in the whole supply chain, which means that the production is make-to-order and the production only manufacturing products when they have a real customer order. This means that Tetra Pak decides the capacity (takt) in the production based on current market demand, which sets the pace in the supply chain. As a result of using this approach, incoming orders are arriving in irregular flows that are not always easily managed.

The cost drivers in the production, at the process cost level, are activity based. These activities are primarily divided into blue-collar workers and test bays, but also white-collar workers are included although not to the same extent as the blue-collar workers. The cost of these activities will change on a yearly basis depending on the takt.

Takt Management

In order to level out the demand and to keep capacity levels in the supply chain more consistent, Tetra Pak is using a takt system. This system sets the pace of production and it helps the production to determine what material lead-times to communicate to the first and second tiers of suppliers, who then adjust their production according to the takt. Takt is also applied in the first tier suppliers and sometimes in the second tier of suppliers.

The number of incoming orders directs what takt to produce against since there must be a queue of orders in order to use the takt system. A takt of 10 indicates that there is a production slot available for an order every tenth workday (WD) and thus there are only resources available for production that specific day (see figure 17). With other words: higher capacity = lower takt. The slot-date is the same date as Tetra Pak orders the modules from their suppliers. This will make sure that a fixed number of filling machines are tested and assembled at the same time, with other words, limiting the work in progress.
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By using the takt system, Tetra Pak aims to shorten the order backlog and delivery lead-time since the orders can be produced in a standardised pace and way, which will discover hidden problems in the production. The production costs could also more easily be kept fixed when applying takt in production. In summary, the takt management system is meant to enable for Tetra Pak to deliver customised filling machines to the customers with short and accurate lead-times at a low cost.

**Takt Complications**

For the moment, takt management is used in the whole internal organisation, regardless of characteristics of the platform. There are platforms at Tetra Pak that are producing both high-volume products as well as low-volume products, as explained above. The takt management works properly for Tetra Pak’s high-volume production but there are some basic rules and tools missing that need to be customised for their low-volume production at CB.

At CB, capacity planning (takt management), in the production department is based on previous experiences mixed with input from market demand forecasts. The capacity planning is also very much influenced on what capacity is possible to have both at Tetra Pak and at first tier suppliers as well as second tier suppliers, rather than what capacity is actually needed to meet demand. However, the takt decision, i.e. which takt to use and when to change takt, is managed differently between different filling machines. It is difficult to know for certain when to “pull the brakes or push the system” since there are no common rules or tools for this (Fuca, 2012). To level out capacity fluctuations that are not planned for, the supply chain planners partly rely on the yearly demand being different for the different filling machines at CB. This means that resources (labour hours and area) not used for the moment can be leased to other machines that are in more need of them at that time. This approach makes the planning of capacity less prioritised, but no one has thought about what would happen if the demand of all filling machines at CB were high at the same time.

Furthermore, CB has problems with staying in takt, which means that they have too few incoming orders per machine to be able to produce in a decided pace. When a slot is left empty, resources are left unused and this imposes great costs on the supply chain. An empty slot indicates that a takt is too low. However, the size of the takt is not unlimited. When the takt is higher than 30 (30 working days between each production slot), the production is considered to be out of takt and it becomes
what Tetra Pak calls a *spot market*. When a spot market occurs orders are produced when they are received but the production do not produce in a predetermined pace. Leaving empty slots should be avoided by proactive management and planning of the production capacity but also with help from other parts of the organisation, like the sales units.

The inconsistency with going in and out of takt has a great impact not only for Tetra Pak, but also on their first tier suppliers as well as the customers. The first tier suppliers often do not have the same possibility to keep as high capacity levels as Tetra Pak has since they are smaller than Tetra Pak. If there is a need to adjust the takt, agreements have to be signed at a higher level in the organisation and the module suppliers need to be involved; hence, the adjustments that need to be done when going in or out of takt are complex from both Tetra Pak’s and the suppliers’ point of view. A buffer stock needs to be kept at the suppliers in order to be able to go in takt quickly again. The difficulty of managing the production capacity will also affect the customers in the long run since this probably will impose longer order lead-times.

### 4.4.2 Levelling

To be able to even out fluctuations in demand Tetra Pak is using an approach called *levelling*. By levelling it is possible to move an incoming order forward or backward in order to keep an even production rate (see figure 18). It is also possible to change the sequence of orders, which can help Tetra Pak to manage urgent orders that must be prioritised. This will of course lead to longer lead-times for orders that are not prioritised but in the long run, it helps Tetra Pak to keep stable lead-times and to lower the overall capacity in the production. To be able level out the demand when producing in takt, a buffer time needs to exist so that orders can be moved back and forth. The buffer time is referred to as a *possible levelling time* (see section 4.3.3).

![Figure 18 The levelling system](image)
4.4.3 Order-to-Dispatch Lead-Times

Order-to-dispatch (OtD) is according to Tetra Pak the time it takes from a customer has placed an order until shipping. The material flow is shown in figure 19. The OtD lead-time is composed by different lead-times that can be either fixed or variable, i.e. not all of them can be influenced. When a customer has placed an order, there is a possible queue time during which the order has to wait before being produced. This is mainly because of the takt management, but there might also be a backlog with X number of orders that will be produced prior to the incoming order.

For each production slot there are pre-determined dates for when the material must be ordered, when the modules arrives from the supplier and when the internal production should be finished. Consequently, the external production lead-time and internal production lead-time in figure 19 are fixed and this was explained further in section 4.3.1. A preliminary slot is then chosen for the incoming order. The supply chain planner tries to place the order as late as possible, while still meeting the requested delivery date, in order to be able to enter prioritised orders earlier if necessary as explained above. As a final step, the finished machines are sent either directly to the customer or to the inventory for finished goods, where they normally lie for 5-7 days until final delivery. The waiting time in the inventory for finished goods is flexible and depends on the confirmed delivery date and the transportation time. The reason for keeping the machine in inventory a couple of days is to be able to match the delivery with the customer's request as well as match vessels for shipping.

![Order-to-Dispatch lead-time](image)

*Figure 19 The Order-to-Dispatch (OtD) Process (from a order lead-time perspective)*

**Information Flow in the Order Placement Phase**

Initiating the OtD-process is a meeting between the customer and a key account manager from one of Tetra Pak’s Market Companies (step 1 and 2 in figure 20). When an order has been placed it is then forwarded, through Sales Support (step 3) with various involvement from M&PM (step 4), to the operations unit where it needs to be confirmed (step 5). M&PM has the overall view of products and is also the unit that take the customers’ and Market Companies’ interests into account within Tetra Pak. The Market Companies is not involved in the daily strategic decisions in the same way as M&PM. Sometimes M&PM themselves are communicating with the Market Companies and sometimes Sales Support are
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handling that communication, which makes it hard to keep track on who is talking to who. After feedback from the Market Companies it is possible for M&PM to substitute an order with another because of an extra important customer needing a machine quickly. After the order has been confirmed and matched against an empty production slot, a delivery date is communicated to the customer. This is done, once again, through Sales Support and the relevant Market Company that has direct contact with the customer. Hence, a lot of communication and information is taking place in between these units and this communication has to be aligned.

The information flow shown in figure 20 is the first part of the OtD-process (order placement, see figure 19), i.e. the information flow that goes between the Market Companies, Sales Support, M&PM, and the operations unit. The information flow is shown with grey numbers for every arrow.

4.4.4 Order Backlog (Queue)

The queue time (see figure 21) partly depends on the order backlog, with other words, how many orders that must be produced prior to the incoming order. The queue time also depends on the takt, since it is the takt that determines how many filling machines that can be produced each month. To be able to produce in takt, an order backlog needs to exist; otherwise it would be impossible to produce continuously in the same rhythm. In the example below, twelve slots are available during the year and three orders exists in the order backlog, which means that the first three slots will be filled. If no more orders arrives prior to the forth slot, then the production will go out of takt.

