

The Impact for Customers of a Productivity Initiative at Heineken



The impact for customers of a productivity initiative at Heineken

An analysis of consequences in the outbound supply chain when Production Time Tables are introduced at the Heineken brewery in Den Bosch

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In this public version, confidential information has been removed or altered. Hectoliter volumes have been replaced with XXX. Countries have been replaced by Country A,B,C etc (randomly). Regions have been replaced by Region A,B,C etc (randomly).
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Management summary

Heineken Netherlands Supply (HNS) is the production organization of Heineken that is responsible for the three breweries located in the Netherlands. These breweries produce around 17 million hectoliters annually. Between 700 and 900 different beer products are produced for the domestic as well as the numerous export markets around the world. The brewery in Zoeterwoude produces around 10 million hectoliters per year mainly for the domestic and American market. The Den Bosch brewery focuses on domestic and other export markets. The small brewery in Wijkre only produces for the domestic market. In general it can be said that 80 percent of the volume is covered by 20 percent of the products. This large majority of the volume is for the domestic and American market. The brewery in Zoeterwoude has a smaller diversity in products than Den Bosch. For that reason Zoeterwoude has large production batches and Den Bosch has small production batches. The main objective of HNS is to produce as cost-efficient as possible against a high level of customer service.

Too much overcapacity on a production line is not cost-efficient. But overcapacity also creates a certain level of flexibility needed for a reliable supply of beer to the customers. Currently Heineken produces very cost-efficiently, but with increasing demand, problems start to occur, because some products cannot be supplied on time due to the lack of sufficient capacity. HNS needs to increase their capacity. Whereas Heineken does not prefer to invest in expensive machinery and/or personnel, they have been looking for an alternative. This alternative is called Production Time Tables or PTT. PTT can be compared with a planning system used in railways or aviation. (Groups of) products are produced only on fixed moments in time in a certain fixed sequence. High demand products can be produced weekly, but low demand products can be produced only every 8 weeks.

Before PTT can be implemented, HNS faces three issues:

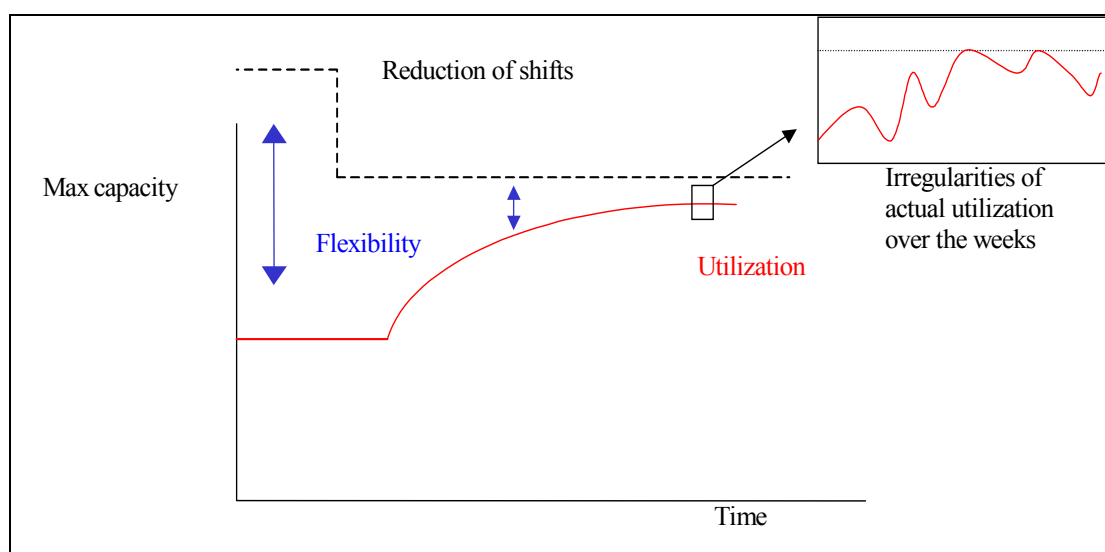
1. It is unknown how the most optimal Production Time Tables should be constructed.
2. It is unknown what will change for the HNS customers if Production Time Tables are introduced.
3. It is unknown what the reaction of the customer will be on the changes caused by Production Time Tables.

The first issue will be resolved by the internal Heineken consultants of Corporate Distribution and Logistics (CDL). The second and third issue will be researched in this report. The analysis is made by using: existing data, observations of processes, interviews and literature/theories. The central question of the research is: *What will happen in the outbound supply chain for customers and with customer response when the production organization of Heineken implements Production Time Tables?*

The delineation for the research is set on the Den Bosch brewery and only for cans and one-way (non returnable) bottles, because the researched PTT will initially be implemented on this part of the production organization. The customers in this research are the direct customer of HNS and not the consumers further in the supply chain, because this final part is either unknown or too divers looking at the entire Heineken export market.

First it is research where this problem comes from and how the Heineken supply chain is formed. The supply chain consists of procurement, production and physical distribution and passes various storage points. There are three different logistical concepts used in the Heineken chain in which customers are supplied from HNS. Make To Order, Make To Stock and Replenishment. The difference between these concepts is based on the storage point in the chain where the activities change from order-driven to forecast-driven. The ordering process from a customer to HNS goes through a preset planning procedure called the Drumbeat. This 4-week process guarantees that every customer order is placed on transport within 4 weeks. The planning department of HNS is responsible for the transition from customer order to production order. This department needs to place all customer orders in a production schedule as efficiently as possible. The brewing and packaging departments execute the planned production orders.

The packaging department can be considered as the bottleneck of the supply chain for two reasons. The first reason is that it has the lowest capacity of the chain and secondly because it is the most expensive link due to the cost of involved assets and personnel. The maximum capacity of the packaging department depends on the amount of personnel, amount of assets and efficiency/effectiveness of the operation. The gap between maximum capacity and actual utilization of capacity determines the level of overcapacity or flexibility. This flexibility is needed for growth potential, buffer capacity, but also for fluctuations in utilization between weeks. The following situation has now occurred. Maximum capacity has been reduced recently by the reduction in personnel/shifts on the packaging lines. Demand (and therefore utilization) has increased by the markets. Flexibility has decreased significantly. Production is very cost efficient, but the risk of having not enough capacity to meet demand is increasing. Fluctuations become more difficult to accommodate. If production orders cannot be produced in time, they will arrive too late at the customer, which effects customer service (the main objective of HNS together with cost efficient production). The figure below gives a visualization of the current situation at Heineken.



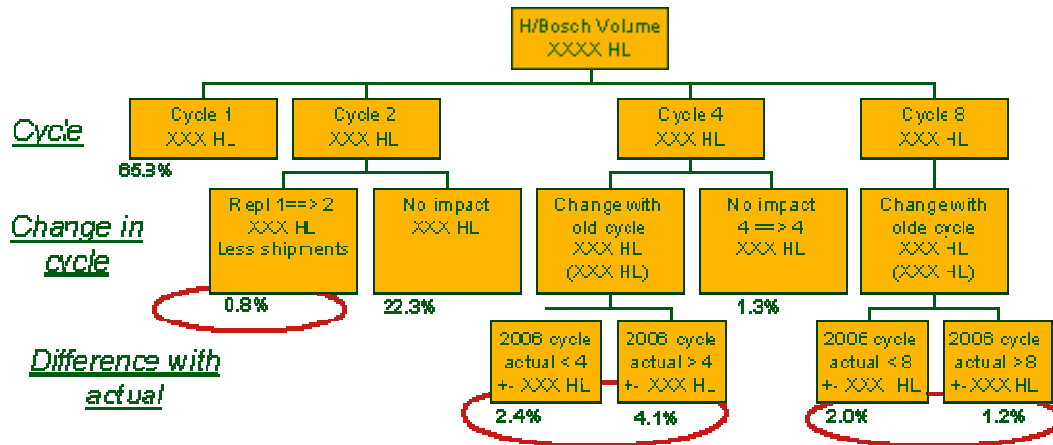
HNS wants to increase maximum capacity and stabilize the irregularities in utilization by implementing Production Time Tables. Every product is placed in a product group/

family. Every product of one family has a very small changeover time with the other members. Changeover times between families are much larger. CDL has calculated the most optimal timetable per production line using production cycles of 1,2,4 and 8 weeks per product group. Some small products are currently made in a very small batch size almost every week, because each customer orders the product independently. With PTT cycles, the batches of certain products become larger by combining customer orders, which reduces changeover time what leads to higher productivity. CDL has calculated that PTT will increase productivity of packaging with 3%. Another advantage is that the predictability of production will be increased. The third advantage should be that PTT creates a fixed rhythm of production which can be adopted by procurement and physical distribution (the two other parts in the supply chain). However, the advantages are the gains within production. Before potential implementation, the disadvantages in the supply chain have to be researched. The disadvantages/impact will especially be on the inventory points of the customers, because the ordering process will change for customers. If HNS wants to implement PTT in the researched form, the gains in productivity need to be larger than the negative consequences for customer inventory. Having set these new focuses, the central question can be changed into the following: *What will happen in the outbound supply chain in terms of customer inventory and customer response when the production organization of Heineken would decide to implement Production Time Tables?*

The current situation and the problem have been investigated. It is important to better understand the perceptions of the customer. In order to understand the perceptions of the parties other than the initiator of the project, various interviews were held with representatives of HNS customers from over the entire world. The challenge of these interviews was to find an expected reaction about a project that was not communicated to them yet. Customers were asked general questions about customer service, inventory situation, freshness of products, their portfolio and the project of mono containers. The project of mono containers has recently been implemented by HNS which sets a minimum customer-order volume. The following points were most remarkable in terms of the PTT project:

- Customers set their priority on reliability of supply. This means a correct estimated time of arrival (ETA) in the customer's warehouse.
- The relationship between HNS and the customers is not unconditional. The customer has many realistic alternatives that can have negative consequences for HNS.
- Customers would appreciate more communication, involvement, discussion and interaction between supplier (HNS) and reseller (customer).

The next step in the research is to analyze the volume that will be negatively impacted by the project. Almost all products that are placed in product groups/families with cycle 1 or 2 can be considered as non-impacted, because there is no difference in lead-time or order volumes with the current Drumbeat process. Products in cycle 4 and 8 show much more impact. Looking at the distribution figure, it can be stated that 10% of the total researched Den Bosch volume will be negatively impacted, which means that there will be consequences for the customers' inventory position.



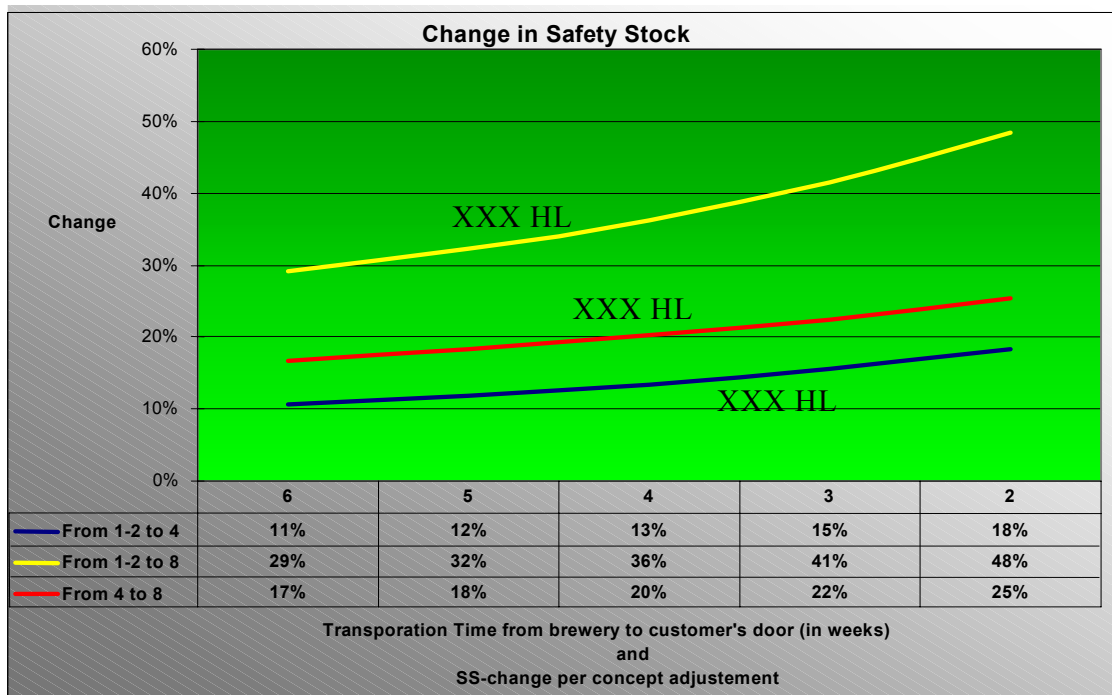
The inventory of customers consists of different types of stock that can be analyzed.

- safety stock
- cycle stock
- strategic stock
- obsolete stock/freshness

PTT will increase the maximum leadtime of an order that is placed in cycle 4 or 8 compared to the current Drumbeat leadtime. Depending on the transportation time on the boat (which depends on the location in the world) the following increases in safety stock can be expected:

- 11-18% increase for products from cycle 1 or 2 to 4 (XXXXXX HL)
- 29-48% increase for products from cycle 1 or 2 to 8 (XXXXXX HL)
- 17-25% increase for products from cycle 4 to 8 (XXXXXX HL)

Putting these numbers in a graph shows the following:



Cycle stock will increase on two levels. First, the customers that order their products more often than the proposed cycle in PTT, will directly have an increase in cycle stock, because they have to order the same annual volume in larger batches. After

filtering the effect of mono containers, 45% of the impacted volume will experience cycle stock increase. This comes down to 4,4 % of the entire Den Bosch volume (XXXX HL). The other increase in cycle stock influences the whole impacted volume of cycle 4 and 8 (XXXX HL). This increase is caused by the combination of PTT and mono containers. Every order has to be rounded up to entire containers. The customer cannot choose the ideal moment of receipt of full containers. This results in sub-optimal order volumes and lack of flexibility for the customer.

Strategic stock is the third type to be impacted by PTT. Customers with products in cycle 8 (XXXXX HL) will have to review their trust in production. Customers can be tempted to hold additional strategic stock, where the customer anticipates on the chance that something will go wrong in production precisely in the (rare) week that his product is planned for production. Depending on the chance that he will not be able to receive his order, he will keep a mega-safety stock of 8-week demand in order to continuously supply his clients when HNS cancels the delivery.

As an effect of the increasing stock levels at the customers, the guarantee of freshness cannot be made anymore and products can become obsolete. This guarantee of fresh beer for the consumer can only be held when every customer will receive fresh product at least once every 8 weeks when cycle stock reaches zero. Not only the freshness constraint will be jeopardized, but PTT will also decrease commercial responsiveness, because the high stock delays the speed of introducing new products or designs.

Next to inventory, it is important to know what to expect from the customers' responsive behavior. Literature is used to show that a so-called repeated destructive act can cause very negative consequences for HNS. A destructive act is when a supplier (such as HNS) performs an activity that has significant negative impact on the business of a reseller (such as a HNS customer). Theory states that if 2 destructive acts are inflicted by a supplier to a reseller (=repeated) it is expected that a much more negative response will show from the reseller compared to a single destructive act. The mono container project can be considered as a destructive act on which customers have responded with (silent) acceptance. PTT can be seen as the second destructive act from HNS in a short period of time. A negative response with negative actions by the customers will increase the total negative impact of PTT.

From the research the following conclusions can be drawn. The advantage of PTT is 3 % gain in productivity of every involved production line and a more predictable production what leads to a more stable actual utilization of capacity over the weeks. The disadvantage of PTT is that 10% of the total researched volume will be impacted by an increase in safety stock, cycle stock and/or obsolete/freshness stock. Increase of strategic stock is merely a risk. Considering the mono container project as a destructive act as well, the implementation of PTT would match the theory of repeated destructive acts and therefore can cause negative consequences for HNS such as customers leaving with their entire portfolio of products or significantly decreasing their effort/attention in the sales of Heineken products. A lower quality of service from HNS can therefore have bigger issues than the increase stocklevels on 10% of the volume. Almost all customers have at least one impacted product in their portfolio. That is the reason that almost 100% of the researched volume could be

impacted. PTT on itself is not a bad project. However, the researched format of PTT with cycles of 4 and 8 weeks is not recommended for implementation.

The following list of six recommendations can be given:

1. Investigate alternatives for PTT that can also help in resolving the issue of lacking capacity and producing as cost efficiently as possible.
2. Perform more research on the implementation option of PTT with a maximum cycle of 4 weeks.
3. Perform more research on the implementation option of PTT where the impacted volume is distributed to the customers through a MTS logistical concept. (and combinations with recommendation number 2).
4. The first steps towards this research of alternatives and implementation options have already been made. An initial setup is placed in the appendix of this report and can be helpful.
5. It is recommended to investigate to what extent the claimed errors in shipping documentation lead to significant delays. This has been brought forward by customers during interviews. HNS needs to find out how large this problem is. It is possible that a higher customer service can be achieved by minor improvements in the handling of shipping documentation.
6. The last recommendation is to involve customers more in two-way communication. Not only has a large majority of the respondents mentioned this desire, but literature has also described various suggestions to involve the customer in projects as early as possible in the process. Customers will experience this as very service-minded. Close contact with the market can also help to prepare for unexpected changes in demand better.

Preface

This bookwork is the final report of my Master Thesis for Technology, Policy and Management a faculty of Delft University of Technology. This thesis can be used as an interesting combination of practice and theory. The report has been made as an exciting assignment, which has been initiated by Joop Knulst of Heineken Netherlands Supply. I would like to thank him for this opportunity where it was possible to combine academic research with operational decision-making.

For regular supervision Charles van Es and Jan-Willem van Riemsdijk have been of great help to me. Not only have they taught me to look further to things than only the first impression, but also to make wonderful graphic sheets, challenging Excel calculations and of course how to become a genuine 'Snippenschieter'.

Prof. dr G.P. van Wee, ir. M.W. Ludema and dr. J.H. Appelman have assisted me from the university by providing very useful tips to find the ins and outs of a supply chain. Especially the advice of Mr Ludema to read "The Goal" by Eliyahu M. Goldratt opened my eyes towards bottlenecks and constraints in a production organization. I am very grateful for all the help.

Finally, I want to take the opportunity to thank all the guys of "Manga '99" and the "Heeren van 9-11" for making my 7 ½ years of studying unforgettable. Cheers!

Carl Eric O. Grootendorst
Zoeterwoude, Friday March 30th, 2007

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1. Introduction

In this chapter a first impression will be given about the content of this paper by presenting background information and a description of the general problem. Then, the outline of the report is given to determine the structure through the report.

1.1. Background information

Heineken Netherlands Supply (HNS) is the department within Heineken that is responsible for the supply of beer to both the domestic and the entire export market. The beer is brewed in three different breweries in the Netherlands. Heineken products are exported to almost every country in the world what makes Heineken the most international beer brand of the world. After buying beer from HNS, the customers resell the products to their clients. The two largest HNS customers are Heineken USA and Heineken Netherlands. Within HNS, the department of Demand & Supply Management (D&SM) is responsible for managing the supply chain process. Their task is to translate the demand from the market into supply.

In general, the internal customers can now order beer products whenever they want. HNS guarantees their customers that the order will be shipped within 4 weeks.

The breweries in Den Bosch and Zoeterwoude that are both located in the Netherlands have recently downsized the 24-hour operational shifts from 7 days per week to 5 days per week to increase cost-efficiency. Now that many lines are operated only 5 days per week, the maximum capacity¹ of the lines has been reduced. In the last few years, demand for beer (especially in the USA) has increased, but the top management of Heineken does not prefer rehiring the additional personnel. This causes the situation that when the utilized capacity increases it approaches the maximum capacity. That is very cost-efficient, because asset utilization and productivity of personnel is maximized, but there is little room for flexibility. Planning the large flow of customer orders within production capacity needs a certain level of flexibility/overcapacity/buffer to handle irregularities in actual utilization. If there is little flexibility, it is more difficult to deliver all orders on time. In figure I, the capacity situation is visualized.

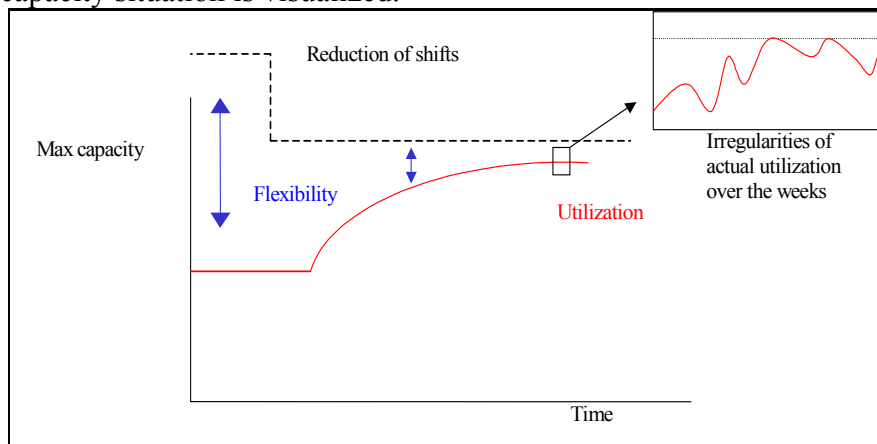


Figure I, Increasing utilization of capacity vs. flexibility and a reduced max capacity

¹ Capacity (APICS dictionary): The highest reasonable output rate that can be achieved with the current product specifications, product mix, work force, plant and equipment.

To deal with the issue, D&SM wants to introduce Production Time Tables (PTT) or the ‘Sporboekje’. This concept of Production Time Tables means that every production line in the brewery will get a schedule with cyclic, fixed slots (buckets) for certain types of product. Every group of products will be connected to a production cycle of 1, 2, 4 or 8 weeks. This means that the group is only available for production once every 1,2,4 or 8 weeks. The concept can be compared with the timetables used in aviation and railways where some planes or trains travel more often than others, but translated to a production organization. D&SM believes that PTT will not only create additional capacity on the line, but it will also create a predictable rhythm in the supply chain.

1.2. Problem formulation

PTT is a capacity improvement project, but there is a problem. The gap between the criteria and the expected situation is defined as the problem (Enserink, 2002). In all situations, D&SM needs to be as cost-efficient as possible and guarantee a certain level of customer service. These are the criteria. Introducing PTT creates the need for an optimal timetable per production line. The expected situation is that once the timetables are operational, the inbound supply chain (the production) will be optimized/improved, but it is unknown what will happen to the customers and how they are going to react in the outbound supply chain (distribution). Before D&SM wants to implement PTT, a three-fold problem has to be solved first.

1. *It is unknown how the most optimal Production Time Tables should be constructed.*
2. *It is unknown what will change for the D&SM customers if Production Time Tables are introduced.*
3. *It is unknown what the reaction of the customer will be on the changes caused by Production Time Tables.*

To find the optimal ‘timetable’ per production line, D&SM has consulted Corporate Distribution & Logistics (CDL) for advice. CDL is an in-house group of consultants of Heineken Group Supply Chain (see chapter 3 for further reference). Where others will investigate problem 1, this research focuses on finding answers to problem 2 and 3. The results of this research are dependent on the result from CDL. They will give the input of a Production Time Table, which will be used in this research to evaluate the impact. Finding an optimal PTT and the question if PTT creates additional capacity or not, are considered exogenous factors.

To provide a good indication of the consequences, an analysis of the effects needs to be made together with the use of scientific literature. This literature is mostly used in order to predict the response of customers on the PTT project (chapter 9). In the next chapter, it will be described how this issue will be approached throughout the different chapters.

1.3. Outline of the report

The thesis is divided in different chapters. Each chapter describes another object of the thesis and follows the flow of the visualization on the next page. In the beginning of each new chapter, the figure will be reviewed to pinpoint the location in the storyline.

First, in chapter 2, the research design formulates the main issues, objectives and questions of the report. Chapter 3 gives a general description of the company Heineken to inform about products, the basic figures and the organizational structure. The fourth chapter provides a detailed description of the Heineken supply chain. This description represents the current situation. Not only is it important to understand the logistical, planning and production processes throughout the whole supply chain, but it is also used to compare the effects of PTT later in the report. Chapter 5 focuses on a specific part of the supply chain, packaging. The issue and effects of having higher demand than capacity in packaging is discussed here in detail. HNS would like to resolve that issue with the implementation of Production Time Tables. Chapter 6 describes how PTT creates the opportunity to increase maximum capacity within production and how the concept works. The positive expectations of PTT are described. The origin of the possible disadvantages is highlighted here as well. Referring to the current supply chain, there is an expected impact on customers when PTT is introduced. To learn more about the perceptions and expectations of PTT, chapter 7 describes the results of various interviews with representatives of all customer markets. These results are used in chapter 8 and 9 where the expected impact on customer inventory and their responsive behavior are shown. Together, these two chapters basically form the disadvantages of PTT. The responsive behavior in chapter 9 will be discussed with the use of theories from literature. Finally, chapter 10 gives conclusions and recommendations based on the research design, the advantages and the disadvantages of PTT.

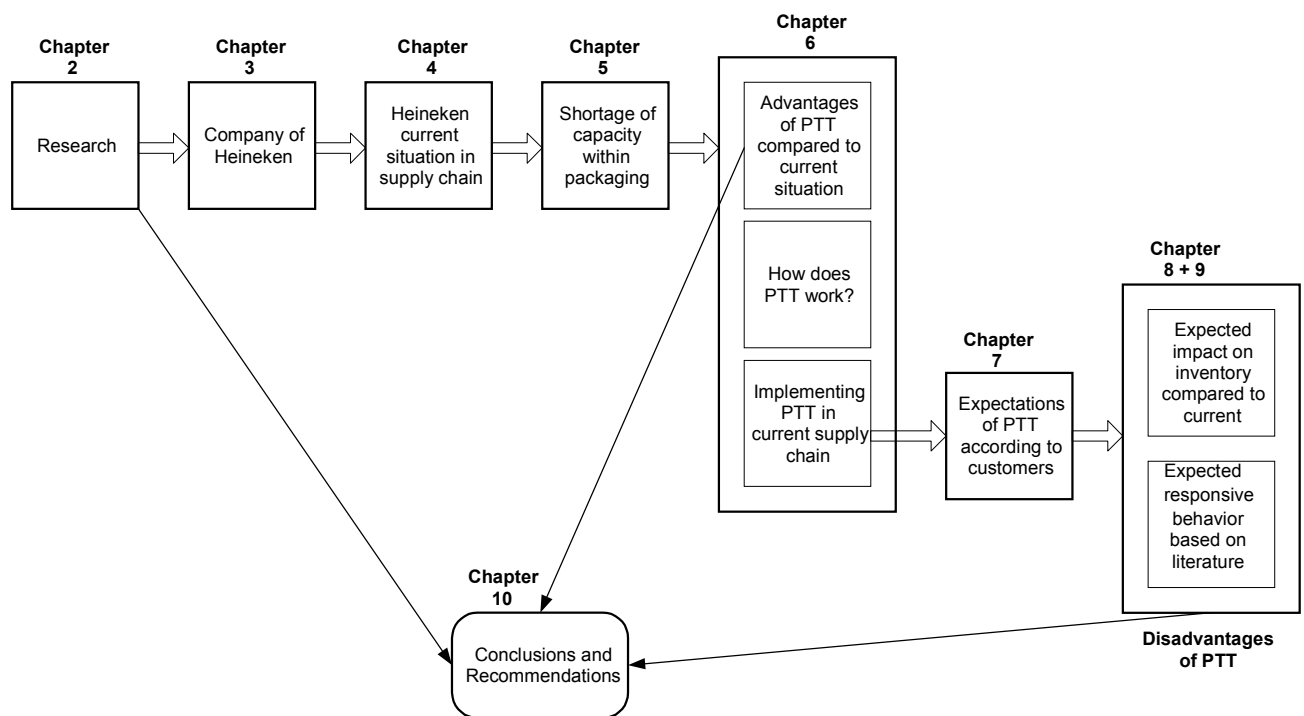
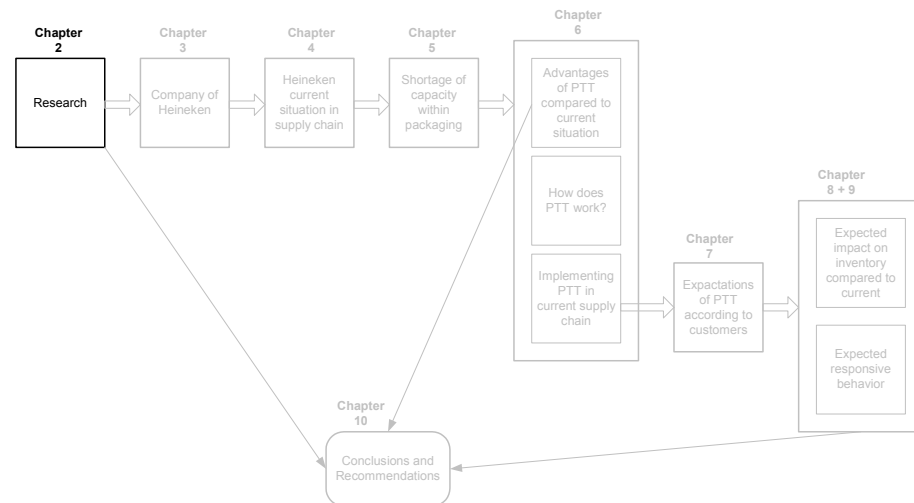


Figure II, Visualization of the outline of the report

2. Research Design



This chapter will explain the research performed in this report. Continuing with the problem formulation of the previous chapter, the company and research objectives are described. The central question will be divided in research questions that can be answered at the end of the report with the found results. Afterwards, a delineation of the research is discussed to communicate boundaries for the research. The data that is needed to answer the research questions is obtained in different ways, which are discussed in this chapter as well. Finally, the initial expectations of the research are communicated.

This research design is the jump-off point for the research. The first chapters will give more insight in the supply chain as well as in the problem. If any new views are found, the research design can be adapted later in the report in order to reapply the focus of this research.

2.1. Company and research objective

The planned research is conducted in order to represent and quantify the consequences of Production Time Tables for parties other than the initiator of the project. The initiator is the production organization Heineken Netherlands Supply and especially Demand & Supply Management. HNS and D&SM will be used interchangeably as the production organization of Heineken and as responsible party for optimizing the entire supply chain. The research objective can be derived from the company (HNS/D&SM) objective.

This company objective is:

“To remain the sustainable, preferred supplier for our existing and future customers by providing the right product with the right quality/volume at the right time in the right place at the best price by:

- *Being first in class for productivity*
- *Delivering lower transfer prices*
- *No out of stocks at customer level whilst reducing working capital*
- *Being the best in class for New Product Introductions (NPI) on cost level and time to market”*

(Lunchmeeting D&SM, 2006)

The research objective is:

Provide Heineken Netherlands Supply with an overview of the effects that Production Time Tables will have on the customer and of their expected responsive behaviour.

The connection between the research and company objective is that the introduction of PTT will improve productivity and save costs in production. The advantages of the project seem promising. The expected situation for/with the customer is unknown. Higher prices, out of stocks and/or longer times to market would be in conflict with the company objective. Remaining the sustainable preferred supplier may neither be jeopardized. HNS wants to avoid a discussion with the customer at the implementation of the project. HNS wants to get a step ahead of the customer's reaction. Having a research with the expected impact makes HNS prepared for customers that are afraid for the new project and claim enormous disadvantages.

The research objective consists of several sub objectives that can be seen as mini results during the research in later chapters.

1. A visualization of the Heineken Netherlands Supply supply chain
2. An overview of the customers that are affected by the implementation of Production Time Tables.
3. An overview of the perceptions of as many customers as possible
4. A tool that is able to give an indication of the effects on customers for different situations/scenarios.
5. An expectation of the responsive behavior of customers based on distribution channel relation theory.
6. A list of conclusions and recommendations for the management team of HNS about (the impact of) Production Time Tables.

2.2. Central and research questions

Now that the (sub)objectives are formed in the previous paragraph, it is possible to determine the central and research questions. The central question for this thesis is:

What will happen in the outbound supply chain for customers and with customer response when the production organization of Heineken implements Production Time Tables?

The answer to the central question can be found by answering several research questions. The methods and techniques to find this answer are indicated per question.

1. *How is the supply chain and logistic organization of Heineken currently constructed?*
 - Analysis of internal Heineken documents
 - Analysis of other thesis reports about Heineken
2. *How does the concept of Production Time Tables work?*
 - Interviews with several initiators of the project within Heineken
 - Review of internal presentations from consultants
3. *What are the parties in the outbound supply chain that will be influenced by an implementation of Production Time Tables*

- Making combinations of products, volume and customers/countries from internal Heineken data.
4. *How can these parties be approached and interviewed?*
 - Making general questionnaires
 - Ask Heineken colleagues to recommend 'experts'
 - Get approval from HNS to contact customers
 5. *What do the various parties think of Production Time Tables and what do they expect of its effects?*
 - Face-to-face interviews
 - Teleconference
 - Email
 6. *What are the indicators that represent the influence on customers?*
 - Supply chain literature review
 - Derive from the answers of interviews
 7. *What methods can be used (from literature) to measure the indicators?*
 - Inventory/supply chain literature review
 - Internal Heineken calculation methods
 - Small scale scenario modeling (Excel)
 8. *What data about the identified indicators can be collected and used from available (Heineken) sources?*
 - Scan Heineken internal server (Strategic Supply Chain Planning)
 - Ask supervisors to provide certain information from SAP Business Warehousing
 9. *How much/little can the indicators in the outbound supply chain change when Production Time Tables are implemented?*
 - Excel calculation
 10. *What does literature say about the reaction on Production Time Tables that can be expected from the involved customers?*
 - Marketing channel relationship literature
 - Service quality literature
 11. *If applicable, what needs to be changed in the Production Time Tables project in order to minimize costs in the entire supply chain?*
 - Review of the found information
 - Communication and discussion with management

2.3. Delineation of the research

To avoid unnecessary complexity and an unstructured research, not all activities and operations of HNS will be taken into account. To understand where the focus of the research lies, this paragraph will pinpoint the most important delineations of the research.

2.3.1. Breweries in the Netherlands

HNS operates with three breweries in the Netherlands. The management team of HNS is interested in the consequences for products produced in the Den Bosch brewery only. Den Bosch is specialized in the small batch packaging. The brewery in Zoeterwoude produces the large-volume products in very big batches where Den Bosch has all the smaller markets.

2.3.2. Products from the production line

Furthermore, the focus of the project is only on the supply of cans and one-way bottles (not returnable). Kegs, Draughtkeg, Beertender and returnable bottles are not taken into account, because no PTT will be produced for these packaging types yet. This focus means a total volume of XXX million hectoliters. The total packaging output of Den Bosch is approximately 6.5 million hectoliter (Annual Report, 2006).

2.3.3. Heineken supply chain

The main focus for this research is on the outbound supply chain. The brewery is responsible for supplies, brewing and packaging. Production Time Tables will have consequences for the internal processes. These effects within the brewery are not in focus for the research, because those factors are intensively analyzed and quantified by CDL. Constructing a timetable is not the assignment for this thesis. The assignment is to find out how customers are going to respond and what consequences there can be expected. These processes play in the outbound supply chain. In most cases, it is unknown how a HNS customer resells and distributes the products. Because HNS supplies so many different customers from Den Bosch (334!) and every customer has his own distribution network, it would become too complex to take the complete distribution network and supply chain into account. For that reason, the supply chain until the customer's storage point is considered in the research. Any negative effect on the customer is considered impossible to forward further into the market.

2.3.4. HNS Customers

Throughout this thesis the expression 'customer' will be used for the customers of HNS spread over the entire world. The customer is the reselling party to whom HNS supplies. Most of the customers are the nation's specific Heineken distributor. The international customers are in many cases (partially) Heineken owned. Others are independent organizations with exclusivity rights for Heineken distribution. The customers are located over the world. It will be almost impossible to understand and take into account every specific situation of all customers. That is the reason for an assumption. The assumption is that there does not exist a physical constraint for storing additional product in the market. Increases in inventory will cost money, but are physically possible.

2.4. *Obtaining data for the research*

In order to perform the described research, information/data is needed. This information can be found in different ways. Baarda and de Goede (1995) describe three ways to obtain data.

1. Usage of existing information
2. Obtaining data through observation
3. Obtaining data through written or oral interviews

Existing information is used frequently. Most data is accessible on the internal server or by an employee of Heineken. The exact location of the used files is indicated in the List of Reference. In most cases, the Heineken supervisors were able to help to find the existing data on demand. For example, if information was needed on the sailing times of vessels to certain countries, the supervisors were able to identify the location of the data or point out the Heineken employee that possesses that data. Obtaining data by observation will not be used in this research where the research is about a future project that has not been implemented yet. Interviews will be held to gather information from customers and HNS employees. Because the project of Production Time Tables has not been communicated during the graduation period, there was an extra challenge to find data about a subject that the customer was not aware of. Chapter 7 will provide all details about the interviews. Additionally, data on several items was found through literature review. The most useable literature was found in (marketing) distribution channel theories. As mentioned before, the responsive behaviour of customers can be matched with this section of science. Other areas of literature review are supply chain management, logistic concepts, Economic Lot Scheduling Problem, statistical inventory control and inventory management.

2.5. *Initial expectations of the outcome*

Three initial expectations can be made for the effect on the outbound supply chain with different timetables.

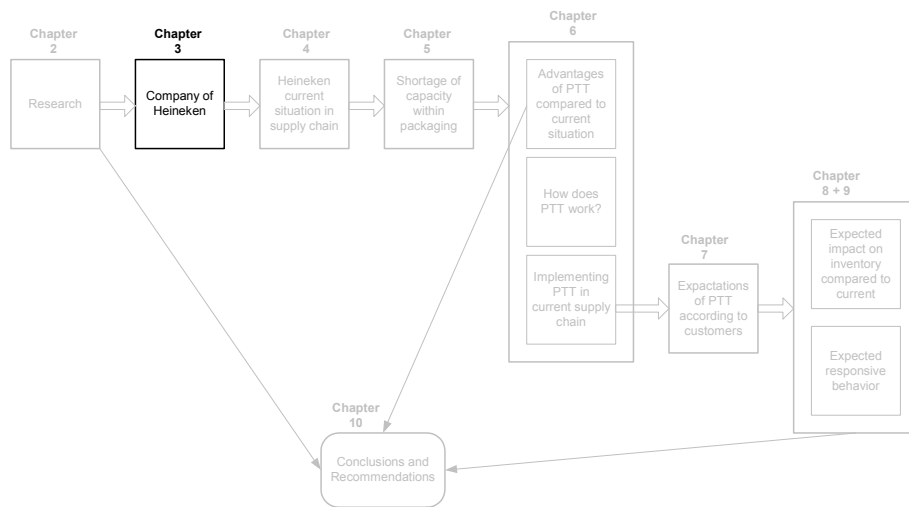
1. Some products will be produced in every week. If only this production cycle is implemented, no negative effects will occur for the customer. There will be no change in the order lead-time. Inventory will be the same as before. It is not likely that all products will be produced this often, because there will be no efficiency gains compared to the current situation.
2. If a timetable proposes larger batches and larger time intervals for certain products, the customer's inventory for this product increase and the freshness of the product will become lower. The customer also has to manage the fact that if sales suddenly increase, he depends on the week number where his product is made again to accommodate this extra demand. The product cannot be produced every week.
3. Currently, a customer can choose his own ordering moment. It will be equal throughout the year independent of his ordering frequency or productsize. In the situation with Production Time Tables, each product will only be produced in fixed weeks for example in week 4,8,12,...etc. A customer with an even lower order cycle that wants his product to be made in week 5 and 10 etc. will also experience difficulties.

From these initial expectations, a first sign of possible disadvantages of the timetables for the customers can be identified. Whenever a product is produced less often than every week, a customer can be confronted with reduced responsiveness. Even if a customer always orders every three weeks (as before the timetables), he cannot choose his own production moment. This means that the customer cannot always perform a quick adaptation if sales suddenly increase. He has to wait for the following production moment. Without the timetables, his product can be produced weekly and receive his product in his warehouse within a fixed lead-time². Depending if batch sizes and time intervals will become larger than before, inventories of the customers are expected to increase, what also means that the average freshness of the beer in the market will decrease.

In order to know if these expectations can form actual disadvantages for the project, more research needs to be performed. That research will come forward in this report. A more in-depth analysis of Heineken and its supply chain is needed to understand where the issue plays before any of these expectations can be confirmed or declined.

² Lead-time (APICS dictionary): A span of time required to perform an activity. In a logistics context, the time between recognition of the need for an order and the receipt of goods

3. Company of Heineken³



This chapter generates a general introduction to the company of Heineken. The next chapters will become more specific. The history, products and structural organization are described as background information of the company that is the centre of this research.

3.1. *Heineken's history*

In the year 1864, Gerard Adriaan Heineken became owner of beer brewery “Den Hoybergh” in Amsterdam. He wanted the steam driven brewery to become a cost effective enterprise and wished for a beer of constant quality. His insights helped the brewery to expand quickly; in 1868 a new brewery was opened at the Stadhouderskade in the centre of Amsterdam. At the end of the 19-th century, a new sort of brewer's yeast was successfully introduced in Germany; Heineken soon understood the importance of this new yeast and started to produce lager. Because of this decision Heineken quickly expanded. Heineken, who always thought about innovations and ways to achieve constant quality, started to work on his own yeast. In 1886 a student of Louis Pasteur developed Heineken's A-yeast, the yeast that even nowadays forms the basis of Heineken Beer. In the beginning of the 20th century Heineken was still growing fast and after taking over a few competitors in the Netherlands starts to focus on export. Europe is the logical market to explore, but as prohibition ends in the United States of America, Heineken is one of the first to enter this market. Because of the quick reaction Heineken achieves big successes. A Heineken beer in New York became available in 1933 and still is today. Through the years Heineken keeps expanding its markets and expanding its capacity. In 1958 Heineken starts a new brewery in Den Bosch. In 1968 the merger with the biggest Dutch competitor, Amstel, is settled. After this merger Heineken opens a big new brewing complex in Zoeterwoude in 1975, from now on this location will be, besides a brewery, the accommodation of the head office of Heineken Netherlands. In 2006 Heineken is the most international beer brand of the world, being available in 180

³ All information about the history, products and organization of Heineken comes from the Heineken Annual report 2005, Heineken intranet, internal Lunch meeting presentation and from ‘Nieuws and Geschiedenis’ on www.heineken.nl.

countries. With total sales over the world of 118.6 million hectolitres in 2005 Heineken has become one of the leading beer companies of the world.

3.2. *Heineken's products*

The most important international brands are Heineken and Amstel. The Heineken brand is the most international beer brand in the world and leading brand in Europe. Resulting from its quality and its image, Heineken beer can be positioned in the financially attractive premium segment of the beer market. Amstel, Europe's third largest beer brand, usually is positioned in the standard segment; the voluminous and middle prized part of the market. These international brands are completed by regional brands and an assortment of special beers like Wieckse Witte (blonde beer for the Netherlands), Morretti (Italy), Kalik (Bahamas), Star (Nigeria) and Tiger (Asia).

The domestic and international portfolio of Heineken exists of 50 different kinds of beer. The beer types can be packed in primary packtypes like kegs, cans, one-way bottles and returnable bottles and in numerous sizes. Secondary packtypes like 6-packs, 8-packs, 12-packs, crates and loose boxes make the variety even larger. Some distributors want to have their own name on the label of the beer to prevent parallel import and all over the world governments demand to have different regulations and/or warnings on alcoholic beverages. Every specific feature needs to be taken into account and makes this complexity even larger. With all the differences in the packaging process, the total number of Stock Keeping Units (SKUs), which are produced in the breweries in the Netherlands, is more than 750. The term SKU is defined in APICS dictionary (1987) as: "An item at a particular geographic location. For example, one product stocked at six different distribution centres would represent six SKUs, plus perhaps another for the plant at which it was manufactured". Heineken uses the term SKU a little differently. Heineken considers a SKU as an item with the exact same characteristics (same materials, same printings), but independent of the geographic location. In the rest of the report, the term of SKU will be used in the Heineken understanding to avoid confusion. Creating an efficient supply chain with so many different products and always trying to keep service and quality high is a constant challenge.

The production of beer takes place in three different breweries; this is the brewery in Zoeterwoude, one in Den Bosch and the much smaller Brand brewery in Wijkre. The breweries in Zoeterwoude and Den Bosch are the most important ones; together they have an annual capacity of approximately 16 million hectolitres. This is more than 3 billion pints of beer per year.

Beer can be placed in the food processing industry described by Soman (2005), where a very competitive supply chain, a large number of products, varying logistical demands and specific packaging exists. Beer also has a limited shelf life⁴ (expiry date), because it is brewed with natural ingredients and through a biological process. Unlike other food products, beer will not become dangerous to drink after expiration. Only the taste can deteriorate, due to the oxidation in the bottle and biological reactions under sun or artificial light. Furthermore, there is sequence dependency in

⁴ Shelf life (APICS dictionary): The amount of time an item may be held in inventory before it becomes unusable.

packaging, where not all products have the same changeover⁵ times. Changing a run on a production line from product A to B can be much more time consuming than changing from B to C.

Finally, beer has certain seasonality⁶. Warm weather increases the sales of beer. Summer is considered as peak season. The effect for Heineken is that summer months are busier and create a higher demand for production output than winter months.

3.3. *Heineken's organization*

This paragraph starts at the top of the hierarchical structure of the organization and works its way down, zooming in on relevant departments for this thesis.

3.3.1. *Heineken N.V. Corporate*

Heineken N.V. is the umbrella organisation of all Heineken activities and consists of different subsidiary companies. The structure of top management has been drastically changed in the last few years. The executive board only consists of two members instead of six in the past. In Appendix A, all relevant organizational structures are shown.

In this thesis the main focus will lie on products made in the Netherlands. The Netherlands is represented within Heineken Western Europe. The beer that is exported from the Netherlands is sold to the customers around the world. These customers are divided under five different regions. Heineken Netherlands represents all Heineken's activities in the Netherlands. Within Group Supply Chain, there is a sub-unit of Supply Chain Services. This department is responsible for support in supply chain issues. One of these departments is Corporate Distribution Logistics (CDL).

3.3.2. *Heineken Netherlands Supply*

Heineken Netherlands Supply (HNS) is the logistic and production organization of Heineken Netherlands. HNS is responsible for the total supply chain of beer produced in the Netherlands; this includes production, purchasing, distribution, warehousing and planning and scheduling. The objective of HNS is to optimize the total supply chain. They want to do this by assigning resources in such a way that they become the best in class by achieving the highest service for the lowest cost.

3.3.3. *Heineken Demand & Supply Management*

Within HNS, Demand & Supply Management (D&SM) fulfills a central role in the supply chain and takes responsibility for managing it. The organizational chart of D&SM is placed in Appendix A as well. D&SM manages the supply chain to all sales organizations of the five regions, including the domestic one. This means that most

⁵ Changeover (APICS dictionary): The refitting of equipment to either neutralize the effects of the just completed production, to prepare the equipment for production of the next scheduled item, or both.

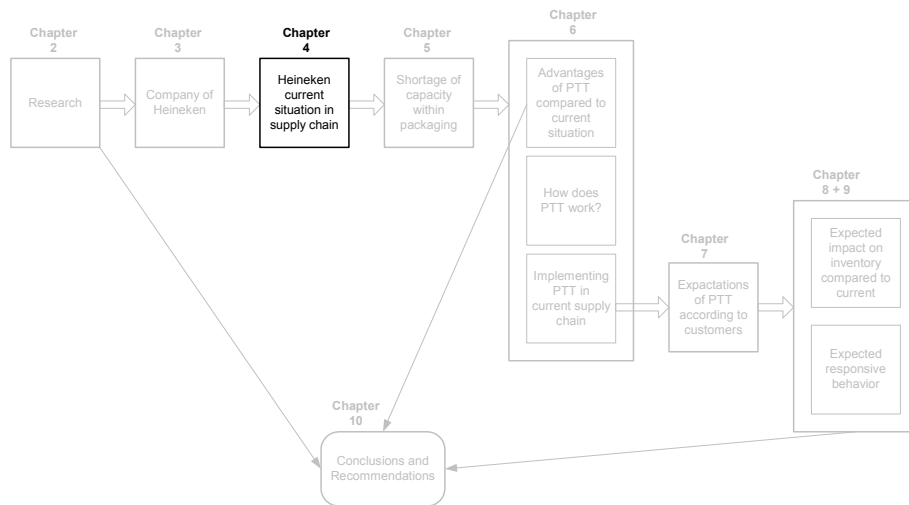
⁶ Seasonality (APICS dictionary): A repetitive pattern from year to year with some periods considerably higher than others.

part of D&SM deals with systematically managing the suppliers, the brewing process and the distribution. The primary objective of D&SM is the realization of an optimized supply chain by being cost-efficient and maintaining a high service level to the customer (detailed objectives in Appendix B). D&SM consists of multiple sub departments that translate demand into supply. These departments are responsible for the long Strategic run (3 year – 1 year plan), medium Tactical run (3 month – 4 week plan) and short Operational run (1 week – 1 day plan). Finally, each of the regions has its own account manager within Market Supply Management (MSM) who is responsible for the supplies to the specific market.

This research is conducted at Strategic Supply Chain Planning. The assignment is given by D&SM. As mentioned before, HNS and D&SM are used interchangeably.

The basic structure of the organization and the portfolio of products have been described in the above paragraphs. The focus of this thesis lies at the Dutch production of beer and its supply chain. To understand more about the different chains within Heineken, the next chapter will focus on the Heineken supply chain.

4. The Heineken Supply Chain



Before focusing on specific departments within the supply chain in the next chapter, first the current situation in the whole supply chain needs to be reviewed to understand where the most relevant pieces for this research are located. Also, this information is needed to have enough knowledge to understand all other chapters. First, the general logistic structure will be discussed. Next the supply chain will be matched with the functional areas from the logistic structure. Heineken utilizes three different logistical concepts. Each logistical concept is visualized and discussed. The difference between the concepts is explained with the position of the so-called Customer Order Decoupling Point. After discussing the different flows of goods through the supply chain, the flow of information will be explained as well. An important process within the flow of information is the planning process. This process and its steps will be discussed at the end of this chapter together with the ordering process of the Drumbeat.

4.1. *Three functions of the logistic structure*

In 't Veld (1996) explains that a company or system can have three basic functions, input, throughput and output. This means that a company receives items and sends items out which represents the customer and supplier function. Bowersox (1996) also distinguishes three similar functions within a system. These functional areas within a company can be named after this approach: procurement, production and physical distribution. These functions are the logistical structure.

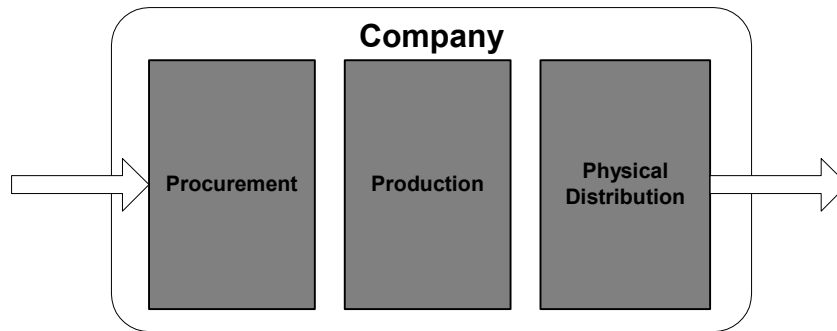


Figure III, Logistical structure with functional areas in a company (Bowersox, 1996)

Procurement is the company's function that arranges all incoming materials that are used internally for the other two functions. The Production area contains all the activities around production of items. The sales and distribution of the produced items to the customers are performed in the last functional area, Physical Distribution.

4.2. Procurement, production and physical distribution at Heineken

The supply chain is the chain linking each element of the production and supply process from raw materials to the end-customer (Scott, 1991). The supply chain travels through the same functional areas as described above. Coyle (2003) gives a general overview of a supply chain. Combining Coyle with Bowersox from the previous paragraph, the three functional areas can be combined with stages in the supply chain as shown in figure IV.

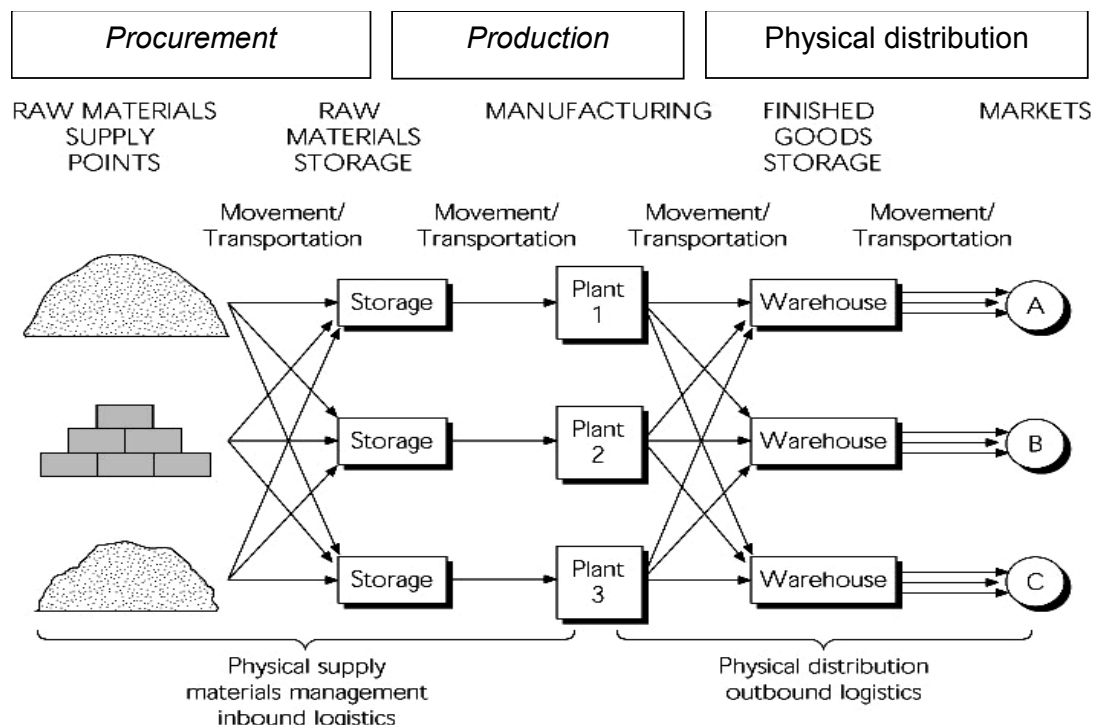


Figure IV, Visualization of logistic structure of Bowersox (1996) and a supply chain according to Coyle (2003)

The same patterns can be identified in the Heineken supply chain. Procurement and production in the supply chain can be summarized as follows.

The flow starts at the raw and packaging material suppliers who send empty cans, corrugated paper, malt, bottles etcetera to the breweries. These items are stored as raw materials and packaging materials. Depending on the circumstances, these stocks are kept as low as possible. Preferably, materials are stored at the supplier in order to avoid holding costs at the own company, but still keeping the advantage of having materials directly available.

Production basically exists of two parts, brewing and packaging. The process of brewing takes between two and four weeks time. This is the process where malt, water, hops and yeast are brewed into beer. After that, the beer can only be stored for a few more days until it is packaged. The packaging department uses the beer (Heineken, Amstel, Amstel Light, Wieckse Witte etc.) to fill cans, kegs, returnable bottles, one-way bottles or so-called Personal Draft Systems (PDS) like the kegs for Beertender® and Draughtkeg®. After the products are packaged, they are either stored on location or directly “cross-docked” in the container. Cross-docking is the process where pallets of products are placed directly from the conveyor into a container to be transported to the harbor. Local storage in Zoeterwoude means that the products are stored on premises of the brewery. In Den Bosch, an external company called Exel manages the storage in external buildings close to the brewery.

Connecting the last functional area, physical distribution, to the supply chain, can be combined with explaining the different logistical concepts.

4.3. *The three logistical concepts of Heineken*

Within the supply chain of Heineken a few differences can be determined in the form of three logistical concepts. It is important to understand these different concepts, because they will be used regularly in this report.

1. Make To Order (MTO)
2. Make To Stock (MTS)
3. Replenishment

Before explaining every concept, the Customer Order Decoupling Point is discussed first. This point distinguishes the concepts from each other.

4.3.1. *Customer Order Decoupling Point (CODP)*

The difference between MTO and MTS/Replenishment can be described in the location of the Customer Order Decoupling Point (CODP). Hoekstra and Romme (1992) describe the theory behind the CODP. The CODP is located at a storage point and separates the order-driven activities from the forecast⁷-driven activities. Production orders of MTS items are controlled by D&SM and are forecast-driven from the market. The production orders for MTO are ‘given’ by the customer and are order-driven. Replenishment is basically MTS with external stock further into the market. This moves the CODP for Replenishment further downstream the supply chain. In the following paragraphs the CODP will be shown per concept with a thick dotted line.

⁷ Forecast (APICS dictionary): An estimate of future demand.

4.3.2. Make To Order

Make To Order (MTO) is the first logistical concept to be discussed. MTO is when D&SM produces exactly what the customer orders. Heineken customers throughout the world use this concept.

The customer orders are transformed to production orders (if there are multiple customer orders for 1 SKU, they are placed together in one production order) and produced in one of the breweries. Next, the production order is split over the original customer orders and transported to the harbor where a container vessel will transport the order to the country of the customer. The final piece of the supply chain (of physical distribution) is not shown clearly in figure V. This has to do with the delineation of the research, which is mentioned earlier. The last piece of the chain can vary too much from country to country or from customer to customer. The actual consumers are somewhere at the end of the chain. Per country there can be one or more distributors. The distributor is Heineken's customer. The customers combine all demand from parties further in the chain and constantly communicate this with the Planning department (see paragraph 4.4).

The CODP for MTO markets is on the beer storage, in the functional area of production. The part of production until packaging (brewing and procurement) is done on forecast. The second part is based on the customer order.

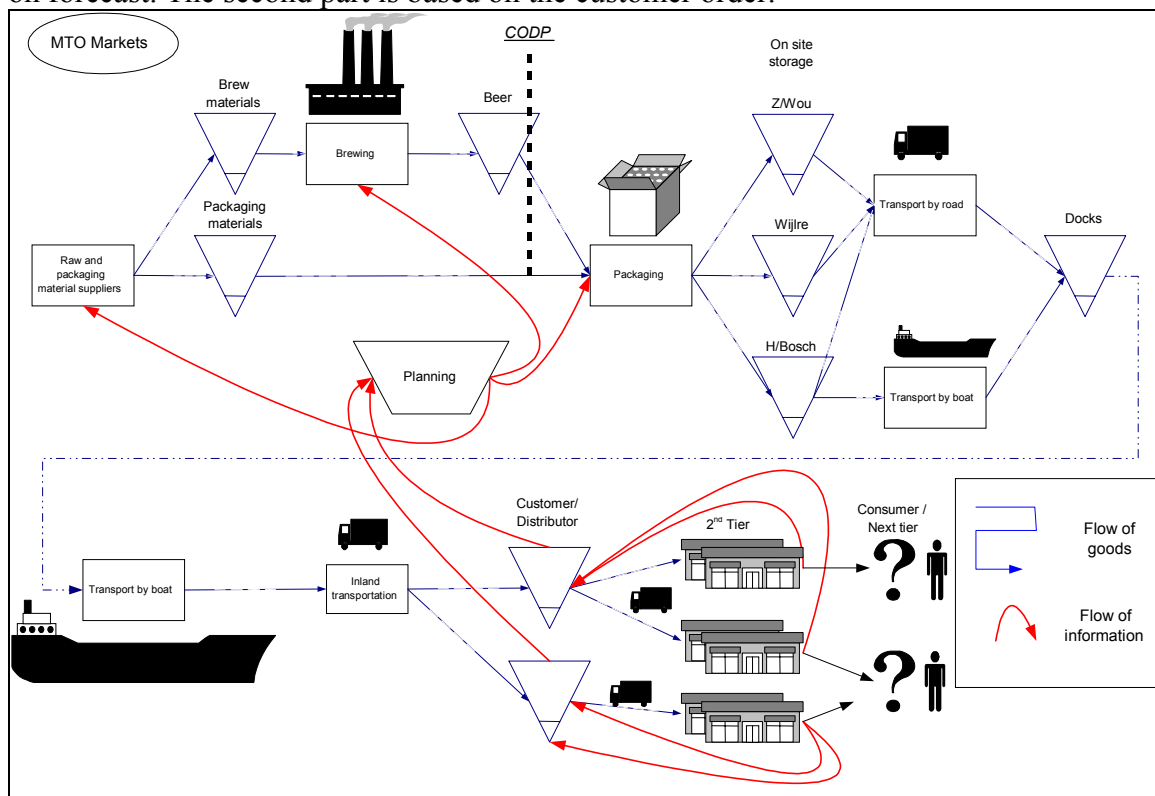


Figure V, Visualization of flow of information and goods in MTO markets

A note needs to be made about the term MTO that is used by Heineken in this case. The APICS Dictionary states, "Where options or other subassemblies are stocked prior to customer orders arriving, the term 'assemble to order' is frequently used." Whereas the packaging materials and beer is already stocked before the arrival of actual orders, the classification of MTO can be questioned in the case of Heineken.

However, in the rest of the research this concept will be referred to as MTO to keep in line with Heineken company understanding.