Figure 21 Example of order backlog

The number of incoming orders directs what takt to produce against. An empty slot that is not utilised indicates that the pace is too high, i.e. that the takt is set too low.
If the order backlog gets larger on the other hand, the total delivery time will be longer and, hence, the customer must wait a longer time to receive their order. The operations unit might then lower the takt in order to produce faster, but as stated above an order backlog needs to exist, so the production unit needs to balance the order backlog and the takt in order to meet customers’ demand. In the end, it is the customer demand that counts and if Tetra Pak wants to level out the demand, it will affect some of the orders and their lead-times negatively and, consequently, the customers will become unsatisfied. Currently, the supply chain managers at Tetra Pak do not have a common practice to deal with this matter and does not know how many orders an optimal order backlog consists of.

4.5 Marketing Strategies at Tetra Pak

4.5.1 Market Demand Forecasts

The forecast system at Tetra Pak is a vital input to their budget. The annual forecast is the basis of the annual takt decision while the monthly (rolling) forecast is the basis for the weekly takt decision. Both in the annual- and rolling forecast an Estimated Time of Arrival (ETA) for each order is created by the Market Companies. The ETA is specified per month. The ETA is chosen by the Market Companies together with the customer and is then revised by the supply chain planner if necessary. The Estimated Time of Dispatch (ETD) is thereafter calculated by using an APO-tool (Advanced Planning and Optimiser in SAP R/3) that is based on ETA. The APO-tool chooses a transport time of 0 or 1 month, depending on which region the filling machine is shipped to. It does not take into account which country the filling machine is transported from. In reality, the transport time can vary from one day to a couple of months. The different types of forecasts will be explained below.

Annual (Budget) Forecast

Every year, starting in quarter three, a budget process is taking place that involves the different units at Tetra Pak. During the budget process the Market Companies creates a forecast based on actual customer demand. These forecasts are then subject to a “sanity check” performed by M&PM. The result of this process is a three-year plan of what the Market Companies, with input from M&PM, believe will be the incoming flow of orders. The three-year plan is forwarded to the operations unit that fulfils the establishment of the production guidelines by adding a capacity perspective to the matter.

The annual forecast (see step 1 in figure 22) is the foundation to operation unit’s budget (step 2) and hence the annual takt decision (step 3). The annual takt decisions are the takt range that should be kept in the production and by the suppliers during the upcoming year. The annual forecast is based on actual orders, with other words orders that are already confirmed by customers. The first year of the forecasts shows a detailed plan per month but the next coming two years are only specified on a yearly basis. The total net sales that are forecasted are the most
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Important facts for the Market Companies in the forecast, since this is the information that Market Companies' budget will be based on. Therefore, the Market Companies do not prioritise the annual forecast. Instead they are measured individually on the rolling forecast (explained below). The forecast precision per month in the annual forecast is therefore not that certain. The combination of different filling machines in the forecast may change completely as well as the estimated time of dispatch.

Figure 22 The Budget Process

Annual Takt Decision

The annual takt range (or the annual takt decision) is, as explained above, based on the annual forecast. Another type of takt decisions is the weekly takt decision, which reviews and modifies the current takt if needed (see two sections below). The decisions concerning the annual takt range are only based on the forecast's total order volume during the next-comining year. The number of orders influences the decision of the maximum takt in the takt range during the year. The information that is received concerning volume per month is not used at all. However, one major decision point is also the capacity that is available at Tetra Pak, with the consequence that the capacity sometimes is based on what is possible rather than what is needed. The actual planning of confirmed orders is instead made based on actual order backlog.

Due to the fact that the Market Companies' performance is measured on accurate forecasting, as mentioned earlier, this creates complications for the operations unit and in the supply chain because they cannot plan for correct capacity levels or safety stock if not knowing the correct number of orders that will be handled over the year. This is especially an issue for CB (low-volume production) since only a minor error in the forecast can cause large changes in the production planning.

Monthly (Rolling) Forecast

The rolling forecast is, similar to the annual forecast, prepared by the Market Companies. This forecast arrives each month on the 15th and it is forecasting the closest 12 months ahead. When the monthly forecast is closed, Sales Support summarises the information and forwards it to the operations unit. If there are any ambiguities in the forecast then Sales Support talks with the responsible market company.

The Market Companies are measured and rewarded with bonus based on the accuracy of their rolling forecast for the next-coming three months. This means that it is possible to postpone an unsure order to the forth month in order to be sure.
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Another dimension is that the Market Companies are punished if they cancel an order too late. Because of this, the Market Companies will create a forecast only with orders that they can fully commit to although in reality there may exist orders that are not 100% confirmed, but these orders are not included in the forecast. Due to this, an error might occur in the forecast that is known by the market company but they have chosen not to change it to avoid affecting the bonus negatively. The longer in the future the forecast is done, the more uncertainties will exist in the forecast.

The forecast is only based on when the customers want the machine and not on the actual confirmed date. Moreover, it is difficult for the sales force to find out the current lead-times for the machines, which complicates the communication regarding delivery date to the customers. Also, a major issue occurs due to the fact the customers are controlling this whole process, i.e. it is the customer that decides when to change to an updated filling machine and often this decision is taken too close to the wanted date, which is a problem perceived by the sales force.

**Weekly Takt Decisions**

The weekly takt decisions are based on the rolling forecast, which shows expected volume of orders per month. During the weekly meeting it is decided if it is necessary to change the takt a couple of steps up or down. However, these takt decisions should be within the takt range decided during the annual takt meeting and it takes time to implement a change in takt internally and within all tiers of suppliers. The time required depends on which takt to move from and to. Present during these meetings are the supply chain manager, the supply chain planner, M&PM and Sales Support, with other words people representing both the operations unit and parts of the sales units.

Based on the way that the transport time is calculated, explained above, the ETD can be somewhat misleading. This is the factor the operations unit use to plan the takt during the weekly takt meetings but they also looks at the ETA to be sure.
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5 Analysis

In this chapter, an explanation of what initiated the capacity-planning complexity at Tetra Pak follows. The first part of the analysis examines to what extent Tetra Pak fulfil the concepts of organisational success and strategic alignment. Thereafter, the performance measurement system at Tetra Pak is considered, which connects to the service level measurement; our proposed solution to the identified problem situation at Tetra Pak. The service level measurement is generated by a capacity tool that in the second part of the analysis will be used to generate various situations to illustrate what different actions could have for Tetra Pak’s operations unit and the sales units.

5.1 Organisational Success and Strategic Alignment

This first section will analyse to what extent Tetra Pak Case fulfils the concepts of organisational success and strategic alignment that are derived from the theoretical framework (figure 23).

![Diagram](image)

Figure 23 Analysing organisational success and strategic alignment at Tetra Pak

Companies need to be effective as well as efficient in order to become successful. To reach effectiveness, it is important to take long-term strategies into consideration and make sure to produce goods that correspond the customers’ demands. One of Tetra Pak’s core values is to create long-term strategies with the customer in focus. Hence, Tetra Pak is most certainly aiming to reach a high level of effectiveness. To become efficient, on the other hand, it is important to optimise the use of resources
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here and now. Tetra Pak have always, historically as well as now, been good at efficiency since they have a strong focus on short-term strategies that will help them keep internal costs low. Moreover, as a result of having a strong lean management focus, Tetra Pak have become enforced to think more in terms of long-term strategies and it is important for Tetra Pak to fulfil this long-term aspect of their decisions taken, i.e. it is important that they keep striving towards becoming more effective and avoid focusing solely on improving their efficiency.