4.3.3. *Make To Stock*

Make To Stock (MTS)⁸ is the concept where D&SM produces to keep stock at a certain level. D&SM is the owner of this stock and it is located on or near one of the breweries. It is kept at a level that will accommodate demand for these specific products. This concept handles a very short customer order lead-time. Order lead-time is the time that goes by between the moment that a customer places an order and the moment that the customer receives the goods (Goor et al., 1996). MTS is used for the domestic market and for a very small percentage to European customers like Country A (approximately 1%). The share of MTS that is used for export can be neglected. For the (domestic) MTS market, Heineken has one customer. This customer is called “Heineken Brouwerijen” or HB. It is a confusing name whereas it’s a customer and not a production entity. The demand from the market is combined by a special department in HB and processed within Planning (see figure VIII).

As shown in figure VI, there is a different distribution for MTS on-premis (hotels, bars, restaurants) and MTS off-premis (supermarkets) sales.

The on-premis markets are served with the use of so-called regional sales units. There are 9 of these distribution centers in the Netherlands. Bars and hotels throughout the Netherlands place specific orders at their nearby unit. The units communicate their demand with HB. The units can be seen as another MTS storage point where clients get their products from HB. HB receives the products from their supplier D&SM. Draft beer is supplied directly from the brewery and is called tank-beer. This ‘product’ is not packaged. It is transported in tanker trucks directly from the brewery to the tanks in the cellars of a client.

For off-premis markets like supermarkets, the demand of each store goes to the distribution center (DC) of that supermarket. These DCs translate the orders into demand and communicate this with HB. Within a day or even in a couple of hours, the clients (supermarkets) of the customer can receive their beer on the desired location. The supermarkets DCs are directly supplied from one of the breweries.

The consumer buys the beer in the bar (on-premis) or at the supermarket (off-premis). MTS has its CODP at local storage. The whole functional areas of production and procurement are based on forecast. Only the physical distribution function is based on customer orders.

⁸ Make-To-Stock (APICS dictionary): A product, which is shipped from finished goods, ‘off the shelf,’ and therefore is finished prior to a customer order arriving.

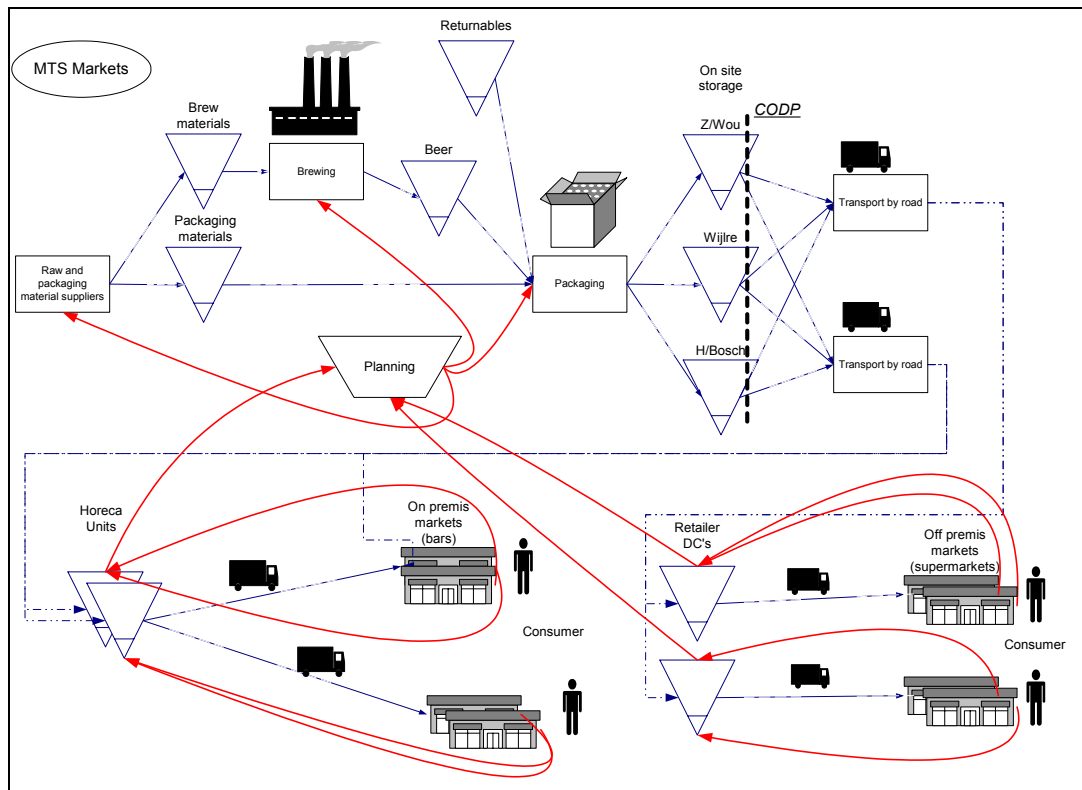


Figure VI, Visualization of flow of information and goods in MTS markets

4.3.4. Replenishment

Replenishment is much like MTS. The difference is that the inventory is located in a different country, in the customer's warehouse, which is called a Demand Point (DP), and is property of the customer. For these markets (with mostly large volumes) like Country C and Country B, D&SM provides advice on how much stock the customer should hold in its inventory. Based on that knowledge, D&SM creates production/customer orders. Figure VII gives a good visualization of replenishment.

The concept that Heineken calls Replenishment can be compared in literature with Vendor Managed Inventory (VMI). Goor and Amstel (2001) write that VMI means that the supplier is responsible for inventory management with the customer and therefore decides when and what product is send to the customer. VMI can also be described as: "A means of optimizing Supply Chain performance in which the manufacturer is responsible for maintaining the suppliers inventory levels. The manufacturer has access to the suppliers' inventory data and is responsible for generating purchase orders" (www.vendormanagedinventory.com). D&SM uses this concept in order to optimize its own production and use a constant production capacity. This is explained in the following paragraph.

Difference with MTS is that Replenishment has the CODP on the stock in the DP, which means that it is placed further into the physical distribution function. Customer orders are taken from the DP, but the whole process before the demand point of procurement, production and a part of the physical distribution is based on forecast.

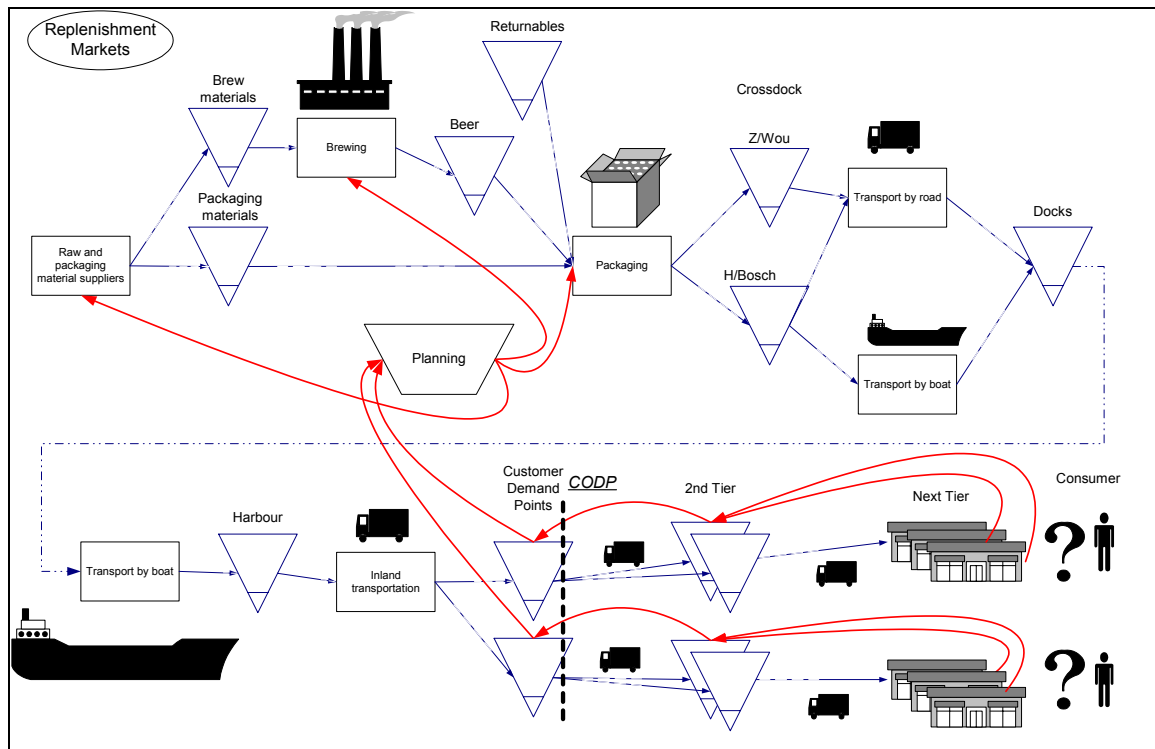


Figure VII, Visualization of flow of information and goods in Replenishments markets

As mentioned before, beer is a seasonal product. More beer is sold in summer months. To prepare for this peak, D&SM produces more than demand in the first part of the year, filling the warehouses of the customer. In summertime, demand can exceed maximum capacity for some customers, but D&SM doesn't need to produce more than in the beginning of the year, because the earlier produced buffers in stock are used. This process of buffer storage can be compared with 'peak shaving' in the energy sector. Peak shaving can be defined as: "Using other sources.... from storage, to supplement the normal amounts delivered to customers during peak-use periods. Using these supplemental sources prevents pipelines from having to expand their delivery facilities just to accommodate short periods of extremely high demand" (<http://www.cc.state.az.us/utility/gas/terms.htm>). The same is done by D&SM with products to customers with extreme high demand seasons. The overcapacity from low season periods is used as an extra source to supplement the demand in high season period to prevent extra investments to increase maximum capacity. The overcapacity in low season is used to build up stocks for high season. This process is an advantage of the replenishment concept.

Just as for the MTO markets, it is not possible to visualize all the possibilities of the final pieces of the Replenishment supply chain. The supply of the Country A market can differ from other replenishment markets like Country B, C or D. In the Country A for example, the Demand Points each supply a certain number of tiers who supply a third party before it can be sold to the consumer. This is regulated by the "three-tier control system" where the sales of alcoholic beverages have to follow three stages. This ensures that a producer of alcoholic beverages cannot sell directly to the consumer. More information can be found via the link of Texas Safety Network in the List of Reference.

Soman (2005) describes the many different ways of choosing why a product should be produced with MTO or MTS based on literature references. It can be decided per product, per group of products or per customer. Heineken decides per customer to

produce a portfolio of products via MTO or MTS/Replenishment. If a customer's annual volume is larger than a certain amount of hectoliters and the market is stable enough, D&SM can decide to manage the customer's inventory according to the replenishment system. Customers with a smaller, stochastic demand are supplied according to the MTO concept. MTS is used for domestic products only, to provide the shortest lead-time and maximum flexibility to the customer (and their clients). Large customers as Country D are supplied via Replenishment to optimize production and use the advantages from the concept of 'peak shaving'.

4.4. Process of planning and the Drumbeat

In the three figures above, the process of "Planning" always translates the information flow of demand from the markets to procurement and production. Planning is a needs of procurement (materials) and needs of production (packaged beer).

In figure VIII, an overview of this process is shown. In this section, a description is given of what the activities inside the process of planning for the short and mid-term following the structure of the figure. The output of this process is send to suppliers, brewing and packaging (procurement and production). Also, the long term planning process will be discussed as well as the Drumbeat, a step-by-step plan how Heineken handles orders.

4.4.1. Short and mid-term planning

First, all demand information from the market comes to Demand Management. Demand Management is a group of departments that processes the information from the demand throughout the world. There are various locations in the world where these types of departments are situated. The information that the department receives from the markets consists of expected growth or decline in market shares, promotions, regular volumes, price increases etc.

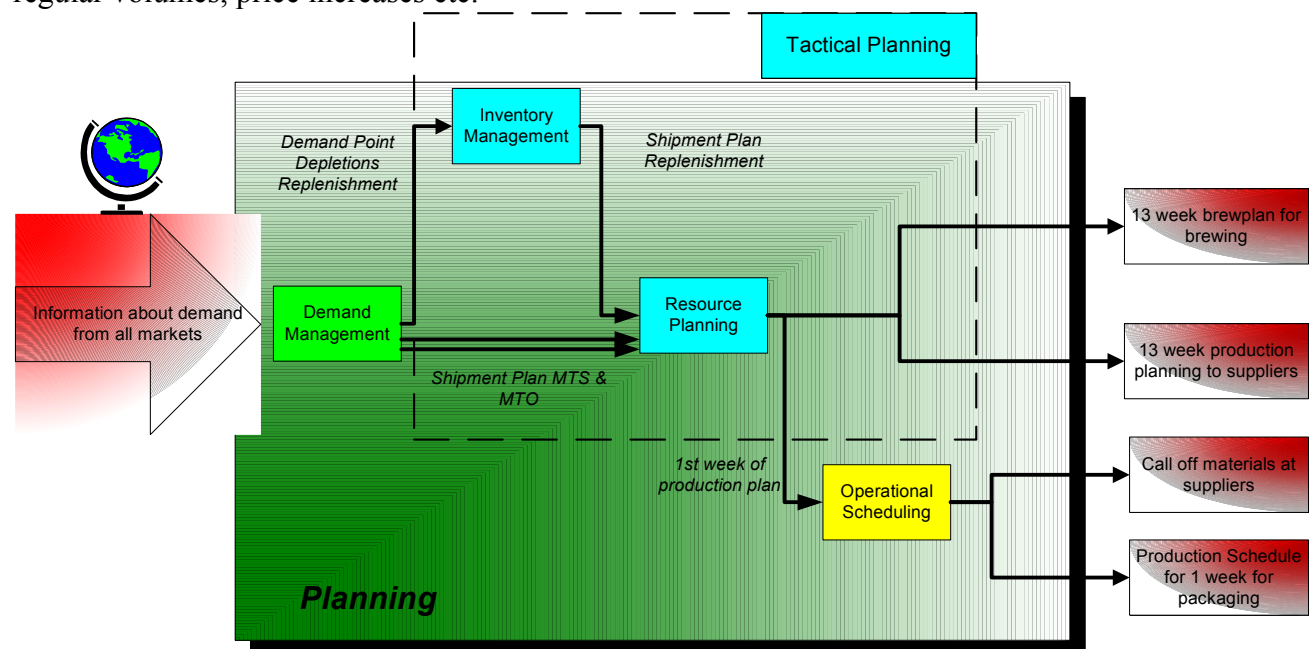


Figure VIII, Process of Planning from information flow to orders and plans

Demand Management processes the information from MTO customers into a Shipment Plan MTO. This Shipment Plan indicates, based on the actual customer orders and forecast, in what week, how much of what product needs to be shipped.

For the MTS market, Demand Management combines the demand from on-premis and off-premis markets. Based on this calculation, an expected depletion of the local (MTS) stocks is made. This is the MTS Shipment Plan. It indicates in what week, how much of what product is sent from the local stock to the different units or supermarket DC's.

For Replenishment markets, the Demand Management departments translate information into so-called Demand Point Depletions. These numbers show how much of which product is expected to leave the various Demand Points throughout the Replenishment markets in the world in a certain week. This information is similar to the MTS shipment plan, but for a lot of different storage points (Demand Points) in the world.

Because the Demand Point Depletions contain information about so many Demand Points, they are sent to Inventory Management. Inventory Management is a part of Tactical Planning that receives all depletions from the Demand Points in Replenishment markets. D&SM has agreed with the various Demand Points to give advice on stock levels. These levels have to be kept between minimum and maximum stock, preferably on target stock, all agreed upon with the customer. This is different than the description of a min-max system as described by the APICS dictionary (1987)⁹. Inventory Management decides when it is necessary to send a new batch of a certain product to a Demand Point. All the information together creates a Shipment Plan Replenishment. It states what the total quantity per product is that needs to be shipped from the brewery on a certain moment in time. The sailing time between brewery and Demand Point are always taken into account.

The three Shipment Plans for MTS, MTO and Replenishment are made every week for the upcoming thirteen weeks. The first two weeks are actual orders and the other eleven weeks can be seen as forecast. The Shipment Plans give a combined total volume per product per week that is desired. It is not detailed where everything is going. A customer in Japan, a customer in China and a customer in Taiwan can order the same product at the same time. For the brewery it is not important where a certain product is going to make a production planning. Here, the customer orders are transformed into production orders.

The 13-week Shipment Plans for MTO, MTS and Replenishment are sent to Resource Planning (another part of Tactical Planning). The Shipment Plan MTS is compared with local inventory. Resource Planning can make adaptations to the Shipment Plan MTS to determine the height of local MTS stock. This process is similar to what Inventory Management does with the Demand Point Depletions, but in the case of MTS it is relatively easy, because it is for local storage only. Now the three Shipment Plans contain the same type of information. All this information is combined into a total volume per product per week. This demand is translated into a 13-week production planning. For this planning, it is checked if all shipments can take place as desired using the maximum capacity of all production lines. The 13-week plan is sent to suppliers as a forecast for needed materials. Also, the planning is translated into a so-called brew-plan. The brew-plan consists of the required volume per beertype in a certain week for packaging. The breweries in the Netherlands produce around 50

⁹ Min-max system (APICS dictionary): A type of order point replenishment system where the 'min' is the order point, and the 'max' is the 'order-up-to' inventory level..... An order is recommended when the available and on-order inventory is at or below the 'min'.

different beertypes. Heineken and Amstel for example can both be brewed in 15 different types. A brew is a fixed volume that takes up the space of one full beer storage tank. This way the tanks are used as efficiently as possible. This results in the fact that a certain beertype is always brewed in a minimum quantity, that of a full storage tank (approximately 800 hectoliters). The interesting factor is that some beers need longer brewing time than others. Heineken beer is one of the most time consuming and takes 4 weeks before it is ready for packaging. This has to do with the biological process of brewing and the recipe of the beertype. From one beertype, many SKUs can be made. When the forecast of one SKU is too high, it will be compensated in most cases by another SKU which forecast is too low. The total volume of this specific beertype will stay relatively close to the total forecasted volume. Once the beer is ready, it needs to be packaged within a few days; otherwise the beer needs to be thrown away.

The first (upcoming) week of the 13-week planning (with actual orders) is sent to Operational Scheduling. This department makes sure that all products of the first week in planning are actually produced in the upcoming week. This means that the sequences and line occupations are planned in a Production Schedule and suppliers are contacted to deliver the right amount of needed materials (depending on the available inventory at the brewery) in the Call-off to suppliers. The day of the week and timing of actual packaging is mainly based on experience of the scheduling team. The scheduler tries to find the most optimal groups and sequences of products to place together on a packaging line. The main objective is to minimize changeover time between the products for the entire week. FAS (Fygir Advanced Scheduling) is a tool that provides help. This tool assists in finding an optimum in minimized changeover time between the desired productions for one week.

4.4.2. Long-term planning

Strategic Supply Chain Planning (SSCP) is responsible for the long and mid-term planning. In fact, SSCP receives the same information as Tactical Planning, but where Tactical uses this information every week, SSCP makes evaluations every quarter and every year.

For the annual evaluation, information from Demand Management (figure VIII) is sent to SSCP on a monthly basis and for the upcoming three years. With this information, it is evaluated if there is enough capacity available in the breweries to accommodate the demand of the following three years (Stiekema, 2004). The capacity is based on the available pack of production lines, personnel, OPI (see paragraph 5.2), raw/packaging materials and other resources. The same process is done every quarter, to assess the forecasts until the end of the running year. This is called the Last Estimate (LE).

By using specialized software programs like Advanced Planning, SSCP is able to monitor demand and capacity on the long and mid-long term (14 weeks-3 years).

4.4.3. The 4-week Drumbeat

The different Shipment Plans to Resource Planning create a large flow of (random) customer orders. The complete pack of customer orders that need to be produced (as production orders) within a certain week can vary from week to week, depending on what customers over the world demand. Currently, customers will get the guarantee

that their products will be shipped within 4 weeks after ordering. The customer can depend on a fixed lead-time (4 weeks plus time for shipping) for all existing products on every moment in time.

Heineken can use a fixed step-by-step plan to deal with customer orders.

- Week 1: Demand Management and Inventory Management create Shipment Plans for all products
- Week 2: Resource Planning plans the new 13-week forecast and Operational Scheduling schedules the actual production orders for next week.
- Week 3: Within the week, the scheduled orders are packaged and if possible already transported to the harbor.
- Week 4: Orders that could not be produced last week are produced in this week. After production, containers are transported to the harbor. Orders, which were already in the harbor, can depart.
- Week 5: All orders should be on the vessel and depart in this week.

The process can be seen as the beat of a drum. This is the reason why this process is known within Heineken as “The Drumbeat”. Together with Tactical Planning, Operational Scheduling is finding an optimized solution to fit all the orders in the most efficient way, considering changeovers, batch sizes, available capacity and to be in time for the shipping date.

Generally orders are produced in week 3 of the Drumbeat. But if there is no more space for a very large order, this order can be postponed to week 4, without falling out the beat. In other words, planning can place the orders within a timeframe of two weeks, creating a larger scale of optimal solutions.

The MTS concept and the Drumbeat work a little differently than MTO and Replenishment, because MTS supplies the domestic market. Lead-times to domestic supermarkets can be as short as 8 hours between customer order and delivery at the Distribution Center. This is feasible, because the requested products in stock. However, HB is the actual customer of HNS. If the customer (HB) suddenly increases the total forecast drastically, it will take 4 weeks until HNS will have this additional demand available for the supermarkets.

With the Drumbeat Heineken can measure their service level towards customers. If an order from a customer is processed within the 4 weeks of the Drumbeat, the order is considered OTIF.

4.5. On Time In Full (OTIF)

OTIF means On Time In Full. An order is OTIF if it is shipped in the correct quantity and at the requested moment (within 4 weeks of the Drumbeat). The level of OTIF is agreed in the Service Level Agreement (SLA) between Heineken and the customer. OTIF is one factor that measures customer service. OTIF is measured in a percentage. 98 or 99 % OTIF is a common percentage that is agreed with a customer. This means that 98-99 out of every 100 orders are shipped as agreed.

4.6. Conclusion

Chapter four shows that markets are supplied via different logistical concepts in the supply chain. This means that many products have different storage points between

the brewery and the customer. The concepts are MTO, MTS and Replenishment. The difference between the concepts is based on the location where forecast and actual customer orders intersect. This point is called the Customer Order Decoupling Point (CODP).

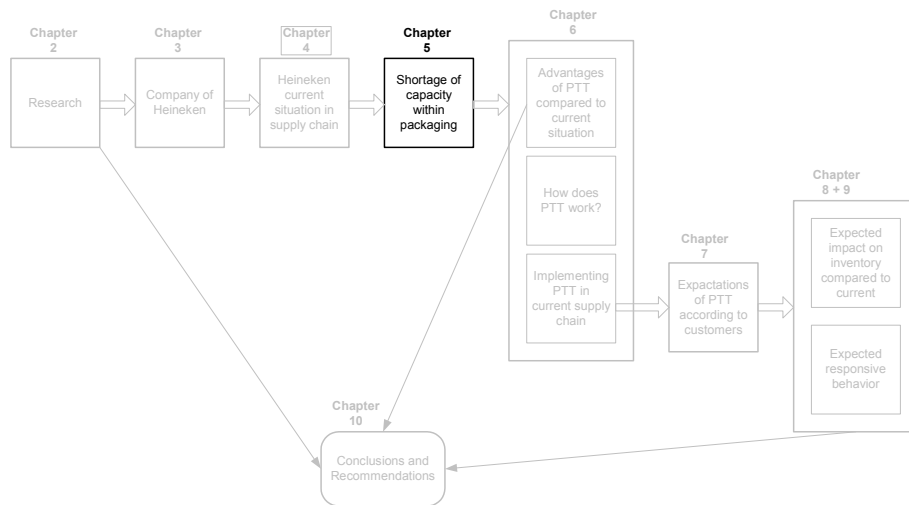
The last pieces of the supply chain towards the end consumer are very divers. It will make the analysis too complex to model all these final distributions. The chain until the storage point of the customer is in focus.

The Drumbeat is the 4-week process that Heineken uses in which every customer order is shipped. Depending on the sailing time, the customer can always depend on the same order lead-time from ordering until the moment the product arrives in his warehouse.

Planning is seen as the complete ordering process from market demand to production order. It is a step-by-step process that can be very dynamic in case of sudden changes, which creates the need for a certain level of flexibility. This system makes it necessary that the Planning department finds an optimal solution week after week. The unpredictable variety of production orders causes irregularities between weeks, which give inefficiencies in the packaging department. This packaging department is discussed in the following chapter to understand more about the piece of the supply chain where capacity and demand are under pressure.

The information in this chapter is of relevance, because all features of the supply chain (logistic concept, customer orders, planning, Drumbeat, OTIF etc) need to be considered if changes are made and many of these concepts are considered known in all following chapters. The interdependency of the features has been shown in this chapter.

5. Packaging department of Heineken



In the previous chapter, the whole Heineken supply chain has been described. In this chapter, a specific part of the supply chain will be discussed. Within the chain, the operation of packaging forms an interesting department. First there is an explanation why packaging is considered so important. Then, the productivity of the production lines, the number of shifts, cyclic patterns and the project of mono containers are explained as features of the current situation in packaging. Next, their relation will be shown in a causal diagram. The chapter ends by concluding the issue at hand about balancing capacity and demand, which creates the case for action. This case for action will then be discussed in the next chapter.

5.1. Bottleneck in the supply chain

The main objective for D&SM/HNS is to optimize the supply chain. In order to efficiently optimize the chain, it is important to find the sections of the chain where effort is most effective. For D&SM the focus is set on the bottleneck¹⁰ of the chain. Improving the bottleneck of capacity will create the most improvement for the entire chain on capacity. The supply chains from chapter 4 can be roughly divided in the links and their capacity as shown in Figure IX on the next page. As mentioned in the last chapter, the interdependencies in the supply chain are important to understand. An improvement project in packaging capacity will have effect on the packaging department itself, but it can also influence the other links.

¹⁰ Bottleneck (APICS dictionary): A facility, function, department, etc., that impedes production, for example, a machine or work center where jobs arrive at a faster rate than they can be completed.

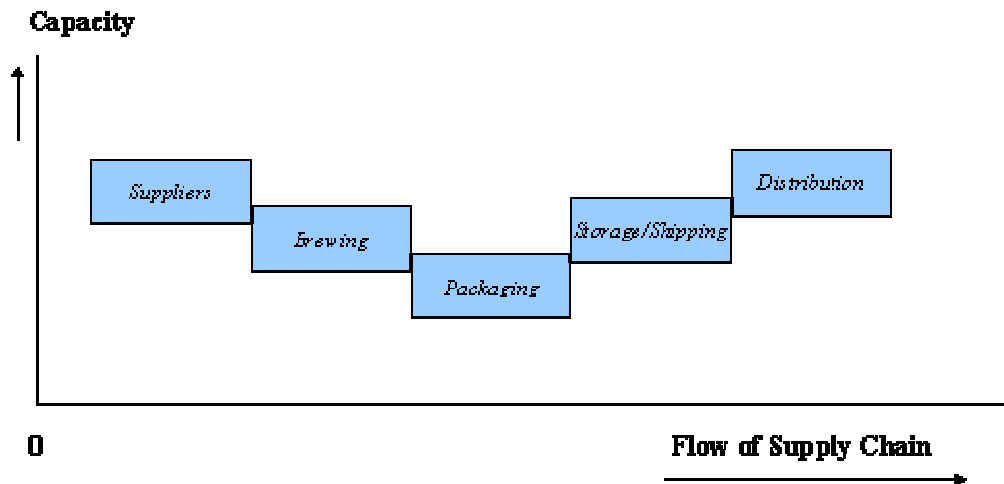


Figure IX, Links of the supply chain and their capacity

Another reason why D&SM considers packaging as the link to focus on is because it is the most cost-intensive link compared to the other parts of the chain. This has the following reasons:

Per hectolitre of beer,

1. The most personnel is involved in packaging.
Many parts of the packaging process are automated, but still many people are needed to operate and control the production lines. Of all links in the chain, the most people are involved with packaging to handle one hectolitre of beer.
2. The most investments on assets are spend in packaging
The machines on each packaging line are very costly. Some of these machines are specially designed for Heineken. The most amount of money is invested in the packaging department per hectolitre of beer.

5.2. Operational Performance Indicator (OPI)

To calculate the efficiency and effectiveness of packaging lines Heineken uses Operational Performance Indicators (OPI). In literature, this indicator is also known as Overall Equipment Effectiveness/Efficiency (OEE) (www.oee.nl). OPI is presented in a percentage (%). There are two different types of OPI, regular OPI and OPI 'Nona' (No Order No Activity). OPI calculates how many hours of the manned time on a line creates good product. OPI 'Nona' represents how many hours of effective working time creates good product. OPI 'Nona' is not affected by the time that the lines are available but there is No Order or No Activity. The efficiency of packaging is based on the time that is spent on fixing breakdowns including products of poor quality. The effectiveness is based on the amount of available overcapacity and the amount of time used for changeovers.

Example, a production line is manned (operators present) for 24 hours on a certain day. The maximum capacity of the machines is 50.000 bottles per hour. At the end of the day 750.000 bottles have been produced. The highest possible output is $24 \text{ hrs} * 50.000 = 1.200.000$ bottles. This means OPI for this line on this day is $(750.000/1.200.000)*100\% = 62.5\%$

It is possible that a production line runs more effectively or more efficiently. It is expected that the OPI would increase with better performance. But, this does not happen directly. OPI can only increase if gained time (by improving efficiency or

effectiveness) can be replaced by extra production output. This means that the created extra capacity is used for production and not for idle time. Using the same example: the line has found some inventive ways to improve effectiveness and efficiency. A 2-hour changeover can now be done in 1 hour and the total time fixing breakdowns is reduced with one hour as well. The line runs 24 hours, but still produces 750.000 bottles. The two hours of gained time on this day are replaced by operators having nothing to do, because there is no additional demand to fill the gap on the line. OPI is still 62,5 %. There is more overcapacity on the line than before. Percentage of OTIF can increase. Cost efficiency stays the same, because the same amount of beer is produced with the same amount of lines and personnel. This is because the time that is saved with working more efficiently and effectively is taken over by time for overcapacity. If a production line is manned but there is no production output, because there are no more orders to perform, this is called no order and no activity.

If demand is increasing, the available overcapacity can be used for production. Going back to the example; in 24 hours, 800.000 bottles are produced now. The new OPI is $(800.000/1.200.000)*100\% = 66.7\%$ OPI. More beer is produced with the same people and machinery. This is more cost-efficient than before. If demand stays constant, but improvements create enough overcapacity to reduce the amount of lines or personnel, the same amount of beer could be made with less people/machines. This is more cost-efficient as well. Reducing the amount of lines or personnel means to close and sell a production line or machinery (disinvestments) or to reduce the number of teams on a line. In the example, this will be to produce 16 hours instead of 24. Each team works 8 hours per day. The same amount of beer is made for less cost. If demand is decreasing, while improvements are made, even more Nona will appear. The amount of lines and/or personnel can be reduced as well. In that case, less beer is made for less cost.

OPI does not show the real performance of a production line. Operators can work perfectly, but if there is nothing to do the OPI will show lower numbers. To indicate the direct performance of the operation in packaging, OPI Nona is a better option. It is practically the same calculation of regular OPI, but without taking No Activity No Order into account. OPI Nona is not dependent of how much overcapacity is available. OPI Nona is based on calculations of effective working time. OPI Nona is used by Strategic Planning to calculate the maximum, technical capacity. How much can be produced if all lines are fully used without overcapacity. Example with the same production line: in 24hrs the output is 750.000 bottles. It is planned that it takes 22 hours to perform this output. $22 \text{ hours} \times 50.000 \text{ (highest possible output)} = 1.100.000 \text{ bottles}$. OPI Nona will be $(750.000/1.100.000)*100\% = 68.2\%$. Imagine that the line makes improvements in changeovers and reduces the time for changeovers with one hour, still producing the same output of 750.000. Now it is planned that it will take 21 hours to perform the same output. $21*50.000 = 1.050.000$. The new OPI Nona will be $(750.000/1.050.000)*100\% = 71.4\%$. With the current performance the production line would be able to produce an output of $71,4\%*(24\text{hrs}*50.000) = 856.800 \text{ bottles per day}$.

A modern production company will always try to produce as effectively and efficiently as possible. For Heineken this is represented by the OPI of production lines. A constant project for HNS is to increase this OPI. The method to calculate OPI and OPI Nona is visualized in Appendix C.

5.3. *Current cycles in production*

All products in Den Bosch are currently packaged once every week or once every two weeks. Some exceptional products have a cycle of four weeks. This is in close coordination with the customers that have the product in their portfolio. If a bi-weekly product is only produced in odd or even weeks, the order can still be produced according to Drumbeat, because there are two weeks planned for actual packaging. Families with cycle 1 will not be produced faster than the Drumbeat, because planning will still need the freedom to postpone a cycle 1-order to the next week. With cycle 1, the order can still be produced one week later, because the product is again scheduled for production. An immediate result is that the products with families in cycle 2 cannot be postponed, because that will mean a delay of 2 weeks.

5.4. *The mono containers project*

As explained in the previous paragraphs, changeovers are a very important cost/time factor. Changing from one SKU to another on the production line takes between 5 minutes and 3 hours depending on if it is a short print code change or a labour-intensive beer change. After a changeover, the line has to be optimized for the new SKU as well. This takes additional set-up time, before the line runs at full speed again. The more time is spent on changing over and fine-tuning, the lower the OPI Nona on the line will become.

A project that will be implemented in 2007 is called 'Mono containers'. The problem is caused by the fact that 43% of all the changeovers are performed for only 4% of the total volume that is produced by the Dutch breweries for export markets. The outcome of this project is that export customers of D&SM have to order at least one full container per SKU. Multiple customers can order an identical SKU at the same time. This means that each customer order has to be at least the size of one container. If placed together this will make a production run of one or multiple containers. Mixed containers (more than one SKU per container) can only be ordered under special circumstances. This counts for a few exceptions. Currently a minimum customer order is one pallet (one 40' container carries on average 22 pallets) per SKU. The advantage for packaging is that there will be less production runs of less than one container. D&SM would like to see that customers drop the very low volume SKUs from their portfolio if the product does not significantly contribute to the commercial package.

Increasing minimum customer orders and therefore production batch sizes results in less total changeover time. This increases maximum capacity and flexibility without investing in personnel or lines. Figure XI will provide more relations like this.

The disadvantage for some customers is the consequence of receiving a whole container of one product instead of smaller batches. This consequence can be higher stock, low freshness and harmonization of the portfolio (dropping a few small volume products and order one large volume product). The created extra capacity on the lines can be used to accommodate extra demand and increase OPI in the near future.

5.5. *Maximum capacity, overcapacity and flexibility of the lines*

Maximum or technical capacity is the highest possible output of a production line with the current assets, OPI and number of shifts. With 5 shifts, the line is used 24

hours per day, 7 days per week. A 3-shift line runs 24 hours per day, but is shut down in the weekend. A 4-shift would only shut down on Sundays.

Overcapacity is the maximum capacity minus utilized capacity. The level of available overcapacity determines the level of flexibility for packaging/planning. This flexibility is needed to be able to fit all orders within capacity (as effective as possible) and to act as a buffer for unforeseen situations. It is possible that a certain required material arrives too late. This means that packaging has to shift that order to another place in the week. This is only possible if there is a certain amount of buffer capacity. A good balance needs to be found between cost-efficiency and available overcapacity.

HNS has recently decided to downsize the amounts of shifts from 5 to 3 on most production lines in Zoeterwoude and Den Bosch to achieve more cost efficient production possibilities. Another advantage of the 3-shift situation is that people are triggered to research improvement projects. If there would be enough overcapacity, such triggers are expected less to occur. By reducing the maximum capacity, a large amount of overcapacity on the production lines disappeared. In the created situation, very cost-efficient production was realized.

HNS is now facing increasing demand that has not been happening in the last four years. The increasing utilization of capacity from various markets (especially USA) and the irregularities between the weeks create the possible situation that HNS is unable to supply. The figure below gives a visualization of the created situation.

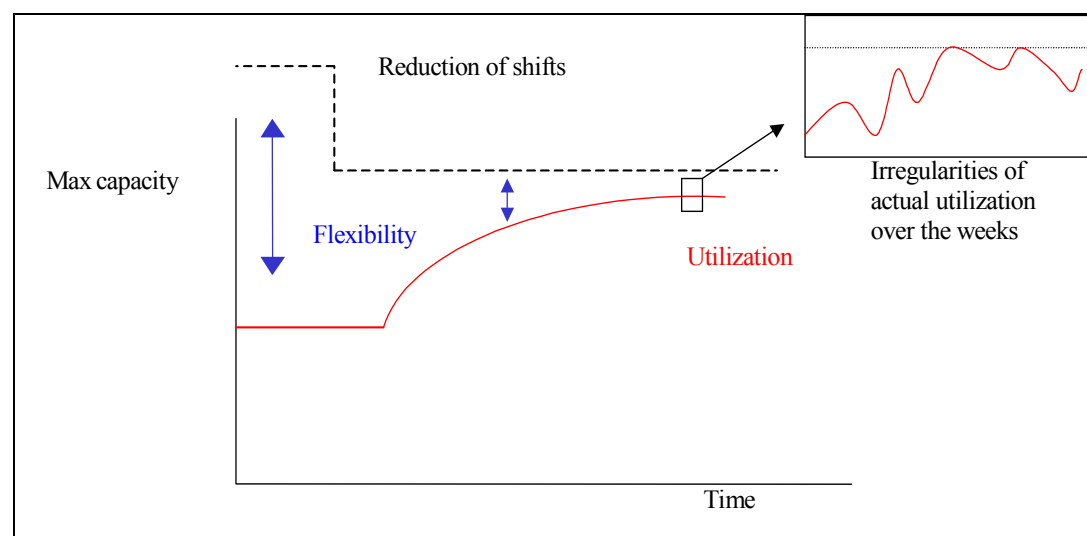


Figure X, Increasing utilization after a reduction of shifts

In the right-top window, possible variance in utilized capacity is shown. Utilized capacity cannot exceed the maximum capacity. The irregularities in the utilization line are caused by the fact that the exact amount of orders and products in a certain week cannot be predicted. Precise production orders are determined only one week ahead. Also there can be various unexpected problems within the production week (too late delivery of materials, quality issues) what forces packaging to divert from the production plan. The range of irregularities in actual utilization between the different weeks determines the minimum amount of needed overcapacity/flexibility/buffer in order to be able to keep supplying all orders OTIF to the customers. The less irregularities, the less overcapacity/buffer capacity is needed at the same certain service level. That is why HNS want to have as little variance between the production plan and the actual utilization.

5.6. Relations within the packaging department

In the previous chapter, interdependencies within the supply chain have been shown. In the last few paragraphs, some interdependencies within packaging have been mentioned already. It is very important for the research to create a good understanding of supply chain and packaging interdependencies. In figure XI, a diagram is showed with the causal relations within packaging. A plus represents a positive influence. A minus represents a negative influence.

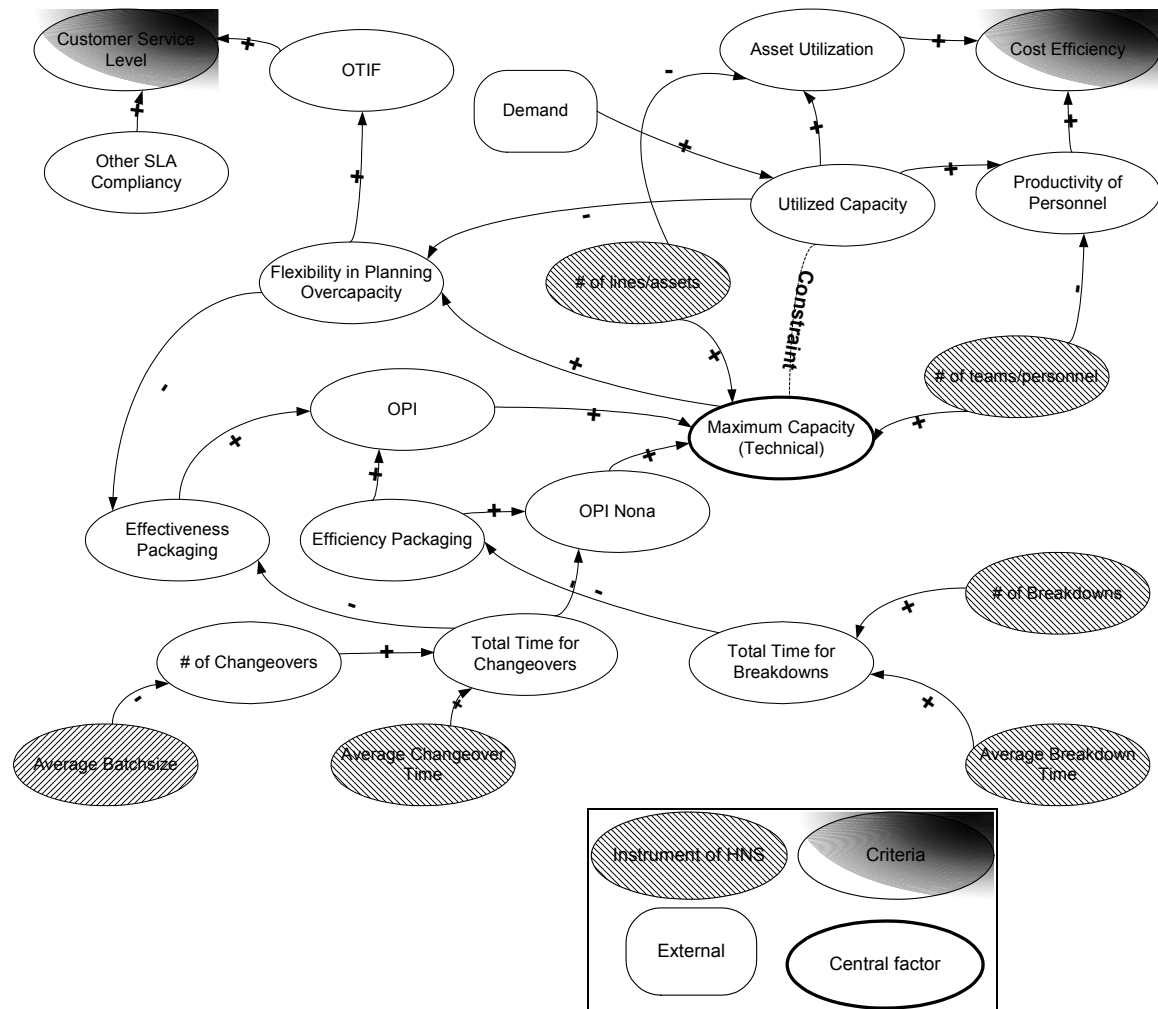


Figure XI, Causal diagram of packaging

Utilized capacity cannot be larger than maximum capacity. That is a constraint between maximum and utilized capacity. The central factor is maximum capacity. The two main objectives for HNS are shaded at the left and right top of the diagram. Instruments in hands of HNS are lined. Projects that have influence on average batchsize, changeover time or breakdowns affect the effectiveness or efficiency of packaging and therefore the OPI. Adding or removing production lines or personnel affect the cost-efficiency of packaging. Eventually, they all affect the maximum capacity of packaging. However it is not the main criterion, because high maximum capacity does not necessarily mean a cost-efficient production. Having a lot of overcapacity is not cost-efficient, because the utilization of personnel and assets are

sub optimal. It depends on the amount of demand, which is difficult to control. The amount of overcapacity is determined by the utilized capacity versus the maximum capacity. But on the other hand, it has been discussed that with too little overcapacity, the OTIF level (and therefore customer service) can decrease. It can be seen in the diagram that the more cost-efficient packaging becomes, flexibility decreases what can bring down OTIF level. This is the balance between cost-efficiency and customer service.

The level of effectiveness and efficiency of packaging is measured by OPI. OPI can only increase if the gained overcapacity is compensated by utilized capacity or less lines/personnel. OPI Nona will increase if improvements to breakdowns/changeovers are made, because it is not influenced by the available overcapacity. This has also been discussed in the OPI paragraph. Improving OPI can influence the cost-efficiency by being able to produce more hectoliters without adding personnel or assets, but only if that additional demand exists.

Finally, customer service is not based only on the level of OTIF. Other SLA compliancy is also important. However this is not a factor that is determined by packaging.

This model is not complete, where more factors can be identified. For the understanding of the current situation with packaging and demand, the diagram is sufficient.

5.7. Conclusion and case for action

Packaging can be seen as the bottleneck of the supply chain in terms of capacity and because of the amount of investments and personnel that are involved in this part of the chain. Currently, there is a capacity issue at HNS. To increase capacity in the chain, it is most efficient to focus on packaging.

The general HNS objective has been discussed earlier in the report, but it is useful to repeat in this context. For every project, HNS should not lose the main objective out of sight. The main objective of optimizing the entire supply chain is two-fold:

- Produce as cost-efficient as possible against a high customer service level

The current issue in packaging is that forecasted demand for the production lines in Den Bosch for bottle one-way can have reached maximum capacity for a period of X weeks (peak season)¹¹ in 2007. There is no slack for additional orders or for buffer capacity to make up for irregularities in demand or unexpected problems in supply or operation. As discussed before, the risk is that when packaging cannot supply every order, the OTIF percentage to the customer will decrease. This is against the main criterion of supplying high customer service. To resolve this issue, HNS needs to find a project to increase the maximum capacity and remain the high customer service.

A more general project of HNS is to achieve a constant increase in OPI in packaging to produce more effectively and efficiently.

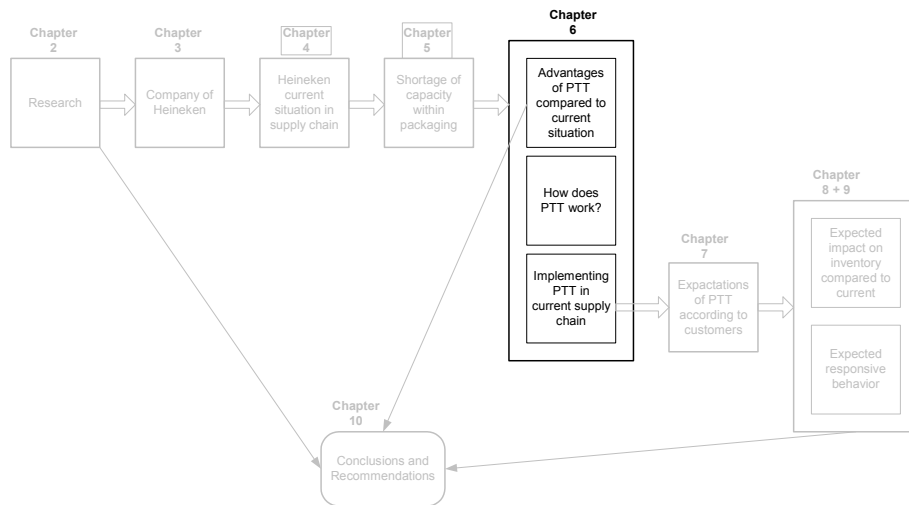
A third project of HNS is to achieve a more predictable production in order to reduce the range of irregularities. If 'rest' in planning/packaging is achieved, not only is less

¹¹ This has been determined by calculations of P. Groenendijk (Strategic Supply Chain Planner) for the year 2007.

buffer capacity needed, but this could also be expanded through the entire supply chain. For example, if suppliers of materials know more precisely and longer ahead what and when Heineken is going to produce, they can adapt their own production patterns accordingly and supposedly offer lower purchase prices in the long term.

After zooming in from total supply chain in chapter 4 to a packaging capacity issue in this chapter, the origin of the current supply chain issue for HNS is described. The next step is to introduce the project of Production Time Tables as a remedy to the capacity issue and also to the other two projects of HNS. This will be done in the next chapter.

6. Production Time Tables



The case for action of the previous chapter indicates the need for a project that can resolve the short-term issue of the reached maximum capacity and more generally increase OPI and create a more predictable actual utilization of capacity. It is desired by HNS to be as cost-efficient as possible and maintain a certain customer service level. Currently, Heineken is experiencing a very cost-efficient packaging operation, but the lack of buffer-capacity jeopardizes the level of OTIF, because some orders have to be postponed or cancelled. To achieve the desired situation in packaging, HNS wants to introduce a concept that is called the Production Time Tables (PTT) to restore the balance between the two criteria of low cost and high customer service. All details about the PTT are described in this chapter.

In the first paragraph, it is explained what Production Time Tables are and what the expected advantages are. An example is given to compare the situations in packaging with and without PTT. Next it is explained how HNS is planning to find/construct the most ideal timetables. Then, the logic of cycles 1,2,4 and 8 weeks is explained. The next paragraph goes back to the description of the supply chain from chapter 4. This is done to evaluate the expected impact of PTT on fields other than packaging. In the last paragraph, the initial research design is reviewed in order to evaluate the correctness. If necessary, adaptations will be supplied.

6.1. What is PTT?

The concept is based on the timetables used in aviation and railways, but translated to a production organization. This means that every line will get a schedule with cyclic, fixed slots (buckets) for certain types of product, in a fixed sequence. The PTT of a line consists of several buckets in one week. Each bucket represents a product family¹². A family is a group of products that have similar characteristics and minimal changeover times between members. For example, a Heineken product will not be placed in the same family as an Amstel product, because a beerchange can take up to three hours. However, two similar Amstel Light products with a changeover time of

¹² Product family (APICS dictionary): A group of products with similar characteristics often used in sales and operations (production) planning.

three minutes will be placed in one family. The next thing to be decided is the cycle time of the family. Some families are produced every week some every two weeks and others less often. The sequence between families on one line is determined by the changeover time between families. The most efficient changeovers will be used. With this concept, it is tried to increase capacity by synchronizing the demand from the market with the production of the lines.

In literature the concept of lot sizing and finding a balance between inventory and changeover costs is known as Economic Lot Scheduling Problem - ELSP (Silver et al., 1995). Unfortunately, Soman (2005) mentions that in this study only MTS products are used. He writes: "Incorporating make-to-order items has not yet been studied in that part of literature". Heineken uses MTO, MTS and Replenishment concepts. All bottle and can products produced in Den Bosch need to be taken into account for these Production Time Tables. This mixture of PTT and logistical concepts will be a challenge for D&SM whereas not a lot of literature is available for reference examples.

D&SM believes that the following advantages will be achieved when PTT is successfully introduced:

- Percentage OTIF equal or above the agreed SLA level
- Less total changeover time
- Higher maximum capacity
- Cost-efficiency can be maintained (because no investments have to be made in additional lines or personnel)

Due to the repetition of a fixed production plan, the customers will need to synchronize their orders with the planned production, which means that some products are not produced whenever the customer would like. With PTT, the customer will always know if and when 'his' product is going to be produced.

Because products are grouped and placed in cycles, batch sizes become larger. Larger batchsizes will lead to less changeover time that can increase OPI. A higher OPI can create extra technical capacity on the line. The current cost-efficiency can be maintained, because no large investments in packaging need to be made to implement PTT. No extra lines or personnel need to be added for this project.

6.2. Example of PTT

In this paragraph, an example of a timetable will be used versus the current situation to explain the expected advantages for D&SM. The example is shown with a figure on the next page.

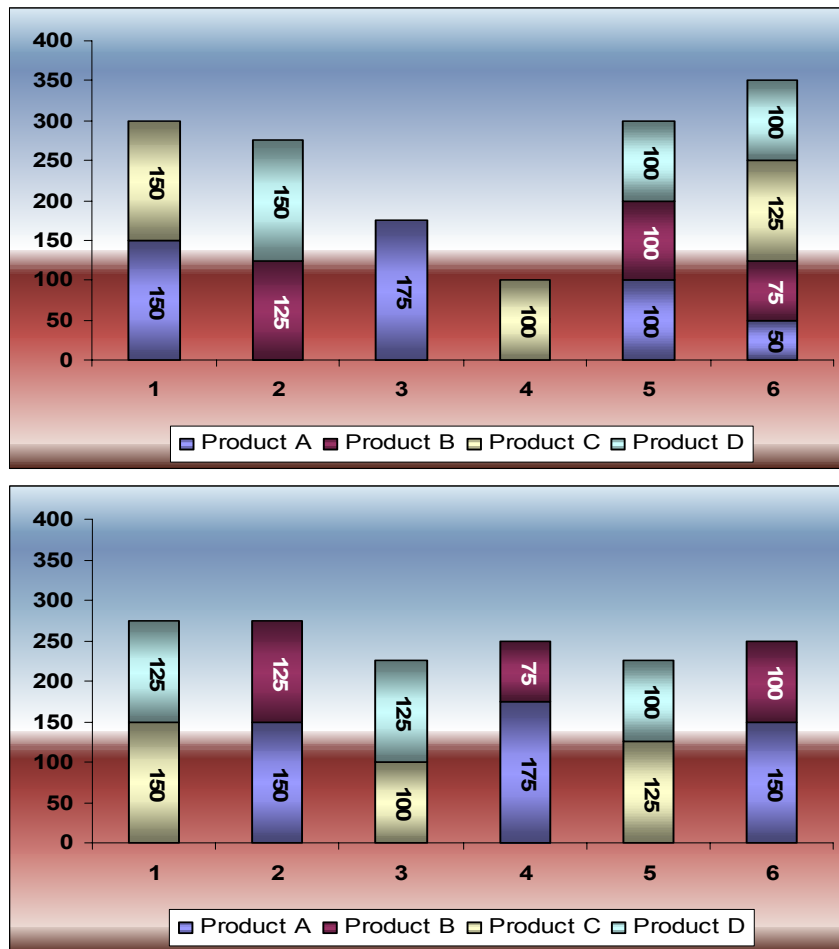


Figure XII, Example of current situation versus a situation with Production Time Tables

Products A, B, C and D can all be produced on the same production line. Figure XII shows a production planning for weeks 1-6. The quantity is set out in units. All products are produced in the same volume for both situations.

Current situation (upper part of figure):

Because orders for the four different products come in randomly, every week there can be a different set of products on the line. The variety in utilized capacity is large and there can be multiple smaller batches of the same product. In week 4, only 100 units of capacity are needed, whereas week 6 needs more than three times as much. This large difference asks for a lot of overcapacity on the line. If the maximum capacity on the line is 400 units, there is no problem to deliver all the orders OTIF. But if the capacity is only 300, some orders need to be changed to later weeks. Re-planning is very time consuming, but more important is that there is the risk that orders are not delivered OTIF, which is not good for the customer service level.

PTT (lower part of figure):

In the new situation, production orders are grouped into fixed weeks. A possible timetable for this line is that every product is produced once every two weeks. The customers know that product A and B are always produced in week 1, 3, 5 etc. They also know that product C and D are always produced in week 2, 4, 6 etc. The customer needs to synchronize their order to the timetable. Even if maximum capacity is 300

units, all orders will still be OTIF. Overall, the production orders are larger, what results in fewer changeovers.

The customer has less freedom, but there is less risk of his order not being OTIF. It is expected from the customer that they monitor their forecasts (MTS/Replenishment) and orders (MTO) more closely, because correction is a slower process. Where in the old situation, customers could order whenever it was necessary. With timetables, customers can only receive their products on fixed moments in time.

6.3. Construction of PTT

Before PTT can be implemented, D&SM needs to know how the timetables should be constructed to be as optimal as possible. This construction/calculation itself does not belong to the research, but the results are used. For that reason, the construction of PTT is reviewed in this paragraph. To calculate the most efficient construction of the PTT, D&SM has asked the consultants of CDL to develop a tool. They are specialized in case studies and model development. The tool uses all relevant parameters and constraints to come to an optimum of lowest cost in production. The modeling is quite complex due to all the factors that have to be taken into account. In figure XIII, a layout of the Run Size Models (RSM) is shown.

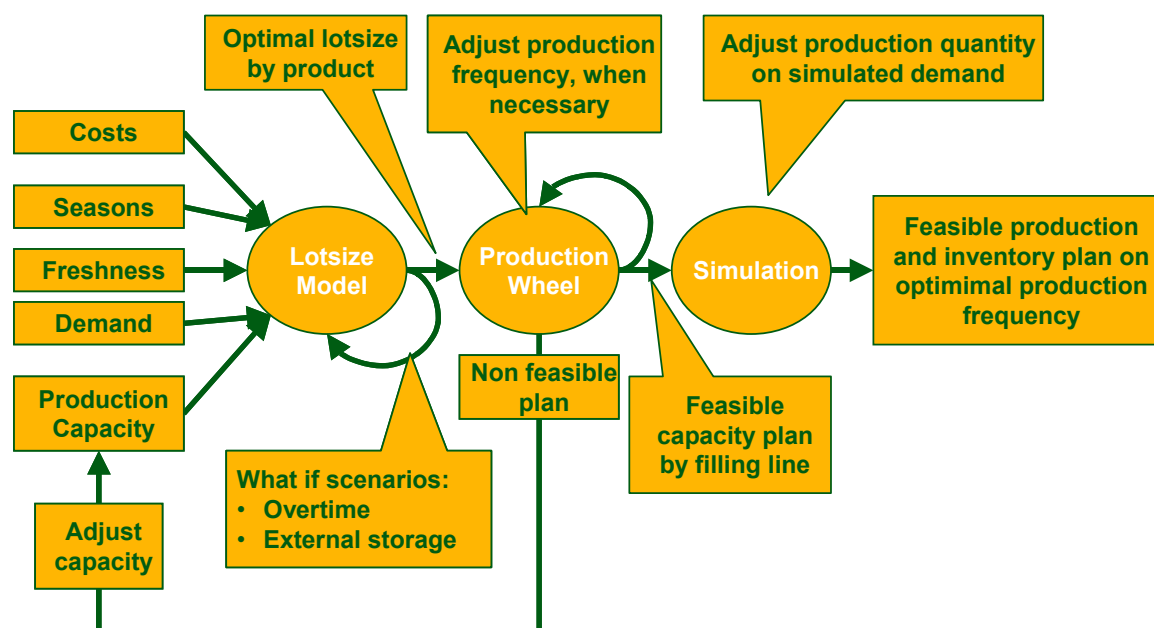


Figure XIII, Construction of Run Size Model (CDL, 2006)

The tool uses the optimizing program AIMMS (www.aimms.com). The objective is to create timetables with the most optimal families, cycles, and capacity utilization under a number of constraints.

The model works in three steps and is an iterative process. First a lotsize model is created. This is based on the calculation of an Economic Order Quantity (formula of Camp). The EOQ is the optimal size of a production run, looking at the cost of changing over and the cost of storing the products in inventory. In figure XIV a basic visualization is shown of the calculation of EOQ. Starting with all available products, available production lines and demand a lot size/order quantity is determined for every product. The EOQ is calculated without many constraints.

After the first calculation, different kinds of constraints are added to challenge the results of the lot sizes. This process is repeated until all the constraints are met. For example, the production lines have a certain maximum capacity and the local inventory has a certain maximum. If these constraints make the suggested lot sizes unfeasible, the optimizer searches for new solutions.

After the optimizing calculations, an initial timetable is constructed for every production line in the Den Bosch brewery. This is the part of creating a production wheel. In this part the best sequences are searched. Families are created to find the best combinations that have the least changeover time between members. Also, the best frequencies are determined. Based on the proposed size of a batch and the total demand of the product, it is easily calculated how often a product should appear in the timetable. Every week, once in two weeks or less often.

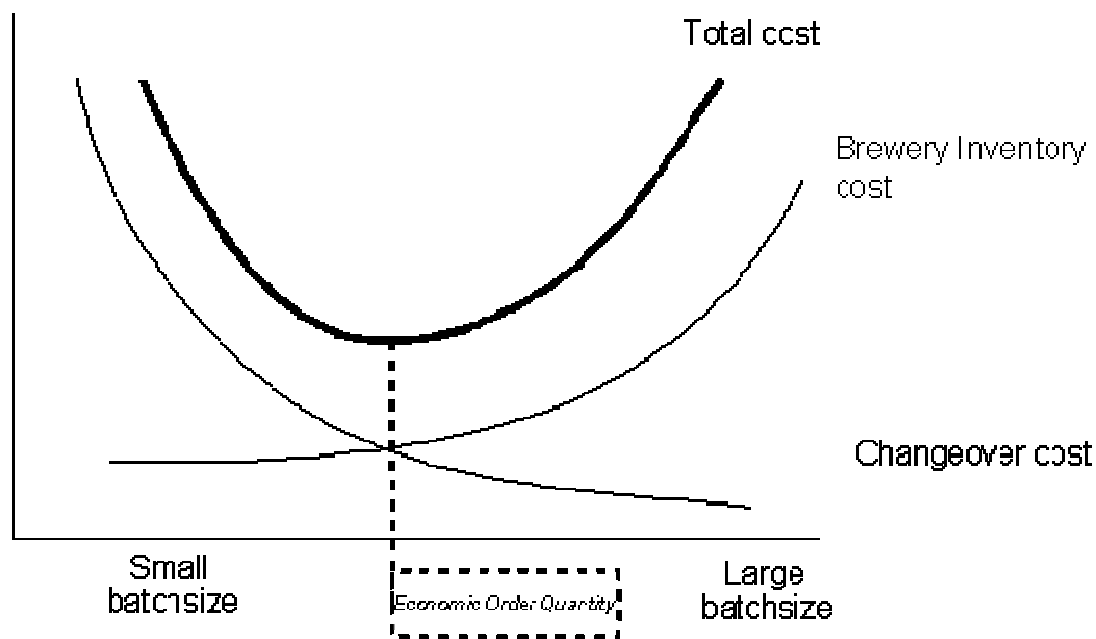


Figure XIV, Simple visualization of Economic Order Quantity

In the third step, it is tested if the proposed timetable is feasible. Entering the actual production orders of 2005 in the production timetable will test this feasibility.