Although Tetra Pak has a higher aim of becoming a more effective organisation that takes the customers’ interest first and foremost, there is one aspect that needs to be in place before this state can be reached. There is a need of more strategic alignment between the sub-units so that the company as a whole work towards achieving the synergies that in the end will lead to customer satisfaction. The different sub-units need to improve their integration, which will cause them to better communicate to each other and take more strategic decisions that benefit the whole company rather than single units’ performance. Aligned goals between the different sub-units are of great importance to reach customer satisfaction.

Tetra Pak already has great focus on integration and business processes management. This implies that they should have good control of the flow of related activities that together create value for their customers. However, there are factors that indicate that they have not yet succeeded in implementing the business process thinking in the whole organisation. Although they seem to be organised to a well-thought-out structural system, it seems that the different structural units have difficulties understanding the functions and actual output of the different units. If crossing the structural system with the functional system, and for example looking at the budget process (table 6) or the OtD-process (table 7), it is possible to see that alignment must take place between the operations unit and the sales units for these processes to run smoothly. The crossing of structural and functional systems also makes it easier to see what structural unit is involved in what functional performance and the performance of the different units is of great strategic importance in order to reach effectiveness as well as efficiency. It is vital that the employees working in the different units aim to create a mutual goal in all of the phases of a process where the units have shared responsibility of the output.

<table>
<thead>
<tr>
<th>Structural System</th>
<th>Functional System</th>
<th>Annual forecast (3 yrs. plan)</th>
<th>Budget (Prod.)</th>
<th>Annual takt decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/C unit</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M&amp;PM unit</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCO Unit</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Table 6 The budget process from a business process point of view
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<table>
<thead>
<tr>
<th>Structural System</th>
<th>Functional System</th>
<th>Order placement</th>
<th>Order confirmation</th>
<th>Order matching</th>
<th>Delivery date confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/C unit</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M&amp;PM unit</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sales Support unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCO Unit</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 7: The OtD-process from a business process point of view

As visualised in the two tables above, the need for alignment between the operations unit and the sales units is greater during some phases in the different processes. In the budget process, there is a large need of alignment in the phase when the forecast is being created and forwarded to the operations unit because otherwise the planning of capacity might be based on wrong information. And in the OtD-process, it is possible to recognise a greater need of alignment when the confirmed delivery date is being communicated to the customers. In the case of business processes that are cross-functional, the aim is to create a collective effort among employees in different units.

As mentioned above, total alignment is currently not in place. Tetra Pak’s sales force is focused on optimising sales while the operations unit strive towards keeping production capacity and costs under control, which is a typical issue within the field of organisational theory. Regarding the market strategy, not all units have the extensive knowledge of the market that is needed to increase sales and overall profits. The sales units have a closer distance to the market and should therefore know more about the relationship to the customers. However, neither them nor the operations unit seem to know for certain what the customers require in terms of lead-times, quality and similar factors. Due to this, it becomes especially complicated for the two units to unite around a common strategy. Moreover, if considering the operations strategy, the capacity planning issue at Tetra Pak affects the company’s ability to meet the customers’ demands of lead-times. The capacity requirements planning is not done in the same way throughout the whole company and not based on values that satisfy the customers, which lead to the operations unit not being able to make a strategic decision regarding the production capacity. In order to solve this issue, the different units need to acquaint themselves more with what the market actually demands, aim to achieve more transparency and cooperatively work more proactively when it comes to the capacity planning.
Concluding Remarks Organisational Success & Strategic Alignment

- Tetra Pak is aiming to reach a high level of effectiveness but they already have a strong focus on short-term strategies that will help them keep internal costs low and good efficiency.
- There is a need of more strategic alignment at Tetra Pak between the sub-units in order to become more effective.
- The analysis indicates that Tetra Pak have not yet succeeded in implementing the business process thinking in the whole organisation.
- The crossing of structural and functional systems makes it easier to see what structural unit is involved in what functional performance.
- In the budget process at Tetra Pak, there is a large need of alignment in the phase when the forecast is being created and forwarded to the operations unit.

5.2 Key Performance Indicators

This next section will look further into how the performance measurement system is set up at Tetra Pak in relations to what is common practice when it comes to Key Performance Indicators in theory (figure 24). The analysis will focus on the operations unit and the sales units.

Figure 24 Analysing the performance measurement system at Tetra Pak
To keep track of the performance of the different units in a company it is important to have a solid measurement system that takes financial as well as operations measurements into consideration. At Tetra Pak, a measurement system is surely in place. However, a special situation have developed due to the fact that Tetra Pak have become more differentiated and instead of having one manager responsible for the whole measurement system, as it used to be, they now have separate managers in each unit that are responsible for that specific unit’s performance. As a result of this new set-up, the operations unit and the sales units have unintentionally started to work in different directions, which contradicts the idea of integration as an important factor of organisational success. The performance that these different units get measured on neither reflects the goal of high customer satisfaction, which is not measured to a greater extend today, nor does it align the units’ way of working.

The operations unit partially gets measured on their dispatch accuracy. This leads to the whole operations unit working towards delivering filling machines on or as close as possible to the confirmed delivery date. However, the confirmed date can be far from the customer’s wanted date (which is directed by the REOtD). If an order is not delivered within the time of confirmation, it often depends on an error at the operations unit. Thus, this KPI only measures the percentage of how many times the operations unit worked flawless not how often Tetra Pak fails at delivering according to the customers’ expectations. Hence, this measurement does not really take the customer’s interest and expectations into consideration. If also measuring the operations unit’s performance according to how accurate they are at delivering the machine on the wanted date, i.e. the date that the customer actually expects to receive the machine, it would be possible to align the operations unit’s performance with the overall goal of Tetra Pak.

The other measurement of the operations unit, the order confirmation accuracy, is not an optimal measurement either if wanting to achieve a higher level of goal alignment. It measures how often the operations unit confirms the order dispatch date within two weeks from the customers’ expected delivery date. The expected delivery date, however, is not always the same as their real expectations, since the Market Companies are involved in deciding upon the expected date.

If considering the measurement system of the sales units, it is especially interesting to look at the Market Companies’ performance measurements. There are three important aspects of their measurement system that complicates the alignment with the operations unit: 1) the individual seller is measured on how accurate his/her rolling forecast is, but only how accurate the three upcoming months are, which creates incentives to push unsecure orders forwards to the fourth month where they do not affect their bonus, 2) the sellers unit gets affected negatively if an order is cancelled too late, which also results in orders being pushed forwards so that cancellations might be avoided, and 3) the sellers are measured on accuracy on the total monetary number in the yearly forecast, which the Market Companies have
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Forecasted that they will sell according to. This makes the yearly forecast less prioritised and makes it hard for the operations unit to plan their capacity. All of this creates complications in the supply chain because the operations unit cannot plan for correct capacity levels or safety stock if not knowing the correct number of orders that will be handled over the year.

A joint measurement in terms of a service level would be a first step towards finding a solution to the non-existing alignment of the above two measurements systems. The overall purpose of this service level measurement would be to combine all the factors that are important when considering the alignment between the production and sales units, i.e. forecast, market expectations and production capacity. This would lead to a better understanding from Tetra Pak’s side for how to plan their capacity while still meeting the customers’ order lead-time expectations. The service level measurement will, in accordance with the theoretical definition of a service level, take into account the customer’s expectations, i.e. the percentage of customers that receive a good within their expected waiting time.

Concluding remarks: Key Performance Indicators

- The operations unit and the sales units have unintentionally started to work in different directions, which contradicts the idea of integration as an important factor of organisational success.
- The operations unit’s measurements do not really take the customer’s interest and expectations into consideration.
- If also measuring how accurate Tetra Pak is at delivering the machine on the expected date, it would be possible to align the operations unit’s performance with the overall goal of Tetra Pak.
- The sales units measurements creates incentives to push unsecure orders forwards to the fourth month and makes the yearly forecast less prioritised, which is the forecast the operations unit plan the capacity according to.
- A joint measurement in terms of a service level would be a first step towards finding a solution to the non-existing alignment of the above two measurements systems.

5.3 The Capacity Tool

As stated above, a service level measurement could be used in order to achieve a common goal for the operations and sales units. For Tetra Pak, a capacity tool has been created in Excel in order to generate this service level measurement. The measurement is meant to reveal the percentage of how many orders that will be delivered in time for the customers expected lead-times (see Appendix II). The capacity tool will show how the service level measurement is affected by changing the input data and can be used by Tetra Pak when planning capacity during the budget meeting. This will guide them in making more strategic decisions about
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capacity in production. The model will reveal if it is possible to meet the forecast on a monthly basis with a decided takt and how this will affect the service level.

In addition to capacity planning, the model can be used as an internal communication tool in relation to the yearly budget process. If representatives from the sales units and the operations unit is looking at the capacity tool together, we believe that the operations unit and the sales unit (at least M&PM) will create more understanding for each other’s problems and goals. At the same time, as both parts should strive towards satisfied customers, both of them should also be aware of the costs that comes with a higher capacity. In the end, the production cost will be reflected on the price of the filling machines, which obviously also will affect the sales units since it will be harder for them to sell the expensive machines. The cost aspect that will be revealed by the model is the difference in cost for the higher and lower takt in the takt range, as well as the cost per machine. The cost is based on, just as in reality, the number of blue-collar workers and test bays needed per takt.

The cost for these two factors includes the blue collar salary, social fees, employment tax, pension compensation, bonuses as well as a standard cost for other costs like working clothes, taxi fees, HR service, IT etc. The white-collar personnel are not included in the cost calculations since the number of white-collar workers does not follow a pattern as the blue-collar workers. It is therefore harder to calculate how many white-collar workers that are needed per takt.

We have identified five important variables within operations strategy firstly as well as marketing strategy that will affect customers’ satisfaction in lead-times and, hence, have been identified as important to the service level measurement. The capacity tool includes all these variables;

- Lead-times (order-winner/order-qualifier)
- Market expectations in lead-times
- Production capacity (Capacity planning and Queuing theory)
- Forecasts

The above variables will therefore be of focus in the next part of the analysis that deals with order-winner/order-qualifiers, operations strategy and marketing strategy (figure 25).
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The variables and the relationship between the variables are shown in figure 26, and this figure also shows how the capacity tool is coherent with the ICOS-framework shown in figure 3. The crosshatched boxes show the coherence with theory.

The levelling time, and total production lead-time will together with the order backlog, forecast and production capacity have a direct impact on the service level. The levelling time and the total production lead-time together with the REOtD (Real Expected Order-to-Dispatch Lead-Time) will affect the WEOtD (Wanted Expected Order-to-Dispatch Lead-Time). The way these variables affects the expected service level will be shown in figures and tables in each subchapter below. Each figure and table is generated with help from the capacity tool.
5.3.1 Order-Winner & Order-Qualifiers

Time-based companies compete by satisfying customers’ needs as soon as possible, which is applied especially in make-to-order firms, who start to work on an order as soon as it is placed. Tetra Pak is a make-to-order company but they are not starting to produce an order as soon as it is placed due to their takt system. They are instead working with queues, which is inevitable whenever there is variability in demand and production. The variability in the production will however not exist at Tetra Pak since they produce according to a takt system.

As stated above, in order to create strategic alignment in a company, with focus on sales and operations, common goals needs to exist. It is also important to specify the
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order-winners and the order-qualifiers and most often, the knowledge and view of the market is limited to the sales unit and does not involve the operations unit. This is the case at Tetra Pak where the sales units have some knowledge about this but operations unit do not know what makes Tetra Pak win orders and what makes them qualified to compete for orders.

A factor that is of importance for the customers in a time-based industry with highly customised products is lead-times, with other words the time between a customer’s order placement and the point in time in which they receive the good. For staying competitive, low cost and high quality is not enough; time has thus become an order-winner. However, Tetra Pak means that they win orders due to their outstanding service, better quality than competitors and a famous brand name. Short lead-time is according to Tetra Pak a factor that makes it possible for them to compete at the market. It is however not only important for a company to work with its order-winners, order-qualifiers is also important because without the order-qualifiers, the company will not even get the chance to negotiate and compete in the market.

**Lead-Times**

The operations lead-time is according to theory the process lead-time plus the longest time of the material lead-time and the order backlog. In the Tetra Pak case, the total operations lead-time is longer since they, as well as their suppliers, are producing according to takt and so the order must stand in queue before the supplier will start to produce their order as well. The consequence is that the operations lead-time includes both the order backlog and the material lead-time as well as the process lead-time, see difference in figure 27:

**According to theory**

Operations lead-time (OLT)

<table>
<thead>
<tr>
<th>Order backlog (OBL)</th>
<th>Process lead-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material lead-time</td>
<td></td>
</tr>
</tbody>
</table>

**The Tetra Pak case**

Operations lead-time (OLT)

<table>
<thead>
<tr>
<th>Order backlog (OBL)</th>
<th>Material lead-time</th>
<th>Process lead-time</th>
</tr>
</thead>
</table>

74 Figure 27 The Operations lead-time according to theory and in the Tetra Pak case
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The customer lead-time is the time customers expect between the order is placed and the required delivery date and this lead-time is often compared to the operations lead-time. Two scenarios are common, either the customer lead-time is longer than the operations lead-time, or it is shorter. Both of these scenarios exist at Tetra Pak for different filling machines, which will be investigated in in the section about Marketing Strategy. If the customer lead-time is shorter than the operations lead-time there are ways to change the operations lead-time, i.e. increase the short-term capacity by applying overtime in production or by changing the prioritisation of the orders, which is done at Tetra Pak for the moment. The more sustainable way to handle the operations lead-time could be to increase the capacity in production, keep products in stock or change the production from i.e. make-to-order to assemble-to-order to be able to faster produce the product.

Table 8 shows that service level increases with decreased process lead-time (also called product lead-time) and constant takt. This is because they have more days to level out fluctuations in demand with a shorter process lead-time. Tetra Pak is always working with continuous improvement to shorten the internal lead-time.

<table>
<thead>
<tr>
<th>TT/3</th>
<th>Takt</th>
<th>Process lead-time (work days)</th>
<th>Service Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>80</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>60</td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>40</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>20</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 8 Effect on service level with decreased process lead-time for TT/3

Concluding Remarks: Order-Winner & Order-Qualifiers

- It is important to specify which are the order-winners and the order-qualifiers but at Tetra Pak the knowledge and view of the market is limited to the marketing department.
- For staying competitive in a time-based industry with highly customised order, low cost and high quality is not enough; time has thus become an order-winner.
- At Tetra Pak, time is considered an order-qualifier.
- Two scenarios are common when considering lead-times, either the customer lead-time is longer than the operations lead-time, or it is shorter.
- A sustainable way to handle a too long operations lead-time is to increase the capacity in production, keep products in stock or change the production from i.e. make-to-order to assemble-to-order to be able to faster produce the product.
- The service level increases when process lead-time decreases.
5.3.2 Marketing Strategy

Market Expectations

Market expectations are hard to interpret. In the theory it is often implied that a shorter lead-time is better in order to meet the customers’ expectations. However, in some cases, customers order the product pre-hand, knowing there are queues and delays, which can lead to a too early delivered product to the customer, which could be as bad as a delayed delivery. Tetra Pak, however, often has problems with customers deciding to invest in a filling machine too late. Furthermore, M&PM at Tetra Pak is sometimes prioritising orders according to certain customers’ desires and based on the importance of the customers. The issue with too early deliveries should therefore not be an extensive issue at Tetra Pak. However, there is still a minimum pre-installation time needed at the customer’s factory, which varies for different customers and is communicated to M&PM and the Market Companies. Sometimes the production of filling machines will still be finished before the customer requires the delivery and put in inventory for finished goods. However, this is not because of orders being placed too early by the customers, it is rather a result of the takt system and the levelling of demand. The problem with too late deliveries according to the customer’ expectations, however, could still be a problem. Currently the operations unit has no idea what the customers really expect and one sub-goal of objective C in the purpose was to gather the Market Companies’ view on what Tetra Pak’s customers expected and include this aspect in the capacity tool.