If all constraints and simulations have been successfully passed, this proposal for a timetable will be discussed with the brewery. The experienced personnel and managers can make last practical adaptations to the final output. After modifications from a practical point of view, the model calculates the impact on productivity.¹³

6.4. Cycles of PTT

The cycles of 1,2,4 and 8 weeks have been chosen based on iterative possibility. If a product with cycle 4 is produced in week 2 and week 6, it is again produced in week 10 and 14. This is needed to keep the same families of products in the same week during every complete process of the Production Time Table. This would not be feasible with cycles 1,2,4 and 6 or with 1,2,3,4. The cycles of 1,2,3 and 6 are possible

¹³ The results of this optimization model are used as input for this report to create a concrete indication of the expected impact of such timetable.

of course. Cycle 8 is chosen to be the longest cycle based on a freshness constraint. It is calculated that a product that is produced every 8 weeks can still be consumed within freshness constraints in the world market. More about freshness is discussed in paragraph 7.3.3.

6.5. PTT in the supply chain

The advantages of a supply chain with Production Time Tables have been described in the previous paragraphs. The real opportunities for PTT are increasing the productivity of the brewery and making production orders less volatile. HNS also believes that by setting a certain fixed rhythm in production, more stability in the entire supply chain can be achieved. Without large investments, the output of packaging can be increased. The initial advantages are obviously settled in production departments. However, a project that changes factors in the packaging and planning department can also have (negative) influence on the other parts of the supply chain. Because the project alternates the ordering process, the customer will probably experience effects from the change as well. These effects might be out of sight or focus from the production departments. Improving a supply chain is not only about increasing productivity. This research is performed in order to understand the impact of PTT on non-production parties of the supply chain. That is in this case the customer of HNS. In figure XV, a visualization of the Heineken supply chain is shown as used in chapter 4. The departments of planning, packaging and the customer inventory positions are circled. The advantages of PTT are mainly focused on improvements in planning and packaging. The dashed circle in the figure with the question mark represents the unknown effects on the customer. Its inventory in the supply chain is the most important focus for expected impact of PTT. There will be no additional storage on site (brewery) or in the docks, what means that the extra stock will end up in the customer storage points. This particular impact needs to be researched first in order to understand the full range of effects that Production Time Tables can have.

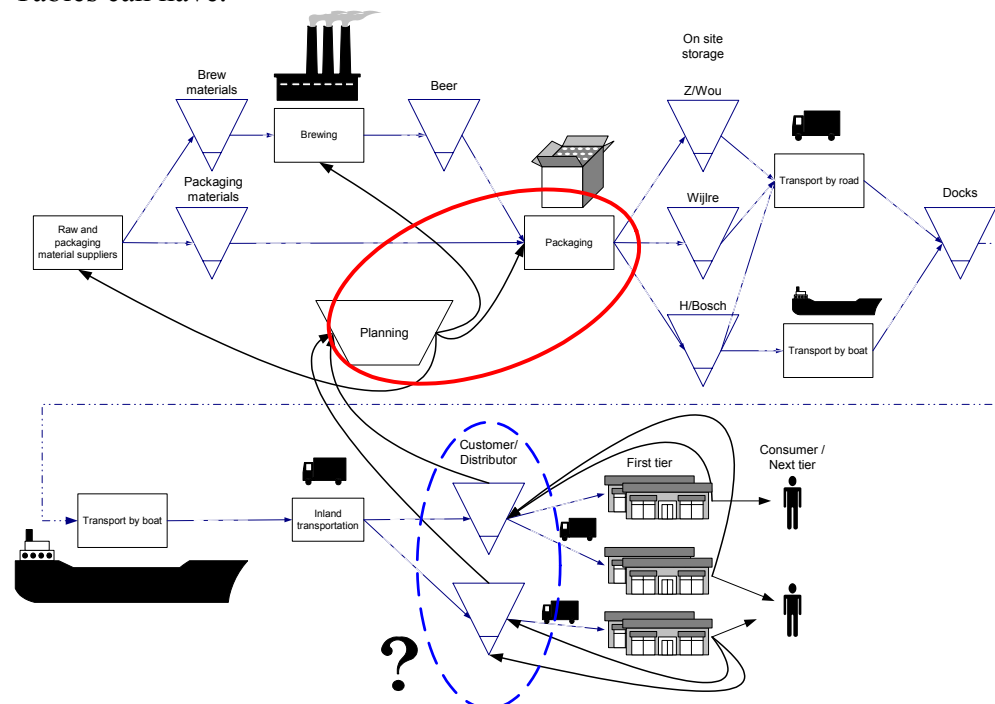


Figure XV, The locations of planning, packaging and customer inventory in the supply chain.

6.6. *Conclusion*

In the current packaging situation, most products are produced weekly or bi-weekly. This does not mean that customers order 52 or 26 times per year. Multiple customers order the same SKU. A SKU can be produced every week, but that does not mean that it goes to the same customer every time. It is possible that 5 different customers order the product 10 times per year on a different moment in time. In the most inefficient case, the product is produced 50 times per year. The basic concept of PTT is to group all the separate small orders from different weeks, into a combined production batch once every 4 or 8 weeks. Not only will the total amount of changeover time decrease, the production becomes more predictable and spread as evenly as possible over the weeks.

The main advantage of timetables is that maximum capacity can be increased without large investments within packaging by making production weeks less volatile. However, it seems that the issues in packaging are being solved by storing more products in the end of the supply chain, what is beyond the control of the planning department. Solving an issue and compensating some negative effects is different from placing it at another location.

A relevant question is if customers are sufficiently compensated with higher productivity from the brewery for all impact that PTT will have. PTT is a productivity project that increases the maximum capacity of the production lines. It can only be an improvement to the supply chain when all effects are known and the sum of the impact is positive. When the project will have only positive influence on the entire supply chain the project must be implemented. When a project has positive influence on production and unknown effect on the outbound supply chain (e.g. inventory situation of customer), these effects need to be researched before any decision about implementation is made. This is a change in the approach of the research that needs to be mentioned. In the next paragraph, adaptations are discussed to underline the shift of focus in the research.

6.7. *Two adaptations to the initial research design*

Looking back at the initial research design, there are two adaptations to be made, based on the first six chapters of this report. This is relevant to know, because a better central question can be formed now that more information has become available.

The first change is that the investigation on the impact on the customer can be shifted from general (random) impact on the customer to impact on the customers' inventory. The effect of PTT for the customer is that some products can only be produced on fixed moments in time. This will change the order pattern and therefore the customer batch sizes. By ordering different batch sizes, the customers' inventory changes compared to the current situation. The planning process will change with PTT. For the customer this will mean that the ordering process is the changing factor. Indicators that can measure this change are to be researched in inventory.

The second change is in focus-size of the entire problem. The initial research was to balance the advantages and disadvantages with the production department in the center. The new focus is to show the advantages and disadvantages with the entire supply chain in the center. The reason for this research was to be prepared for the effects on and of the customers. With the results of this research, HNS should be

prepared for the discussion with the customers about the effects of a new project that HNS was about to implement. However, the first steps in the research indicate that the focus for the research has shifted towards a more supply chain analysis. Is the project of PTT going to have a positive effect on the entire supply chain of Heineken or are the disadvantages and risks significantly larger than the gains in productivity. The implementation of the Production Time Table project should be approached as a possibility, not as a probability.

The central question can be adapted to a more specific one. The research questions that answer this central question can stay the same without losing their purpose. The initial central question was:

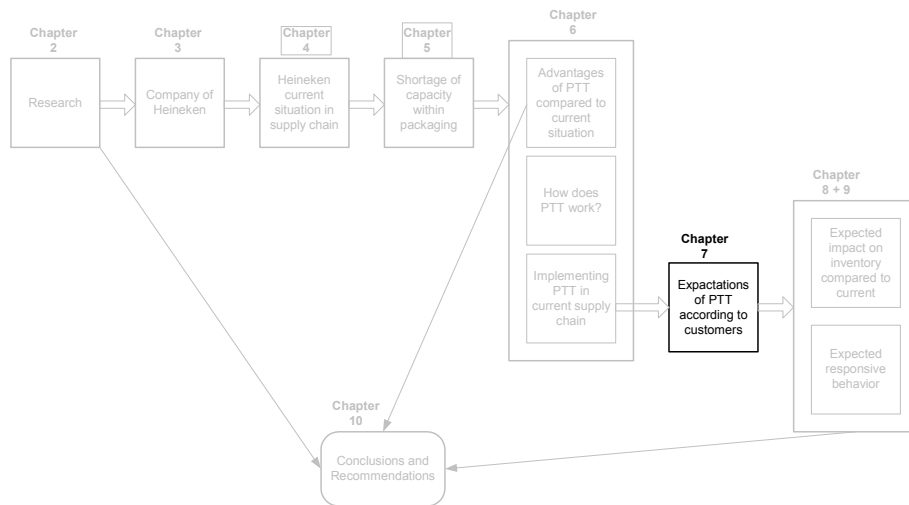
What will happen in the outbound supply chain for customers and with customer response when the production organization of Heineken implements Production Time Tables?

It can be adapted to:

*What will happen in the outbound supply chain **in terms of customer inventory and customer response** when the production organization of Heineken **would decide to implement Production Time Tables**?*

With the new central question, the next step in the research can be taken. The expected disadvantages of the PTT project are researched in chapter 8 and 9. First, in chapter 7, a summary is given of a series of interviews with representatives from all the different markets to create an insight in their perception of the supply chain and of customer service. The customers are the parties, in the outbound supply chain, that are influenced by the project of Production Time Tables.

7. Interviews with representatives of the market



In order to obtain perceptions from customers in the outbound supply chain, 19 separate respondents were interviewed, some of which were interviewed more than once. This information can be very useful in the analysis of impact on the customers in the next chapters. A list of interviewees and their positions can be found in Appendix D.

This chapter will first describe the challenge of obtaining data about PTT. Next, a range of qualitative results will be displayed. With these results, the positions of the customer in the outbound supply chain can be represented to a more valid extent in this research. The interviews can also create additional information about customer inventory in the supply chain, especially because that is the area where most impact is expected.

7.1. Challenge in the interviews

The project of Production Time Tables is a confidential idea to increase productivity. Nevertheless, no markets had been informed during the time of this research. No information was communicated to the market, because no final timetable per product was available and more important, because HNS was not convinced to implement the project unconditionally. Communicating the project with the HNS customers is postponed until all details about the project are known and a final decision about the possible implementation is taken. HNS does not want to provoke discussions with the customers about a plan/project that might never be introduced. The decision to not involve the customer in the project is understandable. On the other hand, there is literature that states that a customer attaches more value to being involved in processes with his supplier than to the amount of money he earns from the relationship. Kumar et. al (1995) write that so called ‘procedural fairness’ is highly important for the quality of the relationship between supplier (HNS) and reseller (customer). Moreover, it is considered more important by resellers than ‘distributive fairness’. “Procedural fairness is the reseller’s perception of the fairness of the supplier’s procedures and processes in relation to its resellers”. Distributive fairness is the perception of the reseller about the earnings and margins as an outcome of the

relationship. Many (supplier) managers believe that resellers are primarily interested in the margins received from the supplier. But competitors can often match high margins. That is not the case for healthy procedural fairness. Explanation of the supplier's policies/channel decisions and involving the customer in bilateral communication are two of the key components of procedural fairness between supplier and reseller. Irrespective of the theory, HNS has chosen to keep the customer out of the discussion.

The group of interviewees can be divided in two groups. Nine respondents were aware of the project (Demand & Supply Management personnel) and ten respondents were not supposed to be informed yet (parties other than D&SM/HNS). The challenge in the interviews exists of posing the right questions to find out as much as possible about the perception of the customers about Production Time Tables, without asking directly or suggesting an upcoming project like PTT. In agreement with the Market Supply Manager of D&SM and the Heineken project supervisor, respondents were selected and approach. Interviews were held face-to-face. Three interviews were performed via teleconference.

7.2. *Set-up of interview*

To gather as much information as possible and to create a univocal list of questions, a questionnaire was used for the interviews. The questionnaire was only adjusted for specific respondents to avoid questions that were not applicable to the respondent. Of course, respondents that were aware of the PTT project were approached in a slightly different way. An example of a questionnaire can be found in Appendix E. In order to find the appropriate, worldwide information about possible consequences of Production Time Tables, respondents of different regions in the world were approached. Representatives/coordinators of the following markets were approached and interviewed:

- Heineken United States of America (HUSA)
- Asia-Pacific
- North-West Europe
- Domestic (Heineken Brouwerijen)
- East and Central Europe
- Africa
- Middle East
- Caribbean
- Duty Free
- Central and Latin America

To keep the interviews as structured as possible, several topics were discussed by asking a few questions per topic. The discussed topics were:

- Perception of customer service
- Inventory situation
- Perception of freshness
- Consistency of portfolio
- Impact and perception of mono containers

7.3. Results of the interviews

From the in-depth interviews with the representatives, several results can be noted. These results can be used further in the research. All results are perceptions of customers and are not necessarily proven to be true. For this research, the answers of the respondents are all considered credible. It is assumed that all respondents had no reason to lie or withhold general information.

7.3.1. Perception of customer service

The various customers have different opinions on customer service. Each market uses different examples. Five important statements can be derived from the interviews.

1. Customers believe that OTIF is more important than lead-time. If the customer knows precisely when an order will arrive at his door, he has less priority for the time it takes from ordering until delivery. Again, as long as the customer receives a guarantee that the order will arrive as agreed. The only exception is Country G. Country G gives priority to lead-time. Their lead-time is already very short (the brewery is relatively close to Country G compared to Region B or Country H), but they would like to see it even shorter. Country G and Country F are markets with many design changes and promotions. This means that the market responsiveness needs to be very high. An important factor in responsiveness is lead-time.¹⁴ Lead-time for the customer means the time it takes between ordering and the moment that the products arrive at the customer's doorstep.
2. Issues around shipping influence the percentage of OTIF. Customers consider OTIF as an indicator that an order arrives as planned including shipping and the product being physically available. HNS considers an order OTIF when the product is physically present at destination. Exact agreements are made with the customer in the Service Level Agreement (SLA). Respondents indicate that they see more delays and issues in shipping after reorganization and downsizing by HNS in the order management and shipping departments. Less people are performing the same work and it is believed that less attention is the cause of declining quality in documentation and shipping accuracy. In the end it means that customers are not able to receive their orders OTIF, even if HNS believes that they did.
3. More two-way communication is crucial to overcome issues and prevent unnecessary high cost. This point is of such interest, because many respondents came up with this point themselves. Respondents claim that it occurs that HNS withholds information from the customers, because HNS assumes the subject is obvious for the customer.
4. Being treated in a fair and honest matter is important. Smaller customers have the feeling that they are not considered equally with larger customers. Not all respondents agree.
5. The general relationship between the customer and HNS is ok and mostly has a long history. Customers however indicate that HNS does not have unlimited credits to handle without cooperation of the customer. Recent developments are the reason for some negative scores about the relationship.

¹⁴ More information about responsiveness and other supply chain performance attributes can be found in Appendix F.

7.3.2. *Inventory situation of the customer*

This topic is discussed because it will be the main indicator of the effects of the project. How do customers consider inventory and what happens in out-of-stock situations? The following summary can be given about HNS customers and their inventory situation:

1. Only a few customers have actual physical constraints that make it impossible to expand their storage if necessary. Most of the customers use external companies. If stocks grow, more space can be hired. The delineations mentioned in the beginning of the research stand at this point.
2. Replenishment customers have a calculated safety stock level, mature MTO markets have sufficient safety stock and the new, less mature MTO markets have trouble setting safety stock levels, because forecast and actual sales of products are difficult to predict. In general it can be said that most markets handle sufficient safety stocks. Sometimes a good safety stock level is found by trial and error and sometimes with profound calculations. A large majority of respondents indicate that the current safety stocks are in order.
3. In case a customer goes out-of-stock, this has a large impact on the market position of the customer and therefore for Heineken. Apart from the lost sales and missed potential, there are other consequences of an out of stock in the market according to the respondents. If the HNS customers cannot deliver to their second-tier clients, respondents answer that various negative consequences can occur.
 - a. The customer receives penalties because he cannot supply his clients
 - b. The customer loses shelf space in supermarkets or liquor stores. Not only the missing product is removed, but also other Heineken products could be removed from the shelf.
 - c. The customer has a damaged reputation. In annual negotiations with his clients, the out of stock situation(s) will be mentioned and used to decrease margins and increase service demand.
4. The large majority of the customers has no production facility and therefore tends to focus on marketing and sales instead of inventory management. Customers are commercial resellers. This means that they buy finished product from HNS and resell this to other parties. Some respondents explain that the customers rarely have logistic expert that facilitate the storage and the ordering process. They order ad-hoc when they realize that sales are increasing. However, the large mature customers give serious attention to the ordering process and reducing inventory. The question if customers see inventory management and order management as a priority/core business is difficult to answer. The replies vary from customer to customer.

7.3.3. *Perception of freshness*

It was expected that freshness would be of very high importance to the customer. In the interviews, most markets have not had many issues about freshness. This means that freshness itself stays important, but not in a way that beer of 1 month old is more valuable than beer of 2 months old. As long as the beer stays within expiry, freshness is in order. The most interesting points are:

1. In the United States, where the hype of fresh beer comes from (Moore, 1999), freshness is only as important as the expiry date agreed with HNS. This counts

for almost all the markets. The expectation that fresh beer would be more valuable than an older variant seems to be untrue. As long as the beer is within agreed expiry date, it can be sold to the customer without substantial issues.

2. The customer in the County C needs to deal with one of the most strict expiry demands. Country C is a fairly new market for Heineken. Heineken Country C (= the HNS customer) can only supply to their clients if the product has at least 2/3 of the expiry date left. If a product has an expiry of 6 months after production, Heineken Country C can only resell it in the first 2 months, otherwise it will be rejected by the supermarket chain or other client.
3. The long-distance markets (Region A and Region C) appear to have the most issues with the expiry date, because shipping the product from the Netherlands can take up to 6 or 7 weeks. These markets have sporadic experience with destruction of product. Nevertheless, a majority of the customers indicate that freshness has not created any trouble in their market.

7.3.4. Consistency of portfolio

The most interesting part of how the portfolio of customers is set up is the importance of smaller products.

1. Small volume products can be of high strategic importance to the customer. An example is a very special Amstel can. This project has a very low volume each year and is supplied to Country K. This product appeared to be one of the most important products in the portfolio, because it is exclusively sold in a sports arena. The commercial value of this product is very high. Country K claims that a national advertising costing millions of dollars has less effect than this specific can in terms of brand exposure and image. Products cannot be rated on their volume only. Whenever there is difference between products, then they are sometimes categorized in A, B or C products depending on their strategic importance and margins.
2. Small products are often needed to compose a certain package of products. Many supermarkets over the world will only let a certain brand on their shelves if at least three types of this brand can be supplied. This means that the HNS customers have to provide their clients with diversity. The HNS customer needs the smaller products to expose the mainstream (large volume) products.
3. As mentioned in the Inventory topic, small products can be of equal importance in terms of reliable supply to the market. If small products with high margin cannot be supplied to a supermarket, the supermarket can decline the mainstream products as well.

7.3.5. Impact and perception of the mono containers project

The project of mono containers is introduced in January 2007. This topic is of interest in this thesis, because the mono container project has impact on the inventory of customers and is therefore comparable with the project of Production Time Tables. The topic provides a wide range of information. Remarks that have a connection with the PTT project are listed below. Not all respondents are on the same line, but most of them agreed on the following points.

1. Some customers are forced to delist certain products, because a minimum batchsize is set. Customers expect to lose not only the small volume, but also mainstream volume due to the absence of the delisted product.
2. Growth is limited by the project. Example: Growing markets as Region G predict large problems with the project. Many countries in Region G have a history of war. Where the countries are currently slowly developing, the beer market grows in tight competition with the mobile phone market. If Heineken wants to stay in the market and create a distribution infrastructure, smaller volumes need to be admitted. Many customers in Region G cannot sell large quantities yet. Respondents describe that every large market starts small. In other words, the potential growth markets are harmed with the mono container project, according to the representatives.
3. Competitors that can deliver more service are gaining market share, because they can still deliver small quantities.
4. Many customers understand the concept of mono containers and the reason behind the project, but they believe that they get nothing in return. It is a gain for HNS and a loss for the customers. Customers experience the project as a negative impact on the relation between them and HNS.

7.3.6. Respondents' score per statement

To provide a quantitative indication of the results statements are listed together with the percentage respondents that have agreed or disagreed. Using the questionnaires for the interviews (see a copy in Appendix E), respondents are asked open questions about customer service, inventory, freshness, product portfolio and mono containers. Based on their stories and answers to these open questions fourteen statements have been set. Respondents have not directly responded to every statements, but their agree or disagree is filtered from their responses to the questionnaire. For that reason it is not the case that a perception for all statements can be drawn from every interview. Not all respondents have explicitly stated a reaction to each statement what leads to a combined percentages of below 100% per statement.

Statement	Agree	Disagree
OTIF is more important than lead-time	42%	11%
Carrier and documentation issues often delay shipments	42%	5%
More two-way communication is essential for the relationship	58%	0%
Larger customers have more power than the smaller customers	26%	16%
The customer and HNS have a good relationship	42%	21%
Storage can physically be expanded	58%	21%
Current safety stock is proven to be sufficient	68%	5%
An out of stock at the customer has direct effect on his market	58%	5%
Inventory management is not a core business for customers	26%	32%
There are no freshness issues in the current situation	53%	16%
Large products are more important than small products	26%	26%
Marketshare will be lost by the introduction of mono containers	42%	21%
Emerging markets are constrained by mono containers	37%	16%
Mono containers has a negative influence on the relationship	58%	11%

The scores are based on the 19 interviews. Every statement has at least 8 responses (=42% agreed + disagreed). Each statement can be connected to the described results of the previous paragraphs.

7.4. Conclusion

In this paragraph, the most relevant subjects of the interviews will be summarized. These subjects are based on their connection with the Production Time Table project.

1. Customers set their priority on reliability of supply. This means a correct estimated time of arrival (ETA) in the customer's warehouse.
2. The relationship between HNS and the customers is not unconditional. The customer has many realistic alternatives that can have negative consequences for HNS.
3. Customers would appreciate more communication, involvement, discussion and interaction between supplier (HNS) and reseller (customer).

In the following text, all three subjects will be explained.

Customers claim their priority on On Time In Full (OTIF) deliveries and less on order lead-time. This means that the lead-time could be increased a little if that would increase the percentage of OTIF deliveries. A distinction has to be made between HNS OTIF and customer OTIF. Customer OTIF is measured/perceived if the order is physically available in their warehouse. Being unable to clear containers from the port is often the cause of delay. Such a shipment of products is not delivered OTIF for the customer, but it might be for HNS if they measure until the moment that the container is unloaded at the port of destination. Production Time Tables will increase lead-time for certain customers. It seems that customers can agree with a longer lead-time only if orders will arrive as they have planned. Production can become more stable and reliable when PTT is introduced, but shipping is not controlled by the project. There is a risk that PTT is introduced what will increase lead-time, but also increase HNS OTIF. The problem is that customers will not necessarily experience an increase in customer OTIF, because the problems in shipping and documentation continue to occur. Example, HNS delivers all orders on time to the port, but customers still receive order too late. There can be several reasons that need to be researched in the short future. It can be caused by the lack of personnel in the order management/documentation department, but also by the inaccuracy of shipping companies such as Company A and B. HNS should guarantee that no errors are made in order management/documentation. Stricter negotiations with shipping companies and/or more attention by the internal departments for shipping accuracy are possible remedies.

Flexibility is a service that the customer needs. Especially the smaller, growing markets need to be able to explore the market with different products, mostly starting in smaller volumes. The customers fear the mono container project for its inflexibility. PTT could further decrease the customer flexibility in ordering desired quantities. The customers believe that the current relationship with HNS is good, but most resellers do not appreciate mono containers. Customers understand why HNS has implemented mono containers from a production point of view. However, some respondents have indicated that if another project like mono container will be implemented, the effects will be much larger. A very important remark, made by various respondents is that they realize that the good relationship with HNS will not hold customers indefinitely. Some customers are 100% Heineken partner, others only for a certain share. Finally there are the independent resellers that have no organizational connection with Heineken. There are many markets (Region A, B, C, D and E) that have indicated that if service from HNS will further decrease, resellers will be looking for other options.

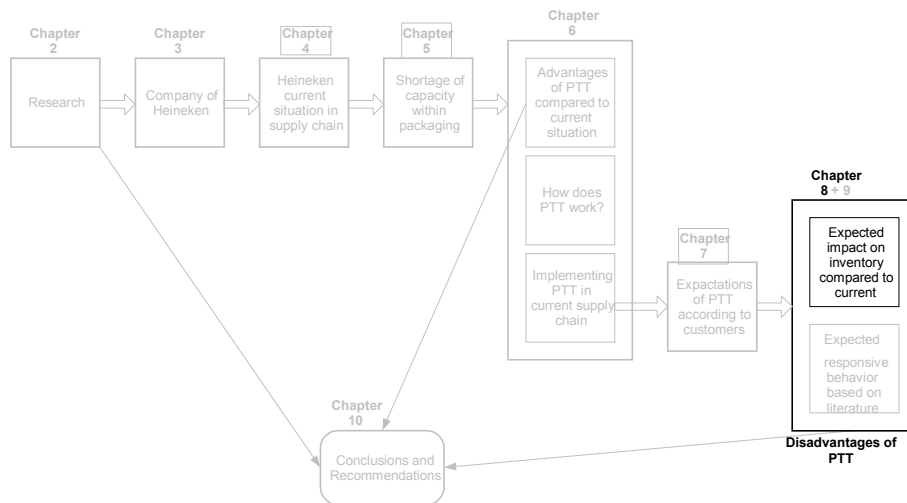
This can be to find another Heineken supplier other than HNS. Local Heineken breweries might be more expensive than HNS, but the service is claimed to be higher. This movement connects with the theory that procedural fairness is considered more important than distributive fairness by Kumar et. al (1995). An example is a customer in Country P that has recently switched from HNS to Heineken France for supply due to the issues in service, quality and supply with HNS. Independent resellers haven options, which are even worse for Heineken. That is that they will switch to the competitor such as Anheuser-Busch (Budweiser), Carlsberg or Inbev. The variety of alternatives of the customers is discussed on a more detailed level, further in this report.

Communication between HNS and the customers is very important. If HNS wants to change something, customers would like to be involved and informed well ahead of implementation. Discussion and influence in the project are appreciated as well. Involving the customer in a project such as Production Time Tables is a clear signal from the market to increase acceptance for a project.

Below there is a free interpretation of an answer from one of the respondents to the question what he would like to change in the supply chain. The text gives an interesting view of the perceived situation between HNS and customers.

Production and commerce are often too far apart. There should be a good market interface that discusses plans and projects with the market before they are implemented. A plan can be very good for production, but it can be devastating for markets. It is thought that production does not overlook the consequences well enough. Long-term growth possibilities should be more important than short-term winnings. What are the real implications of actions? The implementation of cost savings/efficiency actions is understandable, but should not destroy the potential of markets. If you cannot sell beer, you don't need to produce. If you cannot produce beer, you cannot sell it.

8. Expected impact on the outbound supply chain



In the previous chapter, the perceptions of the customers have been explored. Now it is time to overlook the consequences for these parties. Looking at PTT in the total supply chain, the project will probably have effect on the (inventory of) customers. This comes forward in paragraph 6.5. Also in the research design, it is expected that PTT will have a certain impact on the inventory position of the customers. First it is important to calculate the volume on which PTT will have impact. Next in this chapter an analysis will be given about the indicators that show the change in inventory for the impacted volume.

CDL has calculated that the timetable will generate an increase of 3% OPI. Because the suggested setup for PTT is the one that HNS would like to implement, this specific timetable is used for calculations. An overview of this table can be found in Appendix G.

8.1. Focus on impacted production volume

Production Time Tables will be used in Den Bosch for one-way bottles and cans only. These products are packaged on 6 production lines (4 bottle lines and 2 can lines). Before determining what will change for customers and how much things will change, it is important to determine what products/volume is impacted.

8.1.1. Using existing data

As mentioned before, Baarda and de Goede (1995) describe three ways to obtain data. One of them is the usage of existing information. Input data needed for the following calculations are gathered from internal Heineken sources. The exact locations of the Heineken files are indicated in the List of Reference. Figure XVI visualizes the used files to construct a volume distribution file. This volume distribution file is used for several calculations throughout the research.

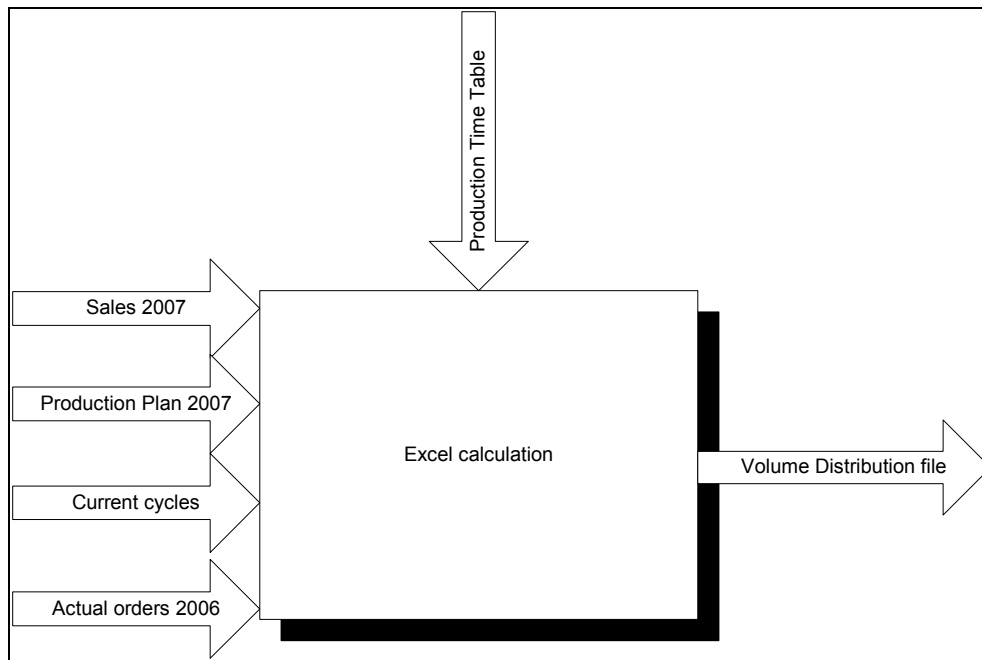


Figure XVI, Use of existing information to calculate volume distribution

The most important files are the Production Time Table files from CDL, the total sales of 2007, the production plan, the current cycles used in production and an overview of the actual orders of a whole year (2006).