According to theory, the customers’ expected waiting time might not be the same as the accepted waiting time, because some time might be added to the expected time depending on production delays or queues. Therefore, the waiting time used when calculating the service level should instead be referred to as an actual waiting time, which is taken into account in the capacity tool since it is based on the actual waiting time instead of accepted (confirmed) waiting time. The real expected OtD lead-time at Tetra Pak’s customers is based on the theoretical definition of actual waiting time and this should be managed according to the wanted expected OtD (WEOtD). This could be done by directing the customers to expect a certain lead-time (WEOtD), i.e. by influencing the customers with help from the sales force (the Market Companies) by for example communicating expected lead-times at the intranet Orbis. It is however important according to theory that the lead-times communicated reflect the reality. At the moment, Tetra Pak CB is not quoting any lead-times. It is therefore difficult for the sales people to find out what the actual operations lead-times are.

It is important, as stated before, for a company to be aware of its customers’ expectations. Today Tetra Pak has no collective view of expected lead-times. But if looking at the expected lead-times investigated for the TT/3 filling machine, it is possible to level out the demand since the production have 58 extra calendar days (36 working days) to level out the demand and the expectations (REOtD) is, see scenario 1 in figure 28. If Tetra Pak is producing in takt 15, this implies that they can
move the order two slots to level out demand. For TPA6 it is clear that the customers expect this machine type to be delivered in a shorter time span than what is even possible from a production lead-time perspective since the possible leveling time is negative, see scenario 2 in figure 28. In the case with TR/28 and TR/27, Tetra Pak also has a negative levelling time. The production time is very close to the expected lead-time but it is anyway impossible for Tetra Pak to meet demand and still level out demand. The only way to produce the order in time is if Tetra Pak starts to produce the order the same minute they receive the order and not using any buffer days that are included in the production time. This example is therefore close to a third scenario, see scenario 3 in figure 28.

**Scenario 1 (TT/3)**  
Possible to plan the production and level out demand

| Production time | Expected OtD lead-time (REOtD) |

**Scenario 2 (TPA6)**  
A stock of filling machines must exist in order to meet

| Production time | Expected OtD lead-time (REOtD) |

**Scenario 3 (TR/28 & TR/27)**  
Impossible to level out the demand because then the production must start at the same time the customer places an order

| Production time | Expected OtD lead-time (REOtD) |

**Figure 28 Production time vs. REOtD for the three filling machines**

**Forecasts**

A forecast is an important tool for a company’s operations function since it is used for operations planning. Sales are creating the forecast by trying to combine historical and future knowledge in order to estimate sales for the upcoming 12 or 24 months. It is important to not base forecasts on a single source of information, like only historical information. At Tetra Pak, the Market Companies are creating an annual forecast (for the next-coming 36 months) and rolling forecasts (for the next-coming 12 months), based on real orders. This could be seen as a single source and subjective forecasting, since they are only taking real orders into account and they base the forecasts on the sales persons’ view on what orders that will be realised. The forecasts at Tetra Pak (annual and rolling) are both long-term forecasts, which is
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appropriate since the capacity planners make long-term production decisions about takt ranges and costs.

Tetra Pak’s process of creating forecasts makes the forecast rather accurate for the orders that are placed in the forecast. Consequently, the forecasts are less accurate the longer the forecasting horizon is since unsure orders are pushed forward according to Tetra Pak. According to theory forecasts are most often treated as known information although they might be inaccurate. The production planning system needs to be adapted to this and respond quickly to forecasting errors. The operations unit at Tetra Pak does not believe that the forecast is accurate, but plans the production capacity based on the total forecasted orders per year. This can be very misleading since the orders are probably not evenly distributed over the year. If 80% of the orders must be produced within 20% of the year according to the forecast, the production will have a large problem since this will imply a very low total service level if not being able to increase capacity a lot, which takes a long time. This, however, could be the case and Tetra Pak does not take this situation into account during the annual capacity planning. This scenario is illustrated in table 9, where the first scenario is where 80% of the orders must be produced within 20% of the year and the second scenario is a situation where the orders are more even distributed. Additional orders are also often added afterwards, which can lead to capacity problems, since the production is low-volume and only one extra order can change the whole capacity planning. Table 10 shows that the service level decreases when orders are added (distributed over the months during a year) to a predetermined and fixed takt, which is an example of the machine TT/3 illustrated with help from the capacity tool.

<table>
<thead>
<tr>
<th>TT/3</th>
<th>Scenario 1 (# orders)</th>
<th>Scenario 2 (# orders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>February</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>March</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>April</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>May</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>June</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>July</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>August</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>September</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>October</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>November</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Total orders</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Takt</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Service Level</td>
<td>69%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 9 Illustration of order distributed differently along the year
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<table>
<thead>
<tr>
<th>TT/3</th>
<th>Takt</th>
<th>Number Of Orders Per Year</th>
<th>Service Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>20</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>25</td>
<td>52%</td>
</tr>
</tbody>
</table>

Table 10 Effect on the service level when increasing number of orders with a constant takt

The capacity tool indicates that when orders are added to a pre-determined takt range, the service level decreases. Because of the low-volume production, the forecasts created are point forecasts, which is a forecast of individual items according to theory that are typically inaccurate in contrast to forecasts of a mass of units. The production planning system need to be able to quickly respond to forecasting errors, which, again, can be a problem at Tetra Pak since it takes time to increase space and personnel. As long as there are blue-collar workers to hire from the other filling machine team, it is possible to increase capacity for the moment, but when both machines produced in Lund (TPA6 and TT/3) need full capacity, Tetra Pak will be faced with a problem. With the capacity tool, Tetra Pak can make sure that they are planning for different possible scenarios, not just the scenario given by the sales forecast.

**Concluding Remarks Marketing Strategy**

- It is important for a company to know their customers’ expectations, since it is difficult to aim at meeting the expectations otherwise.
- By communicating expected process lead-times at for example Orbis (the Intranet at Tetra Pak), it is possible to direct the customers’ expectations. The communicated expectations need to be accurate though.
- Too late deliveries according to expectations is a problem at Tetra Pak, too early deliveries, on the other hand, is not an extensive problem.
- Demand forecasts are not treated as known information at Tetra Pak, but the production planning system still needs to be adapted to be able to quickly respond to forecasting errors, which is not possible today.
- It is important not to base forecasts on a single source of information which is done at Tetra Pak today.

**5.3.3 Operations Strategy**

**Lean**

Tetra Pak is producing their filling machines according to Lean and a pull system, which is a common practice in high-volume production. Tetra Pak CB is manufacturing low-volume products, which implies complications in the planning of orders. In a lean production environment the customer should decide the takt in the production and in Tetra Pak’s case, the capacity planning is made more according to
what takt that can be applied in-house as well as at first and second tier of suppliers, rather than what takt is actually needed. The planning process of capacity can therefore be compared to a push system, due to the fact that Tetra Pak is planning their capacity range pre-hand, based on probable orders. The actual planning of individual orders is instead made based on actual order backlog, according to a pull system. Usually the input to the capacity planning is a deterministic or sales-plan driven capacity plan. Tetra Pak uses a sales-plan driven capacity plan, however, it is a common opinion at the operations unit that the sales-plan is not completely true and will change many times, which was illustrated above in table 10.

Manufacturing Strategy and Sales & Operations Planning

When it comes to the manufacturing strategy, it is possible to say that Tetra Pak is using a track/match strategy but more towards the lag strategy since it is difficult to forecast demand, which leads to that capacity is added in response to changing market demands. Sometimes Tetra Pak have too little capacity and sometimes too much and it does not depend so much on Tetra Pak as on the demand being high or low but they would not i.e. increase the capacity prior to a increased demand. Tetra Pak is trying to keep the gap between capacity and demand as small as possible with help from the levelling strategy. The “step” of the capacity consists of blue-collar workers as well as test bays. This makes the step size quite large since it can be hard for Tetra Pak to acquire these resources, depending on the other machines produced at CB Tetra Pak.

Concerning the sales and operations planning (S&OP) and decisions regarding the rate of production, Tetra Pak is using a mix strategy where the output rates in production are levelled for periods but then changed during the planning horizon. Tetra Pak do however sometimes have troubles in changing the capacity levels as stated above and they are sometimes thinking more about which capacity level that is possible to acquire rather than what is needed, which could make them more a bit towards the level strategy, where a constant production rate is kept.

With the capacity tool it would be easier to make sure that the capacity range (takt range) is correct from the start by trying out different scenarios in the tool before deciding the takt range. The capacity can then be altered within the range. In addition, Tetra Pak should also make sure that the capacity level needed is possible to realise and that it does not take too much time to change from a step to another. Hence, Tetra Pak should make more active decisions regarding these strategies.

If positioning Tetra Pak in the matrix illustrating the effect of combining the manufacturing strategy with the S&OP, Tetra Pak will end up closest to the lower right corner, which is a beneficial strategy, which is focused on price competition and thus resource utilisation. Tetra Pak’s strategies thus support each other, which is good. However, Tetra Pak means that they win orders due to their outstanding service, better quality than competitors and their famous brand name. Price does
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not seem to be the main factor in the industry, which is not coherent with their strategy. Tetra Pak has also identified time to be a crucial factor and talks about being flexible, which is hard with their current strategy.

<table>
<thead>
<tr>
<th>Lead (capacity supply surplus)</th>
<th>Track</th>
<th>Lag (capacity demand surplus)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chase</strong></td>
<td></td>
<td><strong>Limited opportunities to</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>execute chase. Relying on sub-</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>contractors. Frequent</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>overload and delivery</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>problems</strong></td>
</tr>
<tr>
<td><strong>Mix</strong></td>
<td></td>
<td><strong>Combined strong focus on</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>resource availability and</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>flexibility</strong></td>
</tr>
<tr>
<td><strong>Level</strong></td>
<td></td>
<td><strong>Possibility to change the</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>production rate if needed.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Delay new capacity</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>acquisitions</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Combined strong focus on</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>resource utilisation</strong></td>
</tr>
</tbody>
</table>

Table 11 Illustration of the effects of combining manufacturing strategy and S&OP and positioning of Tetra Pak. (Olhager, 2001, pp. 224)

It is difficult to find the right level of production capacity and so is the case at Tetra Pak. They do not know when to pull the brakes or push the system since they have no common rules for that. Since demand often is random, there will be times with both over- and under capacity, which still happens at Tetra Pak even though they are producing according to Lean. However, by expanding the capacity, fewer customers will hesitate to place orders since the waiting time decreases, however, an important effect of having fast service is higher operating costs. Figure 29 shows how the waiting time and costs per machine is affected with an increased capacity (decreasing takt) for TT/3, where the takt and queue is shown in the left axis and cost on the right axis. Figure 30 shows the same thing for TPA6. The waiting time is in this figure the maximum length of queue (number of orders that will be produced prior to the incoming order) that will emerge during the year. TR/27 and TR/28 is a special case because it is outsourced and is thus purchased, the queuing time will however react in the same way as the other machines.
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Figure 29 TT/3, effect of the queue and cost per machine when increasing capacity, the costs follow the same pattern as the reality but is somewhat modified.

Figure 30 TPA6, effect of the queue and cost per machine when increasing capacity, the costs follow the same pattern as the reality but is somewhat modified.

In the TT/3 case, the maximum queue during the year decreases when capacity increases. The cost per machine however is the lowest with a high capacity but also with a very low capacity. This depends on the number of test bays and blue-collar workers needed for each takt. This shows that it is important to also take cost per machine into account and not only the total cost (which naturally will increase with increased capacity). For TPA6 however, both cost per machine and length of queue decreases with an increased capacity, which indicates that it is more beneficial to produce in a higher pace.

Queuing Theory

In order to reduce waiting lines, extra capacity investments are required and when deciding whether or not to invest in the capacity, it is of importance to know what the effect of the investment will be. Currently Tetra Pak can not make strategic decisions when planning their capacity since they do not know how their decisions
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affect customer satisfaction and in the end, sales. Queuing models might help sorting out the reduction in the lead-time when adding extra capacity. The capacity tool is a way of finding out how the capacity investment will affect customer satisfaction in the matter of lead-times. Different performance measures can be generated with queuing theory, one of them is the time a customer has to wait to be served, which is the measurement the capacity tool uses. This is illustrated in table 12 with help from the capacity tool. The total time a customer has to wait on the order is shown in the left column and the number of orders (of 14 in total) per waiting time category is shown in the right columns for three different scenarios, takt 10, 20 and 30 where 30 is the lowest capacity.

<table>
<thead>
<tr>
<th>Waiting time (working days)</th>
<th>Number of orders (in takt 10)</th>
<th>Number of orders (in takt 20)</th>
<th>Number of orders (in takt 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>51-100</td>
<td>11</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>101-150</td>
<td>0</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>151-200</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>201-250</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>251-300</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>301-350</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>351-400</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total number of orders</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 12 Waiting time in working days for three scenarios

A distinction that can be made between different single queuing systems is if the queue length is observable or unobservable. The system utilisation is the highest when the queue length is observable. At Tetra Pak CB the queue length is unobservable for the customer as explained earlier.

There are different structural aspects of queues as well. At Tetra Pak a Service Discipline is not used, with other words Tetra Pak does not apply the first-come-first-served rule since M&PM has the authority to prioritise orders. However, the capacity tool applies the first-come-first-rule for simplicity, since the model does not take detailed orders into account. The aim is rather to look at the bigger picture over a year, to calculate how many of the total number of order that is delivered in time for the customers expectations.

At Tetra Pak, the queue consists of the orders that are planned in production slots, since they must wait on the correct date for the chosen slot. The size-limitation is therefore the capacity, but there will always be a free slot well into the future but preferable there will be no order left to produce when the year is over (closing order stock=zero). Figure 31 shows how the takt will affect the queue, more specifically the closing order stock, which is the number of orders that could not be produced
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![Graph showing TPA6 Takt vs Closing Stock](image)

**Figure 31 The increasing closing order stock with increased takt for TPA6**

As shown in figure 31, for the specific number of 19 incoming orders distributed over the months, the closing stock is zero for takt five and takt ten. When the takt is increased to 15 however, the closing stock increases to four. This implies that the optimal takt for not having any orders left to produce when the year is over, is in this case somewhere in between ten and 15. This kind of investigations is possible to perform with the capacity tool.

The queue system can vary in size and at some point in time customers in a time-based market will hesitate to join the queue. When this point is reached, the product/company is not the only thing the customer cares about, but also the queue system, which directs the customer lead-time. At Tetra Pak, the point in time at which the customer would hesitate to join the queue is called the maximum lead-time in the empirics. Other factors can affect the customers’ decision as well, like higher price of the competitors or if the search cost or switching cost is high. Then a longer queue will be more tolerated by the customer.

**Concluding Remarks Operations Strategy**

- Tetra Pak is producing the filling machines according to *Lean* and a pull system, which is most common in high-volume production and Tetra Pak CB is manufacturing low-volume products, which implies complications in the planning of orders.
- The planning process of capacity can however be compared to a push system, due to the fact that Tetra Pak is planning their capacity range beforehand, based on probable orders. The actual planning of individual orders is instead made based on actual order backlog, according to a pull system.
The combination ends up in a track/match manufacturing strategy together with a mix strategy within the sales and operations planning where the output rates in production are levelled for periods but then changed during the planning horizon.