The sales and production 2007 files are both latest estimates (see paragraph 4.4.2) in order to use the latest information. These files were last updated in January 2007 and provided by Strategic Supply Chain Planning. The sales 2007 file is the latest estimate of sales to each specific country for the whole year of 2007. The production plan 2007 shows exactly how much volume per SKU will be produced in which brewery. The current cycles indicate for each product what the current cycle is in order to compare this cycle with the planned cycle. Operational Supply Chain Planning Den Bosch provided this file. The file that contains the actual orders 2006 is helpful in determining the average actual order frequency of customers and originates from SAP BW, one of Heineken's databases (Business Warehousing).

8.1.2. *No impact for products in cycle 1 and 2*

The cans and bottles can be set in cycle 1,2,4 and 8 (Appendix G). These four cycles are chosen in order to be able to repeat the same pattern after a period of 8 weeks. The current cycles of products are 1,2 and exceptionally 4. HNS wants to know what will change for the customers in comparison to the current situation. Every SKU will have an old and a new cycle. The current situation follows the 4-week drumbeat as described in paragraph 4.3.3.

Comparing the regular 4-week drumbeat with cycle 1 and 2 of Production Time Tables shows that there will be no impact for the customer. It does not matter if products are produced weekly or bi-weekly. The drumbeat has 2 weeks for production. For this reason it is already possible to place products in cycles of 2 weeks and still hold the order drumbeat. Families with cycle 4 and 8 will indeed be impacted due to PTT, because drumbeat will not be possible in every week.

Looking for the impacted volume of Production Time Tables, it can be said that products with cycle 1 and 2 will experience no impact on ordering or inventory. There

is an exception however. Customer orders for Replenishment are made by HNS. These orders are produced directly in the week after ordering. Replenishment orders cannot be postponed a week. For that reason, it can be said that replenishment orders have a 3-week drumbeat and not a 4-week drumbeat. For replenishment markets where orders are currently produced weekly, a change to cycle 2 will have impact. The same counts for replenishment products that change from cycle 2 to cycle 1. All products that change from cycle 1 or 2 are considered equal when they change to cycle 4 or 8.

8.1.3. Volume distribution and localization of impact

In figure XVII, the distribution of volume is shown over the possibilities, depending on their old cycle.

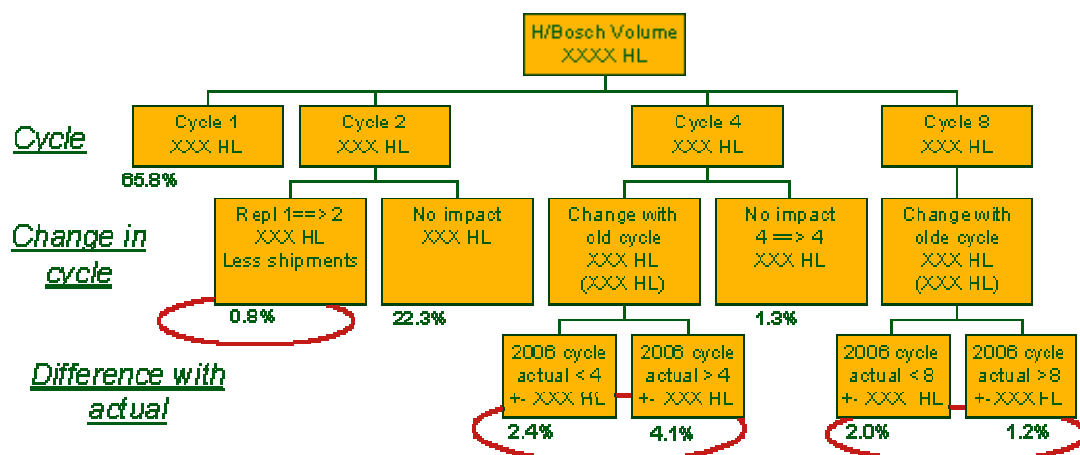


Figure XVII, Volume distribution of Production Time Tables in Den Bosch¹⁵

- 65,8 % of the volume is placed in a family with cycle 1. No impact will occur for these customers
- 0,8 % of the volume is replenishment volume to switch from cycle 1 to cycle 2.
- 22,3 % of the volume will be produced in cycle 2. No impact will occur for these customers
- 2,4 % of the volume will be placed in a family with cycle 4, while the product was ordered, on average per customer, more often than once every 4 weeks in 2006.
- 4,1 % of the volume is also placed in cycle 4, while actual orders from 2006 show that the products were ordered, on average per customer, less often than once every 4 weeks.
- 1,3 % of the volume will not experience impact, because the old cycle was already once every 4 weeks.
- 2,0 % of the volume is placed in a cycle of 8 weeks, while the products were ordered more frequent per customer.
- 1,2 % of the volume is placed in cycle 8, while actual ordering shows an average order frequency of more than once every 8 weeks.

¹⁵ Due to the confidentiality of certain information, not all data can be shown in this public version.

The red-circled volume represents the total 10.5% impacted volume. For this volume an inventory increase and freshness reduction is expected. How large this change will be is assessed in later paragraphs.

To understand where the impact is the largest, the combined impacted volume per country can be analyzed. The results show that the Country A is the market with the largest impact in terms of hectoliters. Country B, C, D, E and F follow. An interesting country is the D. They have several products in their portfolio that are impacted by the introduction of Production Time Tables. Nonetheless, one of the largest SKU's is changed from cycle 2 to cycle 1. Because the Country D is a replenishment market, they are able to receive more shipments than before. The volume of this SKU is XXX HL. The additionally needed inventory space is compensated by the decrease of inventory space created by this large SKU. In the overview below, a list of high impact countries is shown. The SKU's that are shown are only the ones that will be impacted. The cycle one and/or cycle two volumes are not shown.

Country	SKU	Volume
Country A	Product 1	X
	Product B	X
	Product C	X
	Product E	X
Country B	Product F	X
	Product G	X
	Product H	X
	Product I	X
Country C	Product J	X
	Product K	X
	Product L	X
	Product M	X
Country D	Product N	X
	Product O	X
Country E	Product P	X
	Product Q	X
	Product R	X
	Product S	X
	Product T	X
	Product U	X
Country F	Product V	X
	Product W	X
	Product X	X
	Product Y	X
	Product Z	X
	Product a	X
	Product b	X
	Product c	X
	Product d	X
	Product e	X
	Product f	X
	Product g	X
	Product h	X
	Product i	X
	Product j	X
	Product k	X
	Product l	X

Figure XVIII, Countries and SKU's with largest impact and their impacted volume¹⁶

From the list can be derived that the impacted products are mainly in a cycle of 4 or 8 because of the beertype. For example, Country C sells Amstel X, Amstel Y and Amstel Z, which are especially brewed for the area. Also, Country E has a special beertype called He-10, which is different from regular Heineken. Other SKUs are for specific markets within Country F. In some cases, the pack-type is the reason for the

¹⁶ Due to the confidentiality of certain information, not all data can be shown in this public version.

low frequency. Packtypes such as the 18-pack or 20-pack are not very common and do not have a high annual volume.

If the volumes are sorted per Multi Market Operating Company (MMO), the following chart can be presented. A MMO is a group of countries selected by region.

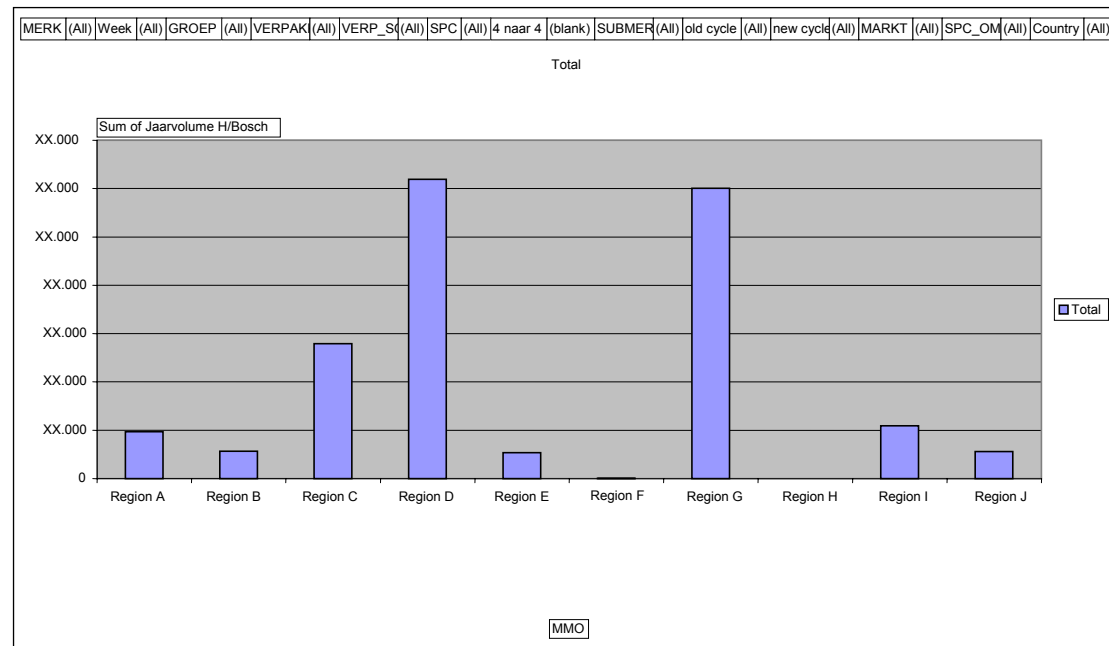


Figure XIX, Total impacted volume in HL per Operating Company¹⁷

Regions C, D and G have the highest peaks. The most remarkable impact is located in Region F and H. They show no impact. The absence of any impact has to do with the fact that almost all SKU's to this region are very general products. No specific beertypes, packtypes or labels are marketed in the region. This originates from the early days where Region F and H wanted Heineken at all costs. HNS offered general products only and this was no problem for the customers. The result is that almost all products are produced weekly or bi-weekly what indicates no impact.

8.2. Identification of indicators

By identifying the indicators that can measure the change in customer inventory, it is possible to review effects in the outbound supply chain. First, the different kinds of stock are identified. Then, the types of stock that change by the implementation of Production Time Tables are described in more detail.

Introducing Production Time Tables has influence on the customers' stock. The question is which stock needs to be reviewed by comparing the inventory situation with the current situation. For this current situation it is assumed that the project mono container has been rolled out at full extent. In other words, the current situation is included with mono containers and the difference with the current situation is considered as impact from PTT.

¹⁷ Due to the confidentiality of certain information, not all data can be shown in this public version.

Durlinger (1998) mentions different sorts of stock. At first, there is a difference between stock of raw/packaging materials and (self produced) end-products. Although inventory includes all goods and materials that are used in production and distribution (Fogarty, 1991), only finished products will be analyzed. The focus is on the effects in the outbound supply chain of end-products. That is the reason that the raw/packaging materials, parts and subassemblies are not considered in this calculation. Next, Durlinger (1998) describes that end-products can be divided according to the following function of the inventory:

Type of stock	Description
Safety stock	Safety stock is held to cover uncertainties from both the inbound flow as the outbound flow of an inventory.
Pipeline stock	The amount of stock 'in-transit' between supplier and customer
Anticipation stock	Building up seasonal stock for time where demand is larger than supply
Cycle stock	Stock based on the size of incoming batches.
Strategic stock	Stock that is held, because some products cannot be supplied at all time. Also known as a mega safety stock.
Obsolete stock	Stock that cannot be sold anymore

Figure XX, Description of end-product stocks according to Durlinger (1998)

Because it needs to be calculated what consequences PTT will have on customers' inventory, only the stocks that will change are considered. The stocks that will not change as a direct effect of PTT will remain of equal value. The transportation time from A to B will not change in the new situation. For that reason 'pipeline stock' is not of interest for the research. It is assumed that demand will not change due to Production Time Tables so that 'anticipation stock' will not be influenced by the project.

The following types of stock are influenced by PTT and used in the further research:

Type of stock	Production Time Table impact
Safety stock	Lead-time
Cycle stock	Batchsize
Strategic stock	Large intervals where no supply is possible
Obsolete stock	Higher stocks approaches expiry date = freshness

Figure XXI, Affected types of customer stock by PTT

Safety stock is used to cover uncertainties in demand and in order lead-time. Both can vary for the HNS customer. The demand from the markets can fluctuate and supply from HNS does not always arrive exactly when expected. Fogarty et. al (1991) describe safety stock as stock that "enables an organization to service its customers when the demand for that service is above average or when delivery of replenishment stocks takes longer than usual." Weijers (2000) said that people are only willing to lower their stock levels if they believe in a reliable supply.

Cycle stock depends on the ordered amount of product by the customer. It is created by the attempt to order and/or supply batches instead of one unit at the time. Since the mono container project has been introduced, all orders have to be of a minimum amount of one full container. Larger orders have to be a multiple of one complete container. Customers will not order one case or tray of beer at the time.

Strategic stock is held to compensate for times that products are not available for supply. Examples are nature products like coffee and fruit. Additional stock is kept to cover for natural disasters or disappointing harvest. The same kind of stock is held in cases where products are available only a few times per year. These strategic stocks are called mega-safety stocks. Strategic stock is a safety stock for large fluctuations in long-terms. (Durlinger, 1998)

Stored products that will not be sold anymore are described as obsolete stock. If food-processing products like beer become obsolete/deteriorated, it is dumped, which not only implicates the lost value of the finished product but also generates additional dumping costs.

Safety, cycle, strategic and obsolete stock can now be considered as the indicators, which need to be reviewed for the impact of PTT on the customers' inventory.

8.3. Analysis of changing indicators

This paragraph will describe what calculation methods are commonly used to calculate changes in the different types of stock. Using the input from the Production Time Table constructed by CDL, actual effects can be calculated to indicate the changes in inventory for the HNS customer if the table would be introduced. The used cycles per family are assumed as most ideal for both production and market. The cycles are indicated in Appendix G.

8.3.1. Impact on safety stock

As mentioned before, safety stock is held to have enough stock for uncertainties in both supply and demand. Hadley and Whitin (1963) have defined a formula that can calculate how much safety stock you must keep to guarantee a certain service level towards your clients.

$\text{Safety Stock (units)} = \kappa * \sqrt{LT * \sigma_D^2 + \sigma_{LT}^2 * D^2}$	
κ	<i>Factor for service level</i>
LT	<i>Average lead-time</i>
σ_D	<i>Standard deviation weekly sales demand</i>
σ_{LT}	<i>Standard deviation lead-time</i>
D	<i>Average weekly sales demand</i>

Figure XXII, Safety stock formula

1. The planned service level indicates a percentage of how often you will have to reject an order, because you have an out of stock situation. For example, if this percentage is 95%, you guarantee that 95 of 100 orders can be supplied from stock. The factor κ is calculated based on a standard normal distribution (mean of zero and standard deviation of one). At 95% service level, the factor is 1.65. At 90% service level, the factor is 1.28. If you want to guarantee a service level of 99,5%, the factor is 2.57. Strike (2003) gives a good visualization of 95% service level where there is a 5% chance that a party does not hold sufficient safety stock.

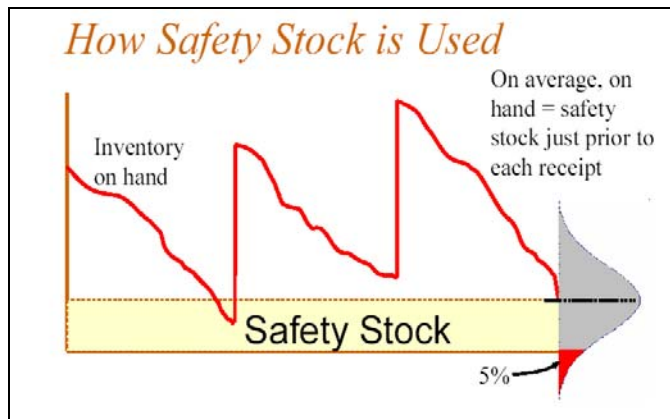


Figure XXIII, Visualization of 95% service level on safety stock (Strike, 2003)

2. Lead-time is the amount of time it between ordering and receiving an order. A mistake that is often made is that lead-time, used for calculating safety stock is measured as being the sailing time. Lead-time should be defined as being the time between issuing an order and receiving it (Sipper et al., 1997). To avoid any mistakes in calculating the real order lead-time, it is decided to split lead-time in two parts, production time and transportation time (ProdT and TransT). Lead-time is the sum of the two parts.

ProdT is the time in weeks it takes from the moment the customer orders until the moment it comes off the production line. The current Drumbeat is 4 weeks between ordering and actual shipping. The final week is used for transportation from brewery to port and administration of the cargo before actual departure of the vessel. This means the current ProdT is 3 weeks. The APICS dictionary calls this manufacturing lead-time, defined as: “The total time required to manufacture an item, exclusive of lower level purchasing lead time. Included here are order preparation time, queue time, setup time, run time, move time, inspection and put-away time.”

TransT is the time in weeks it takes from the brewery until arrival at the customer’s warehouse. This means one week from brewery to port, an X amount of weeks for sailing (depending on the destination in the world) and one more week for clearing the container from customs and delivery to the warehouse at its final destination.

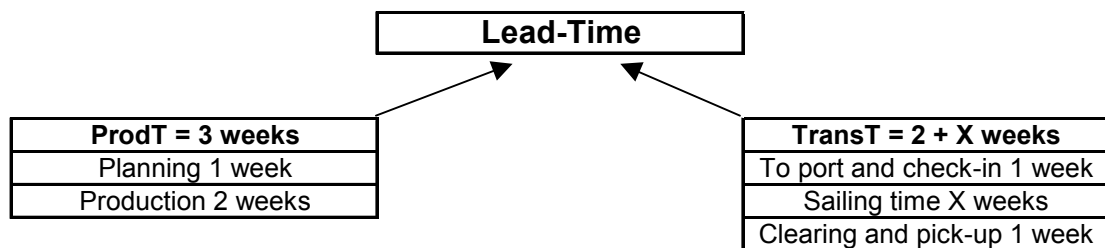


Figure XXIV, Current composition of order lead-time

TransT is not likely to change with Production Time Tables compared to the current situation. The X amount of weeks for actual sailing remains constant. ProdT can increase for products of the impacted group (see §7.1.3), because it depends on the ordering moment whether if the customer can count on the normal ProdT or a longer one. The MTO products with cycle 1 and 2 will keep a ProdT of 3 weeks.

3. The third variable in the safety stock formula is the standard deviation of weekly demand. The deviation indicates how much irregularity there is in demand compared to the predicted average weekly demand.
4. Standard deviation of lead-time indicates the irregularity in supply to the customer.
5. Finally, the average weekly demand is the amount of beer that the customer expects to sell.

PTT influences many different customers over the whole world. To calculate the change in safety stock for every customer individually, this would consume many man-hours and a large amount of data, because every customer has different variables for every SKU. Furthermore, the objective of the research is to create a general indication of the impact on inventory of the HNS customer. In order to create a general calculation of the impact on safety stock by PTT, it is helpful to look at the formula and decide which factors are actually changing and how the formula can be simplified.

First, the service level factor κ of every SKU will remain the same, because the service level to clients of the HNS customer will not change. Next, it can be said that average demand and its standard deviation will not change either between both situations. For lead-time and its standard deviation, it is easier to use the maximum lead-time (instead of the average) and a standard deviation of zero. In the original formula lead-time is set in a normal distribution with a certain standard deviation, which is very product/customer specific. Average lead-time and maximum lead-time are equal for the current situation, because lead-time is the same for every moment in time (Drumbeat). When using cycles of 4 and 8 weeks in PTT, the lead-time can be used that is the least favourable (just missing the optimal ordering window). Together with customers, it has been decided to communicate lead-time in number of weeks and not in days. This simplifies the expectations of both sides and discussions about lead-time deviations. Exact lead-time could be varying between 10, 11, 12 and 13 days, but setting lead-time at 2 weeks is more stable and easier to use for all parties.

After making these simplifications, the only term that changes in the SS-formula is the maximum lead-time. For that reason we can isolate this term and use it to determine the change in safety stock resulting from introducing cyclic production weeks. Lead-time is the sum of ProdT and TransT. Comparing the current situation and different cycles with maximum ProdT with PTT results in the following overview.

ProdT (in weeks)		
Cycle once every X weeks	current max	PTTmax
1	3	3
2	3	3
4	5	5
8	N/A	9

Figure XXV, Maximum production times per cycle

Example: a product is currently being produced in a cycle of once every two weeks. The Production Time Table places the product with his family in a cycle of once every 8 weeks. TransT = 4 weeks.

$$\begin{aligned} \text{TransT} &= 4 \text{ \& Cycle} = 8 \\ \text{Situation0} : \sqrt{LT0} &= \sqrt{(4+3)} = 2.6458 \\ \text{Situation1} : \sqrt{LTptt} &= \sqrt{(4+9)} = 3.6056 \\ \frac{\text{Sit1} - \text{Sit0}}{\text{Sit0}} &= 36\% \end{aligned}$$

The current ProdT is 3 weeks. TransT is 4 weeks. The square root of 4+3 is compared with the square root of 4+9 weeks in the new situation. Max ProdT for the new situation is 9 weeks. TransT does not change and remains 4 weeks. With this calculation it can be said that safety stock is likely to increase with 36% if PTT is implemented. Not all customers have the same TransT. Calculations are made for scenarios between 2 and 6 weeks TransT. It can be said that 2 weeks is the minimum TransT. Packaged products can be transported to the port within one day. Depending on the departure day of the vessel, it can take up to one week until the actual departure day in the week. The sailing time can be as little as one day. The process of clearing, documentation, pick-up and transportation to the customers' warehouse can be done in a few days. Summing the days for TransT and rounding it to whole weeks, the minimum TransT can therefore be set on 2 weeks. A TransT of 6 weeks holds 4 weeks of actual sailing time. 4 weeks sailing time is considered maximum to reach worldwide destinations. For reference, UK has a actual sailing time of 1 day and a container to the USA takes between 2 and 4 weeks of actual sailing, depending on the destination (East-coast or West-coast). In the figure below, the safety stock increase per scenario is visualized.

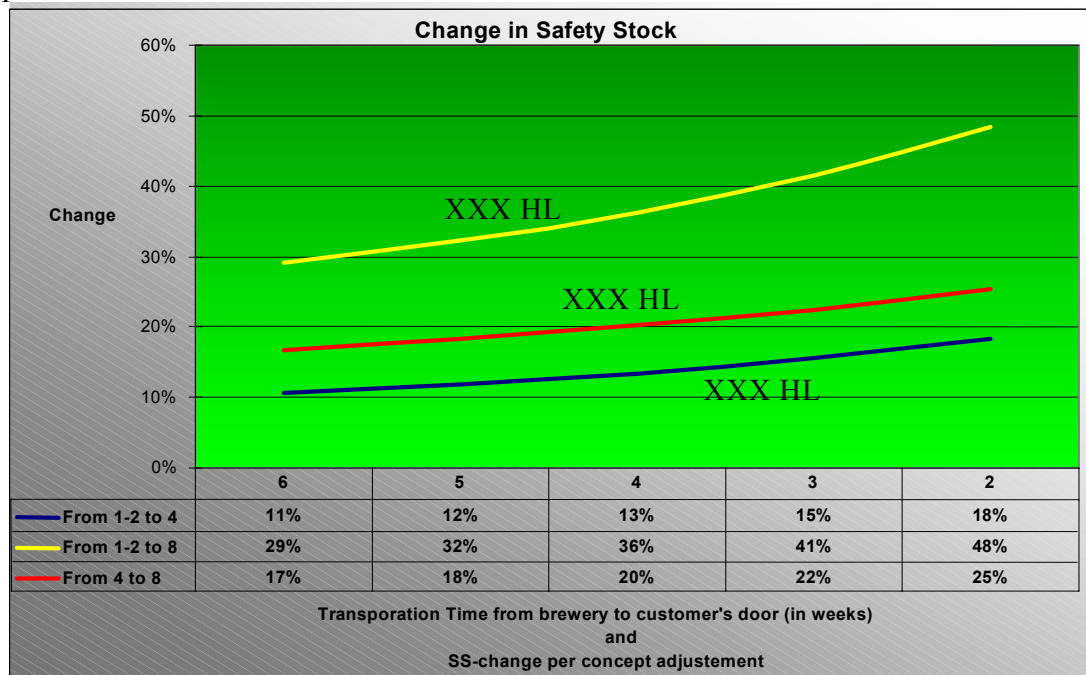


Figure XXVI, Overview of safety stock increase for different scenarios¹⁸

¹⁸ Due to the confidentiality of certain information, not all data can be shown in this public version.

At a shorter TransT, safety stock increases more. This has to do with the fact that the relative increase is larger if lead-time (ProdT + TransT) increases from 5 to 8 than an increase from 9 to 12 weeks. It is no surprise that safety stock will increase more when products are placed in a cycle of 8 weeks (yellow line) than in a cycle of 4 weeks (blue line). If the old cycle is 4 weeks and the new cycle is 8 weeks (red line), increase occurs as well. The impacted volume is indicated per concept change.

An important assumption for the calculation of safety stock increase is that the customers hold a safety stock according to the formula in the current situation. From the market interviews it can be understood that not all customers actually use a formula to determine the height of their safety stock. Many of them determine their safety stock by trial and error. After some years of experience, customers hold a certain amount of safety stock.

8.3.2. *Impact on cycle stock*

Cycle stock is determined by the size of a product order. If for example a customer orders one container every week of a certain product, he will hold a lower cycle stock than a customer that orders 4 containers every 4 weeks of that same product even though the demand is equal for both situations.

Cycle stock can be determined as follows:

- Example: Customer A sells 35.000 HL annually of product X and places 35 orders in one year. The average order size is 1.000 HL. Throughout the year, the customer will have an average of 500 HL cycle stock, which is $\frac{1}{2} \times \text{Order size}$. Cycle stock = $\frac{1}{2} \times \text{Order quantity}$

To learn more about ordering and eventually the change in cycle stock, general inventory models (Coyle et al., 2003, Durlinger, 1998, Fogarty et al. 1991) are analyzed and compared to the Heineken situations.

Ordering always follows this statement: When on a given moment, stock goes under a certain level we have to order a quantity. When is this given moment? What is this certain level? And how much is a quantity? Ordering can be divided in four categories, based on the following two criteria:

1. Will I review stock continuously or in periodic intervals?
2. Do I order fixed or variable batches?

Using this theory, the next overview can be made according to the current Heineken situation, the mono container situation and the PTT situation. They all have influence on one or two of the criteria that constantly changes the ordering situation for the customer and therefore the cycle stock. The focus is still on the products that experience impact from PTT. The review period for Drumbeat and mono containers is considered continuous, because customers can order every day of the week, with an equal lead-time per week (3 weeks + TransT).

<i>Situation</i>	<i>Review period</i>	<i>Order quantity</i>	<i>System</i>
Current Drumbeat	Continuous (weekly)	Variable (at least 1 pallet)	BS
Mono containers	Continuous (weekly)	Fixed in whole containers	BQ
PTT	Periodic (4-8 weeks)	Fixed in whole containers	sQ

Figure XXVII, Ordering systems per situation at Heineken

In the current drumbeat situation, customers can order in variable quantities of at least 1 pallet. This system (BS) is the most flexible where the customer can order what he wants, when he wants.

After introduction of mono containers, the system will change to BQ. Not only a minimum order quantity of 1 container is set, but also ordering 1,5 or 2,5 containers is not allowed anymore. In this system customers have to order whole containers, but can still decide when they want to receive it.

Launching Production Time Tables will reduce flexibility in ordering. Customers only have a 'window' of once every 4 or 8 weeks where lead-time is minimal. It is as if the customer reviews its stock once every 4 or 8 weeks.

The impact on cycle stock from PTT comes from the limited amount of times a customer can order his product in a year combined with the fixed batch sizes.

Moving to the sQ system has a twofold effect on cycle stock of the impacted customers:

1. Same volume, less orders = larger order quantity = higher cycle stock
2. Every order needs to be rounded to whole containers

The objective of this research is to find the impact of PTT on the inventory in comparison to the current situation. Analyzing the two effects on cycle stock will do this.

1. Products that are placed in cycles of 4 and 8 weeks have two types of customers:
 - Customers that (currently) order more often than the new cycle
 - Customers that (currently) order less often than the new cycle

The impact on cycle stock only applies to the first group, whereas the order size will increase compared to the current situation and given the same annual volume. To determine the distribution on cycle stock impact for customers, it is necessary to look at the actual customer orders of 2006. By using the file with actual orders of 2006, an average order frequency per customer-SKU combination can be made. Making this analysis creates a list that indicates, on average, how often customers ordered their SKU's in 2006. As mentioned before, multiple customers can order one SKU. By selecting the most frequent-ordering customer per SKU, this list can be compared with the new, proposed SKU-cycles. The most frequent ordering customer is selected, because that indicates the highest order cycle from one customer. From the comparison a distribution of volume is created.

- SKU's of which the production frequency will become worse for customers compared to 2006
- SKU's of which the production frequency will not become worse for its customers compared to 2006

Of course, the SKU-customer combination from 2006 is not equal to the SKU-customer combination for the future. Customers can change their order pattern and SKU's can be created or delisted. For this reason, a distribution in percentages is made to use on the new volumes. The figure below indicates that 50% of the volume has been ordered less frequent in 2006 than the proposed cycle ('not worse') and the other half of the impacted volume is ordered more frequent ('worse').

Sum of HL/customer		
Compare proposed-actual	Proposed frequency	Total
not worse	4	39,3%
	8	10,4%
worse	4	29,9%
	8	20,4%
Grand Total		100,0%

Figure XXVIII, Distribution of actual order frequency versus proposed PTT cycle

For this research, impact that is caused by the mono container project is included in the current situation and not in the new situation to avoid the mix of impact of mono containers and of PTT. For this reason, the mono container impact needs to be filtered from the results above. In 2006, customers were still allowed to order so-called LCL (Less than Container Loads). Since January 2007 these LCL's are not allowed anymore due to the mono container project. If customers ordered half containers per SKU in 2006, the cycle stock will increase if only full containers can be ordered from 2007. However, this increase in cycle stock is not caused by PTT. The mono container effect is only applicable to customer-SKU combinations where the proposed cycle is worse than the current frequency in which customers order LCL. To identify these orders, customer SKU combinations are labeled LCL if the average customer order is smaller than 144 HL:

Pallets per 40' container = 24

Average # HL per pallet = 6 (24 bottles/cans * 33 cl * 72 cases/pallet)

HL per container = 144 HL¹⁹

In figure XXIX, a sample is shown from SKU's that are ordered in LCL (<144 HL/order). The columns are the actual (average) 2006 cycle, the proposed (PTT) cycle and the average volume per order in HL. The cycles are indicated as "ordered once every X weeks". If these LCL customers would order full containers (144 HL), the order volume is increased and the cycle will surpass the proposed cycle of once every 4 weeks. This counts for all customer-SKU combinations that have been ordered LCL in 2006. Filtering the mono container impact means less cycle stock impact from PTT:

- 3,9 % from cycle 4-worse to cycle 4-not worse
- 1,7 % from cycle 8-worse to cycle 8-not worse.

In figure XXX, the impact on cycle stock without mono containers is shown. This means that no cycle stock increase from mono containers is involved anymore.