Tetra Pak’s manufacturing and S&OP strategies support each other, however, these strategies is all about keeping costs low, which does not seem to be one of Tetra Pak’s main goals.

In a lean production environment the customer should decide the takt but in the case of Tetra Pak, the capacity planning is more made according to what capacity that is available.

Queueing models might help sorting out the reduction in the lead-time when adding extra capacity.

The system utilisation is the highest when the queue length is observable, which is not the case at Tetra Pak CB.
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6 Concluding Remarks

The concluding chapter starts with a repetition of the purpose and objectives and continues with a summary and presentation of the main findings of our study. In the presentation of the findings we refer back to the main purpose and objectives of the thesis. At the end, recommendations and suggestions for future research are presented.

6.1 Repetition of Purpose and Objectives

The main purpose was to analyse the coordination between operations and sales in an industrial environment.

Included in this purpose are three objectives that were to be achieved.

Objective A: to develop a theoretical framework that visualises the relationship between the areas that are of importance to understand the relationship between the operations unit and sales unit (organisational success and strategic alignment, key performance indicators, order-winners and order-qualifiers, operations strategy and marketing strategy), and, in addition, takes capacity planning into consideration.

Objective B: to describe a complex industrial situation that represents a suitable environment to investigate the relationship between the operations unit and sales unit in.

Objective C: to create a tool for capacity planning that can be used to generate a joint performance measurement in terms of a service level (percentage of customers who get their expectations met), which will support capacity planning decisions and visualise how the decisions taken in the operations unit affect customer satisfaction in the end.

6.2 Conclusions

6.2.1 Findings Concerning Objective A and B

A description of a complex industrial situation at the case company Tetra Pak has been made as well as generation of a theoretical framework (ICOS). The ICOS-framework illustrated the relationship between different parts of theory and was done in order to increase the understanding for the relationship between operations unit and the sales unit, within industrial companies in general and at Tetra Pak in specific. The ICOS-framework visualises that the operations unit and the sales unit are often developing strategies that fit their own separate performance, and that their strategies are not aligned to support the actual needs of the customer, which is also the case at Tetra Pak. The ICOS-framework also highlights the importance for
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companies to keep striving towards becoming more effective, and avoid focusing solely on improving their efficiency. Tetra Pak is definitely a suitable example of this since they are aiming to reach a high level of effectiveness but is not quite there yet.

Furthermore, the ICOS-framework indicates that in order to become more effective, strategic alignment needs to exist between the sub-units in a company so that the company as a whole strive towards achieving the synergies that in the end will lead to customer satisfaction. If considering this issue in an industrial environment, where the production is make-to-order and characterised by low volumes, high product customisation and long lead-times, the link between operations and sales becomes especially critical and short lead-times is normally an order winner. It is however concluded that this is not always the case, short lead-time can also be an order qualifier, as it is for Tetra Pak, when the lead-time is not completely known for the time of order placement. It is however equally important to improve the order-qualifiers as the order-winners in a company. In an industrial make-to-order environment, where it is important to meet the customers’ expectations of lead-times, two processes have been identified as critical when it comes to the need for alignment: the budget process and the order-to-dispatch process, which the operations unit as well as the sales unit are involved in. We have concluded that one concern that could exist in these processes is that the sales unit creates subjective forecasts based on only one source of information and, in addition, this unit is measured on short-term accuracy when creating forecasts, which cause complications in the production and capacity planning. The result of this whole matter is that the operations unit does not trust the provided forecasts and bases their capacity planning on other factors. Consequently, the two different units end up having different goals and no standardised way of performing the capacity planning. The consequence is that the external factors, such as actual customer demand and expectations, become ignored when planning the production capacity. A joint measurement in terms of a service level (which measures if the customers expected i.e. lead-times are met) would be a first step towards finding a solution to the non-existing alignment of the above two measurements systems.

In conclusion, the ICOS-framework supports the view that the operations unit and the sales unit strives toward increasing their own separate performance. When units within a company work towards contradictory goals, it is a sign of absence of alignment, which lead to problems in capacity planning and suffered customer satisfaction. In order to solve the issue, the different units need to acquaint themselves more with what the market actually demands and aim to achieve more transparency and cooperatively work more proactively when it comes to capacity planning. At Tetra Pak the operations unit have too little knowledge about market expectations. When knowing more about what the market demands it is easier to achieve coordination between units, where common performance measurements can be of help, which needs to reflect on customer satisfaction. The consequence of not knowing what the market demands is that the company might not meet the customers’ expectations, without even knowing it. This problem together with a
limited knowledge about the competitors’ strengths makes the whole situation critical. If not meeting customers’ expectations (i.e. order-winners and order-qualifiers), there are two possible options; either the company can try to change the customers’ expectations or the company can chose to change their own conditions. The more sustainable way to change a companies conditions by handling the operations lead-time could be to increase the capacity in production, keep products in stock or change the production from i.e. make-to-order to assemble-to-order to be able to faster produce the product.

6.2.2 Findings Concerning Objective C

The third objective within our purpose was to create a tool for capacity planning that could be used to generate a joint performance measurement in terms of a service level measurement, which will support capacity planning decisions and visualise how the decisions taken in the operations unit affect customer satisfaction in the end. Our conclusion is that a joint measurement in terms of a service level (based on actual expectations from customers) could be the first step towards finding a solution to the vague alignment of sales and operations unit. A joint measurement could also be a step towards more aligned internal communication and could help the operations unit, in particular, with their struggle to make a strategic decision regarding the balancing of capacity levels and costs, based on customer requirements and cost.

A company needs to have a manufacturing strategy and sales and operations planning (S&OP) that support each other. It is important for a company to take active decisions in this matter since these strategies determines how the customer is threatened in the end and what is focused on in the production (flexibility/utilisation). The manufacturing strategy concerns timing of the resources and is often decided prior to the S&OP (rate of production), which means that S&OP needs to adapt to the manufacturing strategy. If levelling the production according to the customer demand, it is important to make sure that the capacity level needed is achievable and can quickly be changed. Since Tetra Pak is producing according to Lean and does this with low-volume products, it can be difficult to change the capacity quickly since only one additional product will impose large changes in production. Tetra Pak also needs to think about how their overall strategy of winning and qualifying for an order is coherent with their manufacturing and S&OP strategy of production utilisation.

With a capacity tool it would be easier to make sure that the capacity range (takt range) is correct from the start by trying different scenarios in the tool. The capacity can then be altered within the range. By knowing how the output (service level and costs) is affected by changes in the input (forecast, customers expectations, capacity) it is possible to make some conclusions about how the service level will be affected by late placed orders, too low/too high takt, customers’ expectations and the length of the process lead-time. Information can also be acquired about how a
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derived takt affects the length of the queuing, waiting time and cost per machine as well as closing order stock. This is important information for any manufacturing company, which should be communicated through the organisation. One important conclusion is that with a decreasing capacity comes an increasing queuing time. It is crucial that a company keeps track over the customers’ perceived maximum waiting time, which should not be shorter than the queuing time. Another conclusion drawn from the capacity tool is that an addition of only a few orders in a low-volume production environment can change the service level quite much. It is also important to investigate in the strategy and cost-structure for every product, since it was found that within a low-volume takt production, the highest manufacturing volumes do not always generate the lowest production cost per product. This is an effect of the takt system and the capacity steps.