Actual cycle	Proposed cycle	Average ordervolume in HL
3,3	4	27
2,6	4	22
2,5	4	56
2,6	4	40
2,0	4	13

Figure XXIX, Example of actual versus proposed cycle with LCL order volume

¹⁹ These numbers are provided by B.J.H.van Delft (Manager Operational Supply Chain Planning Den Bosch) and P.J. van Kooten (Project leader Logistics DCS). Container volumes can change significantly, but 6 HL/pallet is the most common number.

Sum of HL/customer			
Compare proposed-actual	Proposed frequency	Total	Without LCL
not worse	4	39,3%	43,2%
	8	10,4%	12,1%
worse	4	29,9%	26,0%
	8	20,4%	18,7%
Grand Total		100,0%	100%

Figure XXX, Distribution of actual order frequency versus proposed PTT cycle without mono container impact

After filtering the mono container effect from calculations, the following impact on cycle stock that is caused by implementation of Production Time Tables can be given. From the impacted volume of cycle 4 and 8 in Den Bosch:

- 43% is placed in cycle 4, but will not force customers to increase their cycle stock / order size.
- 12% is placed in cycle 8, without an increase in cycle stock

-----+

55% will not experience any direct increase in cycle stock

- 26% is placed in cycle 4 and will need to increase their average order size which means an increase in cycle stock
- 19% is placed in cycle 8 for which customers need to increase cycle stock

-----+

45% will experience direct increase in cycle stock

The cycle stock impact of 45% is equal to 4,4% of the entire Den Bosch volume or XXXX HL. The above distribution is used in the entire Den Bosch volume chart in §7.1.3.

The exact total amount of cycle stock increase is impossible to determine, because the order behavior of every SKU-customer combination cannot be predicted. If PTT is implemented it is interesting to review the order sizes a year after implementation. Comparing the numbers to 2006 can give a good effect on cycle stock/order size increase.

2. Except for the fact that some customers cannot order as much as they were used to, there is also the consideration of mono containers which means that whole containers have to be ordered. The situation leads to the following effect: Actual sales from the customer over a period of 4 or 8 weeks are seldom an exact multiple of a whole container. A customer faces this dilemma:

- Divide forecasted sales in one cycle by a whole container volume and round it down. Result: out of stock at the end of the cycle
- Divide forecasted sales in one cycle by a whole container volume and round it up. Result: overstock at the end of the cycle

Compared to the situation with mono containers, the cycle is either 4 or 8. In the mono container situation, customers can decide this cycle to their advantage. 4, 5, 7 or 9 for example, depending on the fluctuations in demand.

All impacted customers will experience this disadvantage of rounding containers. How much extra cycle stock it will generate is impossible to say, because it depends on the exact demand per cycle per product per customer. However, the following indication can be made: Every customer is forced to order full containers sub-optimally, because he cannot determine the week of arrival. This is a lack of flexibility.

8.3.3. *Impact on strategic stock*

Durlinger (1998) describes strategic stock as a mega safety stock that is held, because products are not always available for supply and if they are, the supply is not always guaranteed. He uses examples as seasonal, agricultural products and very rare metals that can only be offered once or twice per year. His approach is that additional stock needs to be kept in case the rare production fails and the supply is missed.

The risk is to go out of stock for a long period if one delivery is not supplied. If a wholesaler needs to have product available throughout the year, but he gets delivered only every other month, he is very dependent of this rare supply. If the supply is guaranteed, there is no further issue, but an unstable supply forces the wholesaler to hold strategic stock in case the supply is cancelled/disturbed. Causes of disturbance can be political unrest, strikes, war and ruined harvest, but also a failed production-run from Heineken. The supply of beer is not directly threatened, but it is very important for Heineken to acknowledge that long interval products cannot be postponed until the next cycle. Products in cycle 4 and especially cycle 8 need to be produced at all cost. Otherwise, supply becomes unstable and all customers with these products have to hold strategic stock.

8.3.4. *Impact on obsolete stock/freshness*

It is possible that a new product replaces an older product, which is still in stock. This is also known as commercial obsolescence. The old part of the stock should not be considered as stock anymore (Durlinger, 1998) but removed as soon as possible. Commercial obsolescence can be seen as a risk of holding inventory. The APICS Dictionary (1987) defines obsolescence as “Loss of product value resulting from a model or style change or technological development. See: deterioration”. The reference to deterioration indicates the link between obsolescence and freshness. Deterioration is “product spoilage”. In this research obsolete stock and freshness are used parallel. When stock reaches a certain level, the freshness can come in danger, which creates the risk to make stock deteriorated/obsolete. This is a large risk for perishable products from the food-processing industry that mostly have expiry dates and therefore restricted shelf lives (Soman, 2005). If the product is older than a pre-determined amount of days/weeks, it needs to be replaced with new product. Obsolescence can also be defined as: “The process of becoming obsolete; falling into disuse or becoming out of date”. (wordnet.Princeton.edu)

After 1999, one of the biggest competitors of Heineken, Anheuser-Busch (Budweiser) began an advertisement campaign in the USA that promoted the freshness of their beer (Moore, 1999, van Riemsdijk, 2003). Heineken needed to react and made changes to their supply chain to reduce the age of the beer by moving the decoupling point between customer demand and actual production more downstream. Freshness

became a hot issue for Heineken in the whole world. As discussed in the market interview chapter, freshness was discussed with various markets. The respondents have ranked freshness still as an important factor, but no large issues could be presented. Markets believe that the current lead-times and stock levels supply the world market with beer that is within freshness constraints.

In the project of mono containers, there has also been an analysis about what the largest cycle of a product could be to remain within freshness. It was decided that a cycle of once every 8 weeks would guarantee freshness through the supply chain at normal sales rate. This is based on an expire time of 6 months of which:

- 2 months production interval (=8 weeks)
- 1,5 month Drumbeat and transport
- 0,5 month safety stock
- 2 month for actual consumption

6 months

In previous paragraphs it is presented that the different stock types of all impacted customers will increase if Production Time Tables are introduced. Stock and freshness are directly connected. If a customer has to hold more inventory than before, the age of the product will increase. The maximum cycle of 8 weeks in the PTT project is based on the calculation above to guarantee freshness after implementation of PTT. However, this guarantee is based on the assumption that a customer receives fresh product every cycle. But due to the fact that the customer has to round up (to avoid out-of-stock) his order to whole containers, it occurs that stocks become higher than 2 months production interval.

In figure XXXI, a simplified visualization of three scenarios is given. Product X has a very steady demand of 21,5 HL/week (=150 HL per 7 weeks). No safety stock is held, because in this example, the deviation of demand and lead-time is zero. In this example, a full container of product X holds 150 HL.

Scenarios:

- Mono container: The customer receives a full container every 7 weeks, holding an average stock of 75 HL.
- PTT 1: The customer still orders one container at the time. The product is only available every 8 weeks, in week 1,9 and 17. The figure shows that the customer will go out-of-stock every week. Back-orders are not included in this graph.
- PTT2: Shows the alternative for the customer to avoid out-of-stock. In week 1 he receives 2 containers of product X. If he does not receive another container in week 9, he will go out-of-stock in week 15 and 16. For that reason the customer wants to receive a full container in week 9. Now he holds almost twice as much cycle stock as in the mono container scenario.

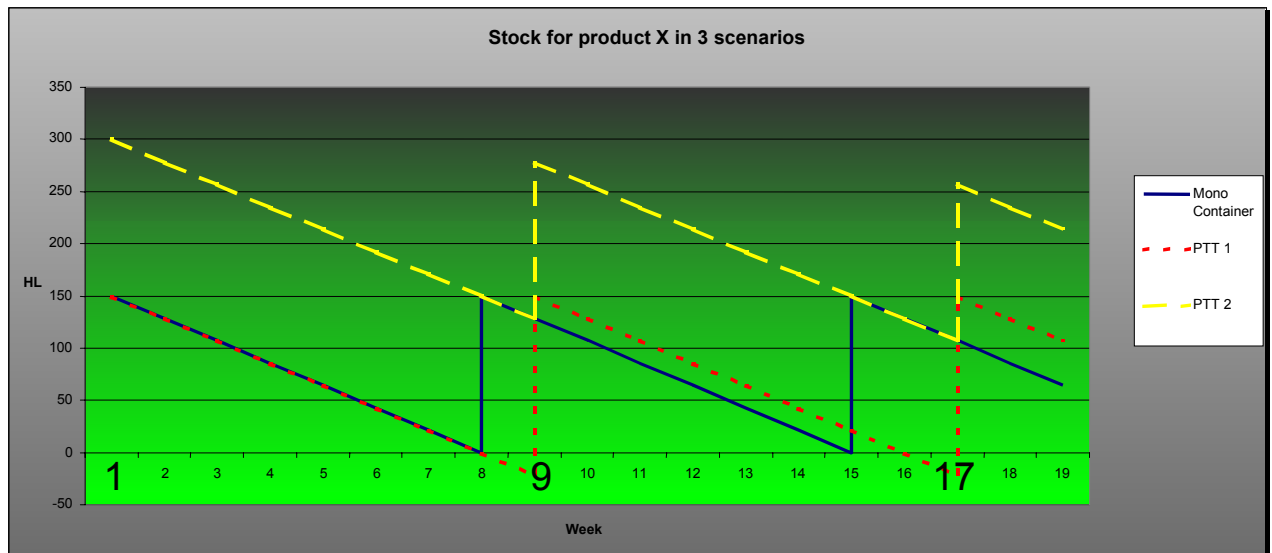


Figure XXXI, Three different cycle stock scenarios for the same product X

The increase in stock has direct effect on the freshness of the products, especially for the products that are placed in cycle 8 (XXXX HL). In the example, obsolete stock is considered deteriorated stock. This is from a freshness standpoint. Stock can also become obsolescence from a commercial standpoint. For Heineken, this can be that the product will receive a new design or is replaced by another type of product. These are commercial instruments to create competitive advantages. The higher the stock, the longer it takes to deplete it. If the commercial department wants to change the design of a product, they will have to wait until the older product is depleted. The higher stocks that are caused by the implementation of PTT can create a risk that commercial responsiveness will decrease.

8.4. Conclusion

Introducing PTT has effect on the inventory position of certain customers. In this chapter it is analyzed which customers will experience impact on what part of the volume. Reviewing the different stock types, shows the inventory impact. Customers will notice effects from PTT if their products are placed in cycle 4 or 8 where they used to be in cycle 1 or 2. Replenishment products that go from cycle 1 to cycle 2 are considered as well. The impacted volume is XXXXX hectoliter divided over 94 SKUs. This is approximately 10 % of the entire Den Bosch volume where the Production Time Tables are used. Country A, B, C and D are the countries with the largest volume impact (XXXX HL).

Safety stock will increase in the following ranges:

- 11-18% increase (XXX HL)
- 29-48% increase (XXX HL)
- 17-25% increase (XXX HL)

Cycle stock will increase on two levels. First, the customers that order their products more often than the proposed cycle in PTT, will directly have an increase in cycle stock, because they have to order the same annual volume in larger batches. After

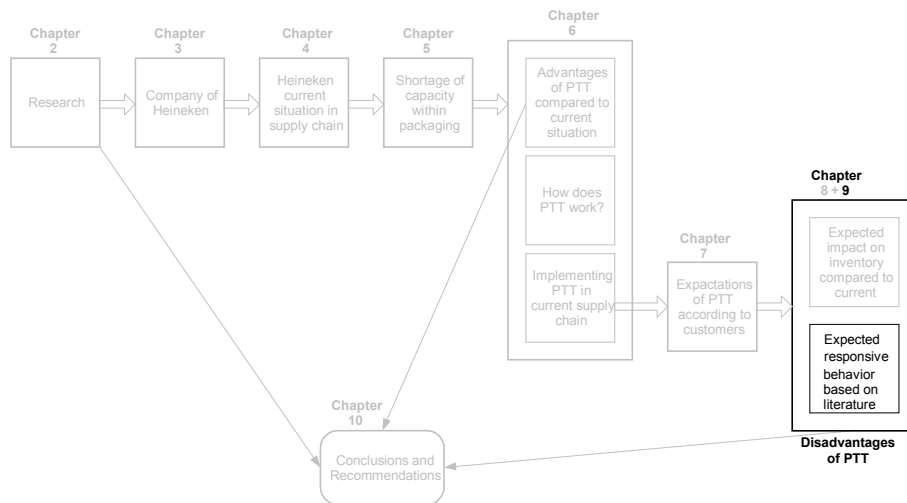
filtering the effect of mono containers, 45% of the impacted volume will experience cycle stock increase. This comes down to 4,4 % of the entire Den Bosch volume (XXX HL).

The other increase in cycle stock influences the whole impacted volume of cycle 4 and 8 (XXX HL). This increase is caused by the combination of PTT with mono containers. Every order has to be rounded up to entire containers. The customer cannot choose the ideal moment of receipt of full containers. The result is sub-optimal order volumes and lack of flexibility.

Customers with products in cycle 8 (XXX HL) will have to review their trust in production. Customers can be tempted to hold strategic stock, where the customer anticipates on the chance that something will go wrong in production precisely in the (rare) week that his product is produced. Depending on the chance that he will not be able to receive his order, he will keep a mega-safety stock of 8-week demand in order to continuously supply his clients when HNS cancels the delivery.

As an effect of the increasing stock levels at the customers, the guarantee of freshness cannot be made anymore and products can become obsolete. This guarantee can only be held when every customer will receive fresh product at least once every 8 weeks when cycle stock reaches zero. Not only the freshness constraint will be jeopardized, but PTT will also decrease commercial responsiveness, because the high stock delays the speed of introducing new products or designs.

9. Expected responsive behavior of customers



The additional inventory that affects the customers of HNS can be considered as a negative impact. But if it is decided that the positive influence by PTT on productivity is larger than the costs created in the market, HNS can decide to implement the project. However, there is another issue that needs attention before drawing conclusions. The previous chapter has described only the first part of the impact on customers. There is also a second part. This has to do with the changing quality of the relationship between HNS and their customers and the possible consequences of that change. By reviewing marketing channel relationship literature from Hibbard et al. (2001) and other sources, another form of impact can be found from introducing Production Time Tables.

Before discussing Hibbard's theory and the Heineken situation, a little bit more is explained about customer service and quality of a relationship according to various sources of literature to show the importance and relevance of service quality.

9.1. Literature on quality of service and relationships

Van Goor et al. (1996) state that "Customer service is a customer-oriented company philosophy that integrates and controls all elements with respect to the interface with the customers, within a beforehand-determined optimum of costs and service." What happens if a company cannot deliver the determined service? Coyle (2001) describes that if you cannot supply your customer, you can not only loose the missed sales, but also run the risk that the customer might permanently prefer the service/product of the substituting company. Furthermore it has been a long-known fact that customer service and company revenue are related. Stewart, W. (1965) wrote that it is recognized that the quality of distribution service can have a significant impact on market share, sales and long-term customer loyalty. However, service and revenue are not related linearly. Christopher (1998) describes the relation between service level and profit contribution. To improve customer service, additional costs are involved. Approaching a 100% service level involves extreme investments. 100% customer service means that a supplier will have product available in any given situation. This

includes that all possible failures in production or distribution are covered as well as all unexpected increase of demand. The relation is visualized in the figure below.

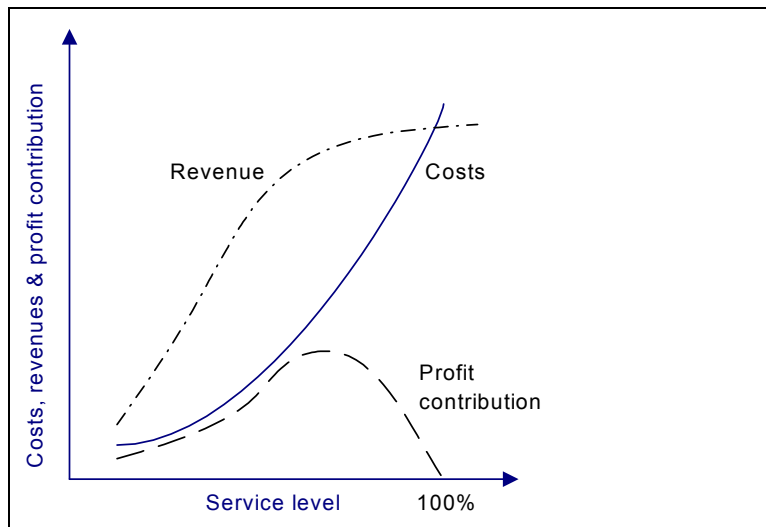


Figure XXXII, Cost and benefit of increasing service level (Christopher, 1998)

Menken (2002), has described the reason of the relation between service quality and revenue extensively. He shows what effect high quality of service has to the market. This analysis in his Master Thesis is based on the vision of Rust et al. (1994).

(start quote)

“Rust has developed a conceptual model in which the general effect of quality on the cost and sales of a company are described. This conceptual model is shown in figure XXXIII and will be explained.

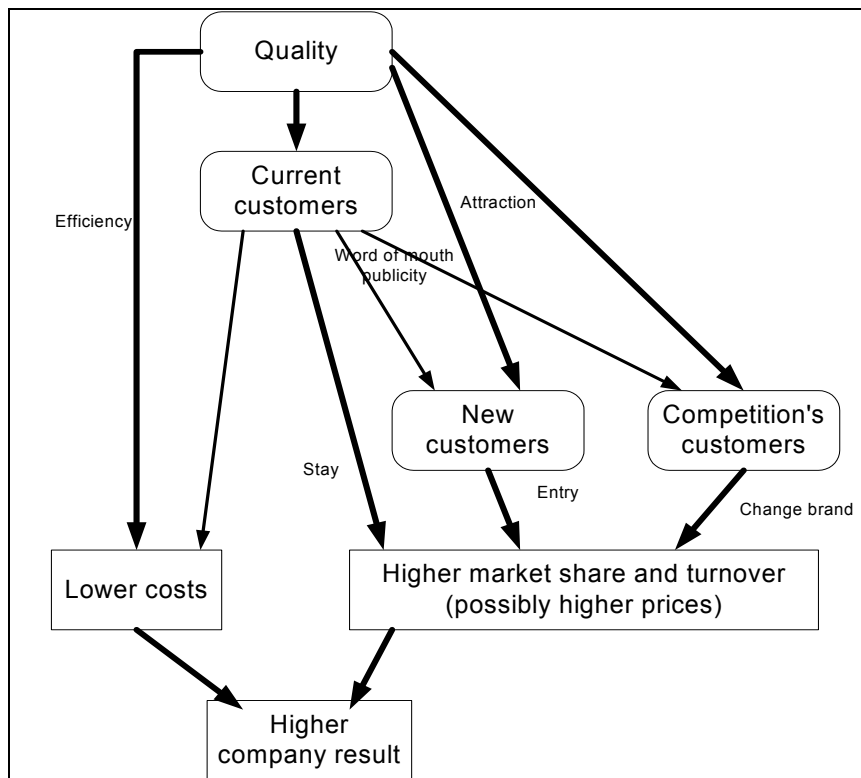


Figure XXXIII, Influence of quality on company result

The most important effects of service quality on the company result will be realized by:

1. Lower costs: by a higher efficiency, the costs will be lower. In the case of Heineken this comes forward by making less mistakes in the orders as a result of a lower workload. Supplying customers less often causes this lower workload.
2. Higher conservation of customers: when customers are more satisfied concerning the quality of the service, they will become more loyal to the venture and therefore change less rapidly to a competitor. A study by the U.S. Department of Commerce has revealed that the costs for winning a new customer are on average five times as high as the costs for preserving a current customer. Further studies have shown that faithful customers spend more. Finally one can work more efficient when one knows the situation of the customer well.
3. Word of mouth publicity: satisfied customers will advice other customers to use products of Heineken as well. This produces new customers.
4. Possibility to charge higher prices: when customers are satisfied they find it less terrible to pay a higher price for the products. This is therefore a very direct manner to increase turnover and with that raise the company result”.

(end quote)

The first effect that is mentioned in the quote above can be misleading; Higher quality can save money. Not only can it lower the workload, but also increase reliability of supply (lower standard deviation). Reliable supply decreases the need for safety stock at the customer. However, it is important to understand that the amount of costs involved to increase service quality is significant (see cost line in figure XXXII).

The quality of the relationship between suppliers (HNS) en resellers (customers) have earlier been discussed in paragraph 7.1 where the difference of procedural and distributive fairness was discussed according to Kumar et al (1995). They also mention that resellers rely on fairness and restraint to avoid mistreatment. Fairness can be seen as a determinant of the quality of the relationship.

From the various sources of literature, the importance of investing in customer service is clear. Keeping the customers happy is extremely important for business. A good relationship with your customers should not be underestimated.

9.2. *The theory of Destructive Acts*

Hibbard et al. (2001) and included references describe the possible consequences for a relationship between a supplier and a dealer/reseller²⁰ if one of the parties enforces one or more ‘destructive acts’. A destructive act (DA) is defined in the article as: “an act that has significant negative impact on the viability or functioning of the affected firm”²¹.

²⁰ Hibbard et al. (2001) utilize the terms supplier and dealer, because the article is bases on car dealers. In the rest of the report dealer, reseller and customer can be considered as one and the same party. HNS can be considered the supplier.

²¹ All further quotes in this chapter come from Hibbard et al (2001) unless indicated differently.

In virtually all marketing channel relationships, one of the parties eventually will engage in an action that another channel member considers potentially destructive for the relationship. How a particular channel member reacts to such an act has implication for the long-term viability and success of the relationship. On the basis of a large data set collected from both a focal supplier and its independent dealers, the authors classify dealers' responses to a supplier's destructive acts by extending the response typology of exit, voice and loyalty, which is based on Hirschman's seminal writings on responses to decline in organizations and states. This study finds that dealers' reactions are influenced by several antecedent factors: perceived intensity of the supplier's destructive act, the attributions relative to the act, relationship quality before the act and the level of interdependence between dealer and supplier. The results suggest that these more proximal dealer responses affect subsequent dealer performance and overall perceptions of relationship quality after an act. The authors draw several implications for both dealers and suppliers.

Figure XXXIV, Quote from introduction summary of Hibbard et al. (2001)

The article describes the situation where the supplier enforces a destructive act that has negative impact on the dealer/customer/reseller. The dealer's responsive behavior to the supplier's DAs is categorized in four possible reactions, based on the concepts of *exit* (1), *voice* (2&3) and *loyalty* (4) from Hirschman (1970).

1. A customer can choose '**disengagement**'. Disengagement covers the reactions where the customer (threatens to) terminate(s) the relationship or passively separates through neglect. Neglect is where the customer reduces attention and/or effort in the supplier's products.
2. If a customer will react with aggressive criticism in order to alternate the DA, this is called '**venting**'.
3. '**Constructive discussion**' is a more positive reaction of the customer that would like to change the DA and eventually reach a mutual solution.
4. The customer can also choose to accept the DA hoping that conditions of the relationship will improve. This reaction is describes as '**passive acceptance**'.

The response behavior of the dealer "can affect not only the dealers' perceptions of the relationship but also the dealers' performance". This means that the choice of response behavior has consequences on the future.

Responding with passive acceptance is the only behavior that influences the perceptions of the relationship and the performance positively. Responding with constructive discussion, venting or disengagement has a negative influence on the perceptions and performance of the dealer. It is remarkable that responding with constructive discussion creates a negative effect here. Constructive discussion in a romantic relationship shows a positive influence. This is because the immediate reaction towards the initiator of the DA will lead to changes in future behavior of the initiator. However, in a business-to-business relationship, the initiator has to deal with many customers. It is nearly impossible that the supplier will undergo a discussion with every single dealer. Furthermore, it is unlikely that every representative of the supplier has authority to make changes. This complexity can explain why constructive discussion has a negative impact on the relationship and the performance. Passive

acceptance seems to be the only response with positive effects on the relation and future performance.

The quality of the relation before the DA is important as well. Trust and commitment have a positive effect on the performance of the dealer. When there is trust and commitment, the relationship can be considered as good. In good relationships, passive acceptance of the DA is likelier to happen than in situations where the relation is not so good. With a bad relationship (no trust, no commitment), customers choose disengagement or venting more often. It is described in the article as either “managing the conflict” in good relationships or as “another nail in the coffin” in bad relationships. “In an environment where there is trust between supplier and dealer, the dealer may see the main danger of a negative response (to one DA) as unending supplier exploiting forgiveness by the dealer. Therefore, the dealer responds with passive acceptance. However, when the supplier will introduce another DA (repeated DA) on a short notice, a passive acceptance will be “an unreasonable response choice”. The chance is large that the response on a repeated DA is a negative one, because trust and commitment have faded.

The theory of destructive acts can be matched with the introduction of Production Time Tables. The negative impact on inventory of the customers proves that the introduction of PTT can be seen as a destructive act from HNS towards their customers.

The market interviews that were held with the representatives of different regions indicate that the relation between HNS and customers can be considered as healthy and positive. As mentioned in chapter 7, PTT could not be discussed with the customers. However, the project of mono containers was open for discussion. Asking the respondents about the impact and perception of mono containers generated mainly a negative image. A few negative consequences of the project were:

- Larger batchsizes caused higher stocks
- No compensation for the impact
- Threat to the introduction of new products (every new product has to be ordered in at least one full container)
- Threat to strategic products that have a low volume but high commercial value for the exposure or image of the entire brand.

For these reasons, the project of mono containers can be seen as a destructive act from HNS toward the customer as well. This thesis is focused on the effect of PTT, but looking at the theory of Hibbard et al (2001) the DA of mono containers is of great importance. PTT cannot be considered as just a DA, but has to be indicated as a repeated DA²². Mono containers have been generally accepted by a large majority of the customers. This is in line with the theory where dealers have a good relationship with the supplier and a single DA occurs. It is very likely that the response of the customers on the repeated DA of PTT will be different. The negative response of constructive discussion, venting or disengagement can be expected. This expectation is in line with the following representations of answers from respondents in the various market interviews.

- *We have a lot of trouble with mono containers, but we can understand why HNS has implemented this project. However, if they do something like this*

²² Hibbard et al. (2001) describe the theory of repeated destructive acts based on the seminal work of Axelrod (1984)

again, I don't want to know how the whole market will respond. It will not be pretty.

- *HNS does not have unlimited credits.*
- *Mono containers need to be closely watched to be a success. It will take some time before all the customers are used to this new way of ordering.*

To explain the process of the destructive acts even better, a probable scenario is described in the box below. It indicates what will happen if PTT is implemented and subconsciously customers start realizing it is a repeated destructive act:

HNS will communicate the timetables to the customers. By explaining the situation of undercapacity and jeopardizing OTIF, HNS gives the customer background information about the project. Some customers will immediately respond to the matter, but they will not have concrete impact examples ready, because nobody has been able to experience/predict actual impact yet. After having implemented the project, customers will slowly start to notice the real impact. Every customer that uses order planning will see his stock levels for cycle 4 and 8 products go up significantly if they want to avoid going out of stock. That will trigger the customer to evaluate their safety stocks as well. Finally, all customers see the impact happening right in their warehouse. All types of customers (large, medium and small) will engage in a conflict with HNS demanding lower prices for the lower service. Some might choose to switch to another Heineken source such as Heineken France or Heineken Italy, because service from Holland is not so superior anymore. There will also be some customers that decide to earn their money with competing brands that will provide more service than HNS. Customers know that it is not the first time that HNS implements a project like PTT that harms the customer's position.

In order to mitigate the effects of destructive acts Hibbard et al (2001) mention two advices for the supplier. First, the supplier needs to have a good framework of his customers. Placing them in particular groups would help the supplier to make decisions about potential destructive acts. For example: customers in the Africa region will experience no impact from a project like PTT, because their product portfolio is very different from the portfolio of the Caribbean region who will have fairly large impact from PTT.

Second, it seems that the perception of the customer about the intensity of a DA is crucial, especially the attributional interpretation. This means that it pays to involve the customer in the process of the act and communicate the fundamentals as early as possible. Again, this matches with the theory of Kumar et al (1995) where procedural fairness is considered more valuable than distributive fairness. "In regard to forewarning, we found that suppliers must honestly communicate the message to dealers (no matter how painful) about a potential DA as early as possible" (Hibbard et al, 2001).

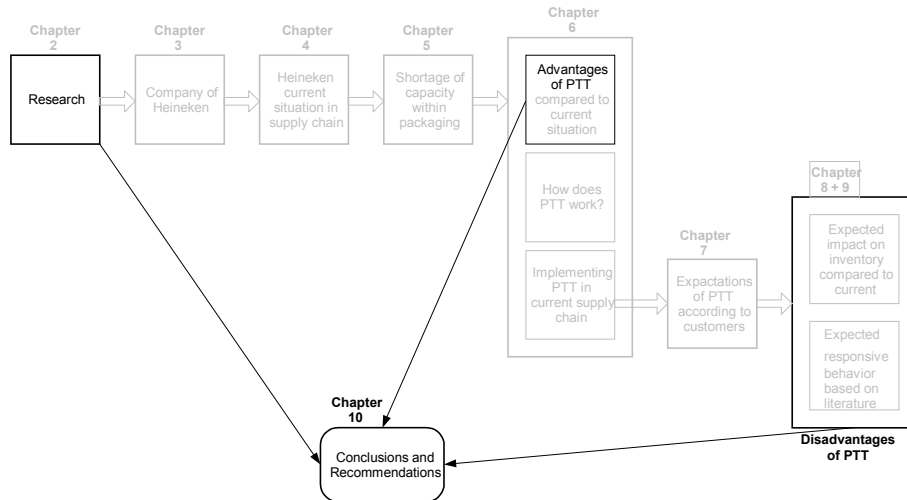
9.3. Conclusion

Considering mono containers and PTT as a destructive act, consequences are not only found in inventory increases, but also in the entire market portfolio of all involved customers. If PTT is introduced shortly after mono containers, this will be a repeated destructive act and the reaction from the customer will not be to passively accept and hope for better times. The chances are large that customers will engage in one of the

negative responses like disengagement, venting or constructive discussion. The risks of these negative responses are maybe even larger than the increases in stock for the impacted products. The performance of the customer will decrease and the quality of the relationship will become worse. The negative influence will not only have impact on the PTT products, but also on the rest of the entire market portfolio. This means that if a customer has 10 SKUs with a total volume of 150.000 HL in his portfolio and PTT influences 2 SKUs that cover 5.000 HL, not only will the stock levels of the 5.000 HL go up, but also the whole 150.000 HL will be at risk for HNS. A few examples of actions that will affect HNS are: Less attention and effort for any promotion by the customer, less quality care for HNS products, preference for other brands, sourcing of Heineken from breweries outside HNS and termination of the contract between the customer and HNS.

If PTT is introduced, it is wise to involve the customers and communicate the potential DA as early as possible. Withholding the customer from the process spoils the chance of mitigating the negative effect the DA might have. In general, it can be said that 10% of the Den Bosch volume will experience direct impact on inventory, but that the entire market of every impacted customer is at risk following the theory of (repeated) destructive acts.