6.3 Recommendations

We advice Tetra Pak and other companies in an industrial environment with similar challenges when it comes to alignment in relation to capacity planning to;

- Determine what the customers’ expectations are, which are the order-winners and order-qualifiers, and focus on them and communicate them through the whole company. All functions should strive towards them.
- Implement a joint measurement in terms of a service level (based on actual expectations from customers) that can help improving the non-existing alignment between the supply chain operations unit and the sales unit, since it will force these two large units of the company to cooperatively focus on the customers’ needs.
- Make active decisions regarding the strategy of rate and timing of capacity, it should be coherent with company strategy.
- Depending on if the focus should be cost (utilisation in production) or customers (flexibility in production), the capacity model can be used in different ways. The output of service level and cost should be balanced and the strategy determines which output is the most important one.
- Use the capacity tool as an internal communication tool in order to understand how changes of the activities in the supply chain operations unit or the sales unit will affect the overall business. By making use of the capacity tool, it could be a way to standardise the process in which the production capacity is planned. If representatives from the sales units and the supply chain operations unit is looking at the capacity tool together, we believe that the supply chain operations unit and the sales unit (at least M&PM) will create more understanding for each other’s problems and goals.
- Look over the strategy and cost-structure for all products, since not all machines is produced cheapest at the highest capacity. It is first important to know what is the most important factor, cost or customers, see above. This is further an important factor when taking capacity decisions, which of
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course should be balanced against the queue lengths (customer satisfaction).

- Solve the issue with the production lead-time being longer than customers’ expected lead-time (in the Tetra Pak case for TPA6, TR/28 and TR/27) by influencing the customers’ expectations through more clearly communicating expected lead-times (i.e. in Tetra Pak’s case at their intranet Orbis). This will also increase the system utilisation and the service level. Another proposition is to decrease the process lead-time by increasing the capacity.

- Create more transparency in the company, i.e. by communicating lead-times at the intranet as stated above, by communicating changes in the forecasts, in order for the forecast to be more accurate and the operations unit to be able to trust the information received from the sales unit and also communicating focus areas like order-winners and order-qualifiers in the entire company.

- Think about how the forecast system can be approved further, i.e. by basing the forecast on more than one source of information and include a measure of forecasting error. Forecast specifically was not a part of our purpose but the forecast is an important input in the production planning and will thus affect it.

- Improve the production planning system to be able to adapt quickly to changes in demand (forecasting errors), even if the forecast system is improved.

6.4 Future Academic Research

To add more reliability to our results, the ICOS-framework should be applied on a larger quantitative scale, i.e. more companies in the same industrial environment. Future research could also investigate in the same matter for high-volume production instead of low-volume production. This study could also be expanded to involve more factors (order-winners as well as order-qualifiers) within the concept of customer satisfaction than lead-times. Our study was limited to investigate the coordination between the operations and sales unit. Future research could also take into account the larger context in an organisation.

6.5 Future Research at Tetra Pak

Tetra Pak should do further research on the customers’ expectations on lead-times in order to gather a full understanding of the demand structure. The research performed in this study is done on the most representative clusters for each machine, but a full study of this should be done in order to, for example, take all cultural differences on lead-times expectations into account. The results should also be communicated to the whole company, especially the supply chain operations and sales units, which must have a full understanding of this matter.
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Investigate in how the forecast system can be improved. When investigating this matter Tetra Pak need to take the insights of aligned goals into account, since the measurement system of the Sales Support unit affects how the forecast is performed. One suggestion is to investigate the possibility to create price and service incentives for the customers to order machines earlier in time.

To increase the incentive for the employees at the Market Companies’ to create more reliable annual forecasts, it could be possible to only use one forecast (the rolling forecast) and to freeze the forecast when it is time for the annual forecast to be summarised. In this way the Market Companies would prioritise both the annual forecast and rolling forecast at the same time they would be measured on the accuracy of both.
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Appendix I

Survey of Market Expectations on Order Lead-Times

The purpose of this survey is to collect data related to market expectations on order lead-times. Three of Teta Pak’s filling machines will be in focus: Teta Pak A6, TR27 & TR28 and T10. The result of the survey will support a project regarding capacity sizing in the production at Tetra Pak CB. Complete anonymity is guaranteed.

What cluster do you belong to?

Which filling machine are you working with?
- [ ] Teta Pak A6
- [ ] TR27 or TR28
- [ ] T10

Please, enter minimum order lead-time for Teta Pak A6 (in calendar days).* The minimum order lead-time is the shortest time that is required by the customer to prepare their own production facility before receiving a filling machine, i.e. installation time etc.

Please, enter maximum order lead-time for Teta Pak A6 (in calendar days).* The maximum order lead-time is the maximum time that the customer is willing to wait for a filling machine delivery before seriously considering changing to another type of machine or cancel their order entirely.

Please, enter customers' expected order lead-time for Teta Pak A6 (in calendar days).* The customers’ expected order lead-time is the order lead-time that the customers expect to receive a filling machine within, i.e. not necessarily the order lead-time that is confirmed by the Supply Chain Operations unit. (Minimum order lead-time + expected order lead-time = maximum order lead-time).

Please, enter minimum order lead-time for Teta Pak TR27 or TR28 (in calendar days).* The minimum order lead-time is the shortest time that is required by the customer to prepare their own production facility before receiving a filling machine, i.e. installation time etc.

Please, enter maximum order lead-time for Teta Pak TR27 or TR28 (in calendar days).* The maximum order lead-time is the maximum time that the customer is willing to wait for a filling machine delivery before seriously considering changing to another type of machine or cancel their order entirely.
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Please, enter customers' expected order lead-time for TR27 or TR28 (in calendar days). The customers' expected order lead-time is the order lead-time that the customers expect to receive a filling machine within, i.e. not necessarily the order lead-time that is confirmed by the Supply Chain Operations unit. (minimum order lead-time < expected order lead-time < maximum order lead-time)

Please, enter minimum order lead-time for TT30 (in calendar days). The minimum order lead-time is the shortest time that is required by the customer to prepare their own production facility before receiving a filling machine, i.e. installation time etc.

Please, enter maximum order lead-time for TT30 (in calendar days). The maximum order lead-time is the maximum time that the customer is willing to wait for a filling machine delivery before seriously considering changing to another type of machine or cancel their order entirely.

Please, enter customers' expected order lead-time for TT30 (in calendar days). The customers' expected order lead-time is the order lead-time that the customers expect to receive a filling machine within, i.e. not necessarily the order lead-time that is confirmed by the Supply Chain Operations unit. (minimum order lead-time < expected order lead-time < maximum order lead-time)

Thank you for your time!
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Appendix II

The Capacity Tool – Excel Version (empty)
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The Capacity Tool – Excel Version (example scenario)
The Capacity Tool - Explanation

The input factor forecast (number 3), together with wanted levelling time (number 5) (which gives the surplus time Tetra Pak wants to have in order to level out demand), together bring the month of when Tetra Pak wants to receive the orders. The orders are matched into free production slots and pushed forward if no free production slot are available. The free production slots available are decided by another input factor: Potential TAKT range for this year (number 7), which is the takt range that is tested. For example, takt 10 implies 2 production slots each month. The forecasted in year-1 and ordered but not produced in current year (number 6) is the number of orders that could not be produced previous year and must therefore be produced before the forecasted orders this year.

The tool then calculates how long time each order:

1. Is waiting in queue before being placed in a production slot
2. Is being produced (which is fixed and depends on the machine type, number 1)

The tool then compares this lead-time to the customers expectations, which is the input number 4 (possible leveling time) plus the production lead-time. If the total waiting time is shorter than the customers expectations, then the expectations for that order is met, if waiting time is longer, then the expectations is not met. The tool then calculates the percentage of orders that will be delivered within the time of the customers’ expectations; i.e., the service level.

The closing order stock is the number of orders that could not be produced within the year and this is then the input (number 6) for next year. The cost calculations have been described briefly in the report but are based a template provided by Tetra Pak with the certain number of blue-collar workers and test bays needed.