10. Conclusions and recommendations



This chapter will draw the appropriate conclusions and recommendations based on the setup of the research of chapter 2 where many answers originate from the chapter 6 advantages and chapter 8/9 disadvantages. First, the answers to the research questions are reviewed after which the central question can be answered. After these conclusions, a validation paragraph will indicate why the results of this research are considered credible/valid. The chapter will end with three recommendations one of which is extensively described in Appendix H.

Before stating the conclusions, it needs to be said that the results have taken another direction than initially was expected. The focus on the issue has shifted during the research, which has been the reason to adapt the central question halfway the research. Initially it was expected that the disadvantages of the project were of minor interest. An analysis of both the advantages and the disadvantages for the chain from a production point of view was necessary to receive enough support from all involved parties at implementation. The research was meant as an investigation of the downsides of a productivity project that needed to be implemented as soon as possible. It was believed that the positive effect of PTT could easily compensate any issues and that it would even increase customer service with higher OTIF. However, shifting the focus more towards a supply chain approach instead of the production-driven approach gave a more realistic view of the issue and the first signs arose that the negative impact might be larger than initially expected.

10.1. Conclusions

The eleven research questions will be discussed first.

1. *How is the supply chain and logistic organization of Heineken currently constructed?*

The Heineken supply chain flows with procurement, production and physical distribution towards the customer. The information flow of the planning process goes upstream. Heineken works with three logistical concepts; Make To Order, Make To Stock and Replenishment. Every order for any product

needs to be shipped within 4 weeks after placement of the order. That is basically the order process of the Drumbeat.

2. *How does the concept of Production Time Tables work?*

All products are placed in a family. Between members of the same family there are only short changeover times. Changeover times between families are longer. Every family is placed in a cycle of 1,2,4 or 8 weeks, based on the summed sales volume of the products in one family. Instead of many random orders with the current system, PTT produces a certain specific range of products each week. This increases productivity, because production batch sizes become larger. This is because not all families are produced every week, but they are centralized and grouped to be produced only once every 2,4 or 8 weeks.

3. *What are the parties in the outbound supply chain that will be influenced by an implementation of Production Time Tables*

10% of the Den Bosch volume of the 1st-tier customers of Heineken will be influenced by the implementation of PTT. Customers with products that are placed in cycles of 4 or 8 weeks cannot order as flexibly as before. The regions with most impact are Region A, B and C. Region D and E appear to have no impact at all. This can be explained by the compilation of their portfolios. All products in their portfolio are very general, which means that the total volume of that family is large. The more general a product, the more customers can order it, the more volume it generates. A large total volume results in a cycle of 1 or 2 weeks. Families in cycle 4 and 8 basically contain the more customer/country specific beer and pack types.

4. *How can these parties be approached and interviewed?*

The impacted customers are found in the whole world. To get a good understanding of their perceptions, representatives of all markets are approached with help of the Market Supply Management. They have the contacts. The project of PTT is not communicated with the customers yet. Questions need to be asked about other projects like mono containers to generate a good picture about the relationship with HNS and the expected reaction on a possible implementation of PTT.

5. *What do the various parties think of Production Time Tables and what do they expect of its effect?*

The customers do not appreciate packaging improvement projects of HNS like mono containers and PTT, because the benefits of the projects are generally not forwarded to the customer and disadvantages often take place in the outbound supply chain. But in general, they can understand that those projects have to be performed to improve the whole supply chain and to remain as cost efficient as possible. However, most of the customers believe that they should be involved more closely to create more commitment for the project and its consequences. The majority of respondents are convinced that their inventory will increase.

6. *What are the indicators that represent the influence on customers?*

- Cycle stock

- Safety stock
- Strategic stock
- Obsolete stock/freshness

7. *What methods can be used (from literature) to measure the indicators?*

Cycle stock is dependent of customer order size. The simple method to calculate cycle stock is that average cycle stock = $\frac{1}{2} * \text{order size}$.

Safety stock can be calculated with the formula:

$$\text{Safety Stock (units)} = \kappa * \sqrt{LT * \sigma_D^2 + \sigma_{LT}^2 * D^2}$$

Strategic stock cannot be measured in this case, because it directly depends on the OTIF percentage of the new PTT situation. In this case strategic stock is a risk to evaluate. Production is under pressure with PTT that every order (especially from cycle 8) must be delivered OTIF to avoid the buildup of strategic stock at customers.

HNS has evaluated that if a customer receives fresh product at least once every 8 weeks, the product is guaranteed to be fresh at consumption. However, after 8 weeks this batch must be depleted and renewed which is not necessarily the case with cycle 8 products.

8. *What data about the identified indicators can be collected and used from available (Heineken) sources?*

- Last Estimate 0 Sales Plan 2007
- Last Estimate 0 Production Plan 2007
- Current cycles 2006
- Actual orders frequency 2006
- CDL Production Time Tables

The required numbers can be calculated by combining the correct information from these different files. All are Microsoft Excel files and therefore easily interchangeable.

9. *How much/little can the indicators in the outbound supply chain change when Production Time Tables are implemented?*

Safety stock can increase between 11 and 48% depending on the sailing time. This impacts 10% of the total Den Bosch can and bottle one-way volume. Cycle stock will increase for 4,4% of the volume, because larger batches need to be ordered by the customer. 10% of the total volume will have small increases due to the rounding up to whole containers on fixed moments. The risk of holding additional strategic stock plays for 3,2 % of the total volume. As long as packaging produces every order correctly, customers will hold no strategic stock. Due to all increases in stock, the freshness/obsolete stock will be affected. This counts for the 10% of the total Den Bosch volume, which is impacted by PTT.

10. *What does literature say about the reaction on Production Time Tables that can be expected from the involved customers?*

The theory of Destructive Acts describes the range of possible reactions of customers that are (negatively) affected by an act from the supplier. The (forced) positive reaction to the mono container project (also a destructive act) fits in the theory. The risk of affecting larger volumes and larger parts of

markets than the 10% of the Den Bosch volume is big. PTT will form a 'repeated Destructive Act', because PTT is implemented shortly after the mono container project. The responsive behavior to such an act is proved by the theory to be negative for the relationship between HNS and the customer. Various sources of literature provide evidence that quality of a relationship between a supplier and a reseller/customer has large influence on the perceived profit.

11. What needs to be changed in the Production Time Tables project in order to minimize costs in the entire supply chain?

To answer this question, the paragraph of recommendations will provide sufficient feedback to this question where implementation options of PTT are discussed.

The whole analysis was based on finding an answer to the central question: *What will happen in the outbound supply chain in terms of customer inventory and customer response when the production organization of Heineken would decide to implement Production Time Tables?*

Answer: If HNS decides to implement PTT, 10% of the volume needs to be held in higher stocks by the customer to avoid out of stocks. Furthermore, freshness cannot be guaranteed anymore with these higher stock levels. The majority of customers²³ will very likely respond negatively on this effect putting their entire portfolio at stake, because it is not the first time that HNS took this type of action.

In order to make the best decision from a supply chain point of view, the advantages and disadvantages of the PTT project need to be compared objectively. From the answers to the research questions, the advantages in terms of packaging and planning can be listed and described as follows:

- 3% Increase in OPI on all Den Bosch bottle one-way and can production lines.
- A more predictable production for cycle 4 and 8 products towards suppliers of materials.

No evidence could be found to prove the claimed advantage that PTT would bring stability to the whole supply chain by setting a rhythm.²⁴

The disadvantages of PTT in the outbound supply chain that can be derived from the answers to the research questions are:

- Safety stock and cycle stock will increase for 10% of the Den Bosch volume
- Freshness cannot be guaranteed anymore with cycles of 8 weeks
- Implementing PTT closely after mono containers makes PTT a 'repeated Destructive Act' what can lead to a negative response from all customers that have at least one product in cycle 4 or 8.

Evaluating the pros and cons of PTT, this research concludes that it will not be a good decision to implement the project in its current format. According to the analysis in this report, the expected situation will be experienced by the Heineken NV company as undesired. On one hand, the production organization will create a very productive

²³ Only the customers in Region D and E will be free of any impact caused by PTT.

²⁴ O.W. Sierksma (Manager Operational Supply Chain Planning Zoeterwoude) has stated that the Zoeterwoude brewery has not experienced significant advantages in stability of the supply chain after putting production in a fixed schedule. The Zoeterwoude brewery has been using cycles of 1 and 2 weeks for a while where every family has a fixed spot/day within the week.

output what increases the cost-efficiency of production. However, on the other hand, customers will have to increase their stocks on certain products, but only if they decide to keep participating in business with HNS, because the bottom line is that customer service is again one level lower right after the previous step down as an effect of the mono-container project. The risk of losing too many customers/volume by implementing PTT is very large for Heineken.

Management of HNS needs to set priorities to the advantages or disadvantages in order to make a final decision about implementation. This research provides HNS with a negative advice. The main objective of producing as cost efficient as possible against a high customer service must be leading in the actual decision of HNS.

10.2. Validation of the results

In order for the results of this research to be useful, there is a need for validation. If there is any considerable doubt that the used numbers and/or information are not accurate, the result loses a lot of credibility. The validation that can be used for this research is the following. The results have been presented to the management team of D&SM and to the management team of HNS in separate meetings. During these presentations the steps toward the results and the final numbers have been discussed/presented. The managers at these meetings have recognized the volumes and other data to be correct. The results have been considered as logical and well declared. The absence of a credibility discussion and the presence of (unexpected) amazement under the managers indicate the validation of results.

10.3. Recommendations

Recommendations can be useful for Heineken to improve their business in the future by learning from passed researches like this one. The recommendations can be divided in three parts.

1. This research has analyzed one possibility of improving the supply chain and gives a negative advice. The actual decision to implement the project or not can be made by management based on the results in the previous chapter. However, during the research, alternative projects have been discussed as well as different options of how PTT could be implemented. These projects have been excluded from the report, because they fell out of scope for this research. These projects can very well be recommended to be subject of research in future studies. This paragraph of recommendations will discuss these other projects.

PTT is not the only project that can create sufficient capacity for demand. There are various other alternatives. These alternatives vary from placing additional production lines or shifts, to increasing the attention of Total Productive Management or outsourcing of the excessive demand in peak season. It is recommended that these alternatives are reviewed as well, because PTT may not require large investments for packaging, but other parts of the supply chain may indeed need extra investments. The results of this research have shown that there are also disadvantages to the alternative.

Shifting the extra inventory that is caused by implementing PTT into the market with maximum cycles of 8 weeks is not the only implementation

option of this project. There are two recommendations in terms of the implementation of PTT. The first is based on a change in logistical concept. The second recommendation is based on reducing the longest cycle.

- A. The extra inventory does not necessarily have to be sent to the market directly. It can also be stored near the brewery first and then send to the customer on the moment it is requested. With the MTS concept, the markets are continuously supplied from stock. This concept can take away the disadvantages of inventory increase and Destructive Act for customers and still generate an increase in productivity of 3% OPI.
- B. Reduce the maximum cycle. Once every 8 weeks can be experienced as a long time interval for the customer. An interesting option might be to maximize the production cycle to 4 weeks. Instead of placing products in a cycle of 8 weeks, they are placed in a cycle of 4. The advantage of this option is that the impact on inventory is lower. The downside compared to maximum cycles of 8 is that with a maximum cycle of 4, only 0,5% OPI is won versus 3% in an 8-week maximum cycle. The calculations of increase in OPI with a maximum cycle of 4 weeks are performed by CDL as well.

The first steps towards reviewing these recommendations have already been made. The initial exploration of the alternatives and implementation options has been included in Appendix H.

- 2. The second recommendation that was already found during the research is resolving the claimed error in shipping documentation. HNS needs to find out how large this problem is. It is possible that a higher customer service can be achieved by minor improvements in the handling of shipping documentation.
- 3. The last recommendation is to involve customers more in two-way communication. Not only has a large majority of the respondents mentioned this desire, but literature has also dropped various suggestions to involve the customer in projects as early as possible in the process. Customers will experience this as very service-minded. Vice versa can help improve avoiding unexpected changes from the market.

11. Reflection

This chapter will give my personal opinion of how HNS could improve in the future. Looking back at the 7 months of research, I would like to point out a few things that I found remarkable and what Heineken could consider to change:

1. My opinion is that the structure of the project was not well balanced between packaging, planning and the markets. The advantages have blinded various parties for the disadvantages. In projects like PTT different parts of the supply chain should be involved. If a multi-discipline project loses the balance between cost-efficient production and high customer service, projects like PTT can cause large damage. If PTT is implemented without knowing the effects for all departments it can inflict very negative consequences. For future multi-discipline projects I would like to recommend an even more involved, multi-faced project team.
2. The management team of HNS has taken this research into account at their decision-making about implementation of PTT in the investigated format. It has been decided that the implementation of PTT is too dangerous for the HNS supply chain. A combination of scientific research and operational decision-making can be a very healthy one and should certainly be continued for upcoming projects. Literature can be a valuable source of information for a large company. The relatively low cost to involve an academic student into a project group can create an interesting asset. The only obstacle can be the differences between universities and companies. For example: companies do not prefer to share knowledge with other parties, where one of the core businesses of universities is to share knowledge. This can be conflicting, but it can be resolved with good agreements between the two parties and the student.
3. Challenging your customer to improve his part of the supply chain is good, but squeezing too much from your customers can create the risk of a bursting tire. It is a challenge to find the optimal point between customer service and cost efficient production. For that reason, Heineken should continue the research on improvement projects. Secondly, the balance between customer service and cost efficiency is not the same for every customer. Some customers demand very high service levels, where others are content with medium or even low service.
4. It has been an important learning point for me to understand that the first impression of a project does not have to be the correct one. When people are amongst each other, group thinking can easily occur while individual, objective reflection is necessary for a project team to come to the right decisions.
5. An important last remark for this reflection is that it should not be forgotten that Heineken would not have neglected a research in any kind on the disadvantages of a project. The decision to give me this assignment was indeed very conscious. The results of the research however were more negative than initially expected.

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Internet sites:

- <http://intranet.nl.heiway.net/irj/portal> (Heineken Intranet)
- <http://www.heineken.com>
- <http://www.oee.nl>
- <http://www.ecr.nl>
- <http://www.aimms.com>
- <http://irs.ub.rug.nl/ppn/271281243> (Soman, 2005)
- <http://www.vendormanagedinventory.com/definition.html>
- <http://www.cc.state.az.us/utility/gas/terms.htm>
- http://www.texassafetynetwork.org/library/papers/documents/tsn_3tierdiagram0904.pdf
- <http://www.ie.umn.edu/cscr/presentation/strike.pdf> (Strike, 2003)
- <http://wordnet.princeton.edu/perl/webwn?s=obsolescence>
- http://findarticles.com/p/articles/mi_qa3766/is_199907/ai_n8854859 (Moore, 1999)

All above website were consulted between August 21st 2006 and January 30th 2007

Locations of internal Heineken data sources:

- **Last Estimate 0 Sales Plan 2007**
 - o T:\Strategic Supply Chain Management\Supply Chain Review\Evaluaties 2007\Sales\0de Evaluatie (januari)\LE 0 totaal 2007 Amsterdam.xls
- **Last Estimate 0 Production Plan 2007**
 - o T:\Strategic Supply Chain Management\Supply Chain Review\Evaluaties 2007\Capaciteit\0de eval 2007 produktie.xls
- **Current cycles Den Bosch 2006**
 - o T:\Strategic Supply Chain Management\VVV\oldcycle-newcycle.xls
- **Actual Customer orders 2006**
 - o T:\Strategic Supply Chain Management\VVV\actualvsproposed.xls
- **CDL Production Time Tables**
 - o T:\Strategic Supply Chain Management\VVV\Spoorboek_v3.xls

The constructed **Volume distribution file** is located at:

- o T:\Strategic Supply Chain Management\VVV\Files Project Carl\oldcycle-newcyclemetLE0salesenproductie.xls

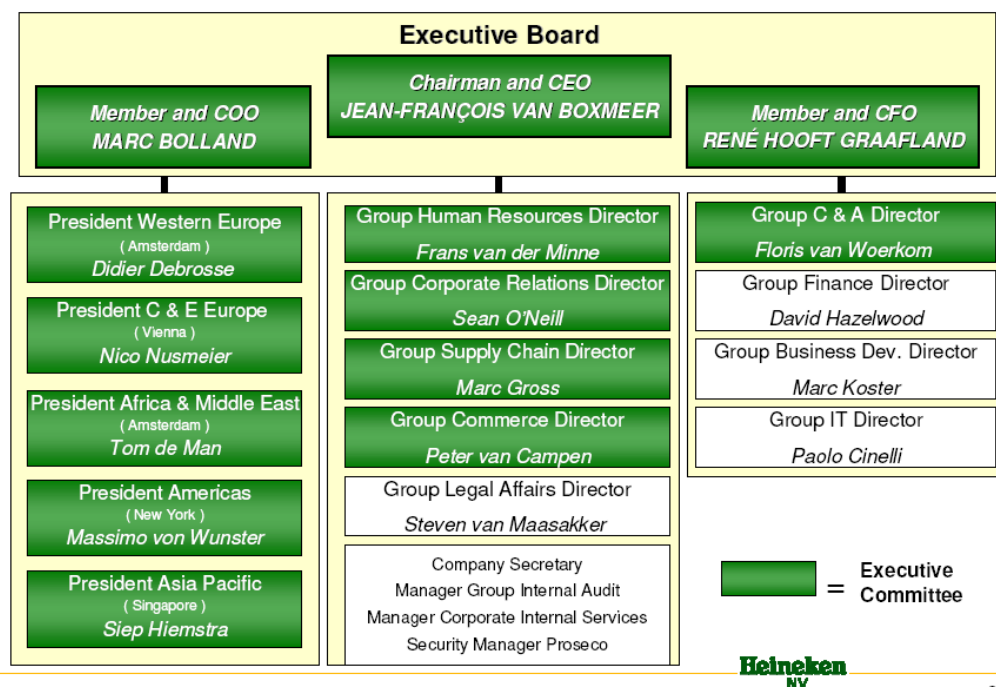
Software:

- Microsoft Excel 2000
- Microsoft Word 2000
- Microsoft Visio 2000
- Microsoft Powerpoint 2000
- Microsoft Internet Explorer 6.0
- Babelfish translation (babelfish.altavista.com)
- SAP Business Warehousing
- Adobe Acrobat Reader
- IBM Lotus Notes 6.5

Appendix

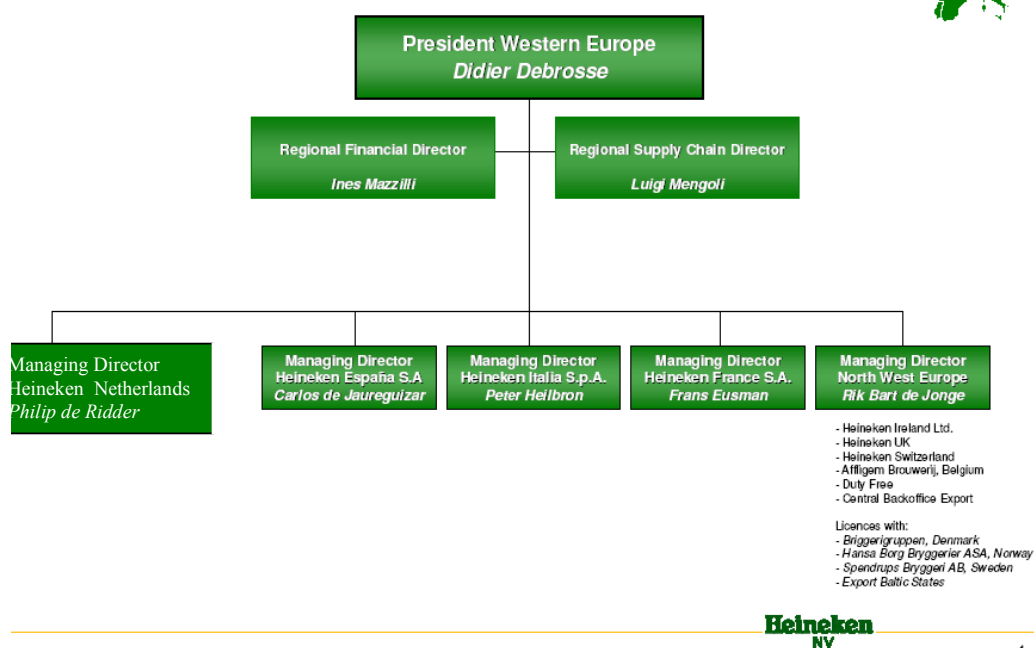
A: Organization charts

Executive Committee



Organization chart Executive Committee Heineken N.V. (source: Heineken intranet)

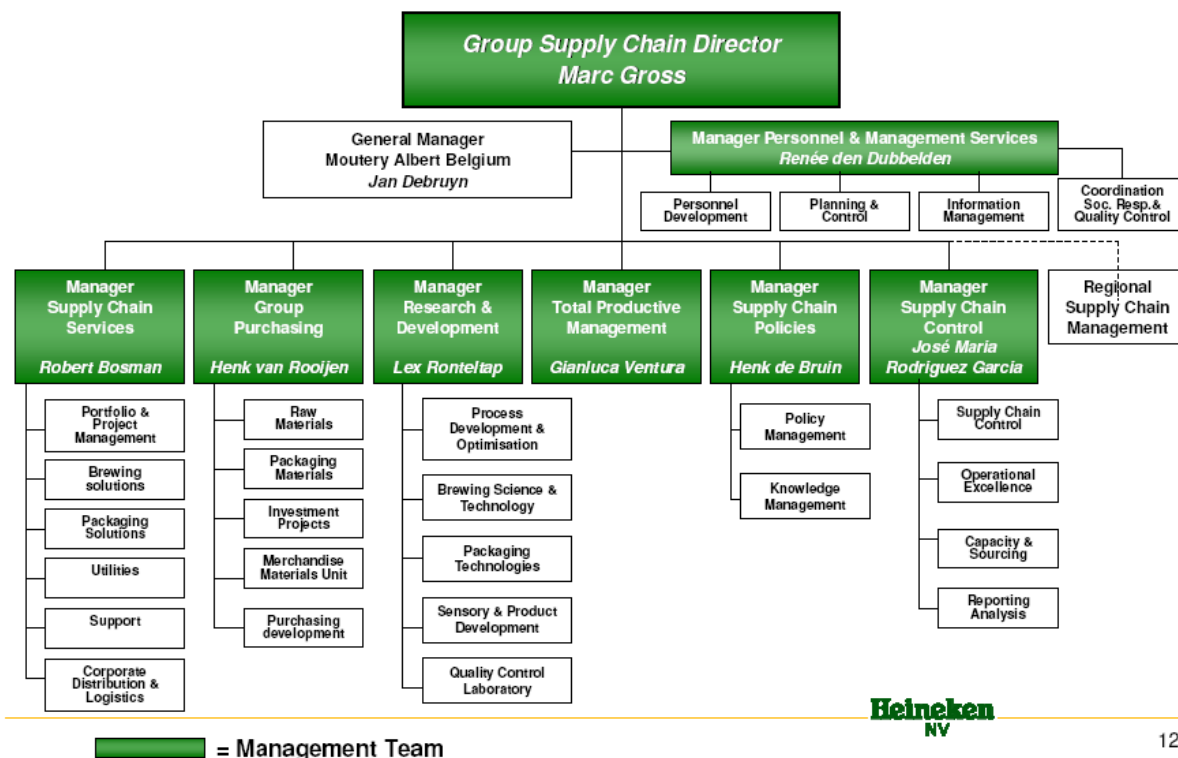
Management Team Western Europe



Organization chart of Heineken Western Europe (source: Heineken Intranet)

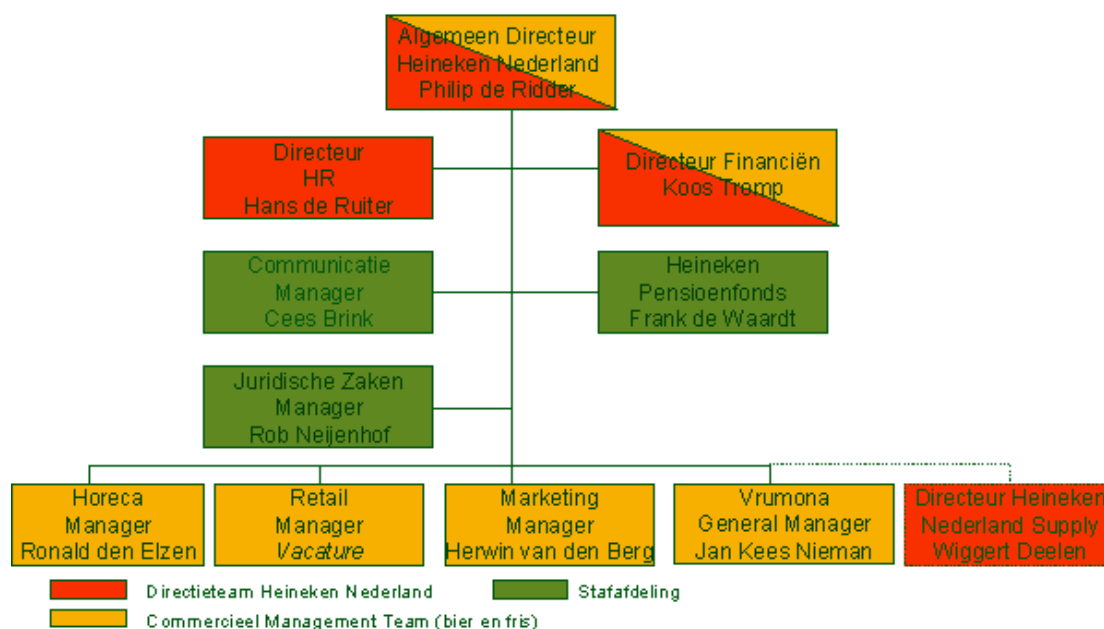


Management Team Group Supply Chain

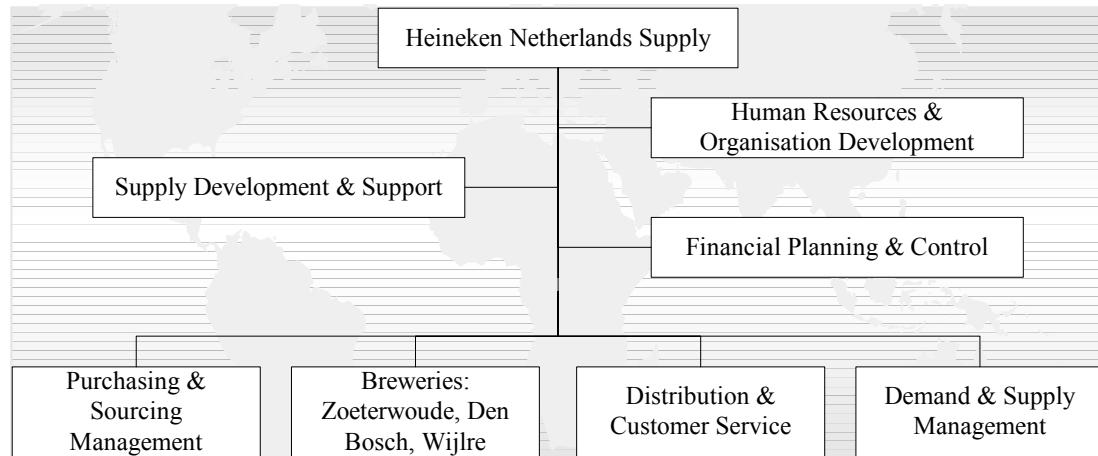


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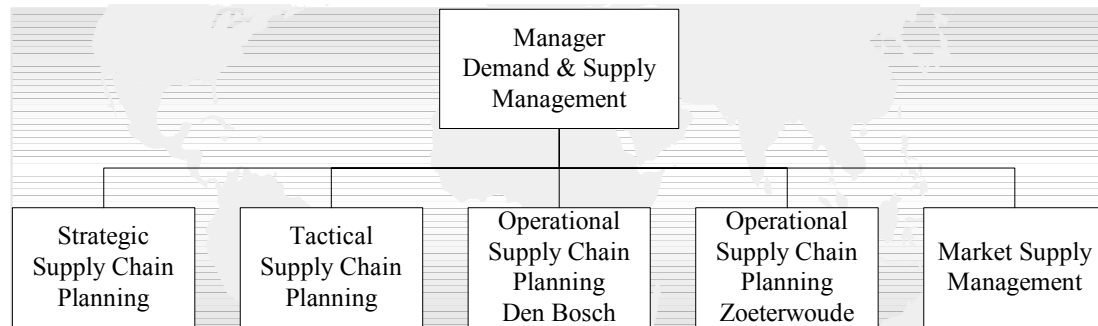
Organization chart of Group Supply Chain (source: Heineken Intranet)



Organization chart of Heineken Netherlands (source: Heineken Intranet)

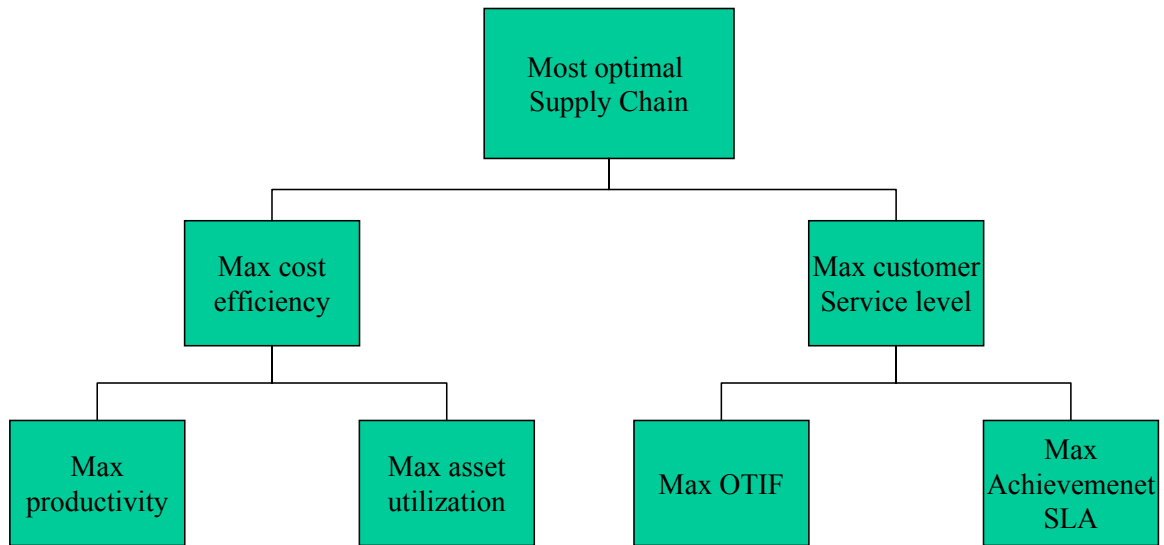


Organization chart Heineken Netherlands Supply (source: Heineken Intranet)



Organization Chart Demand & Supply Management (source: Heineken Intranet)

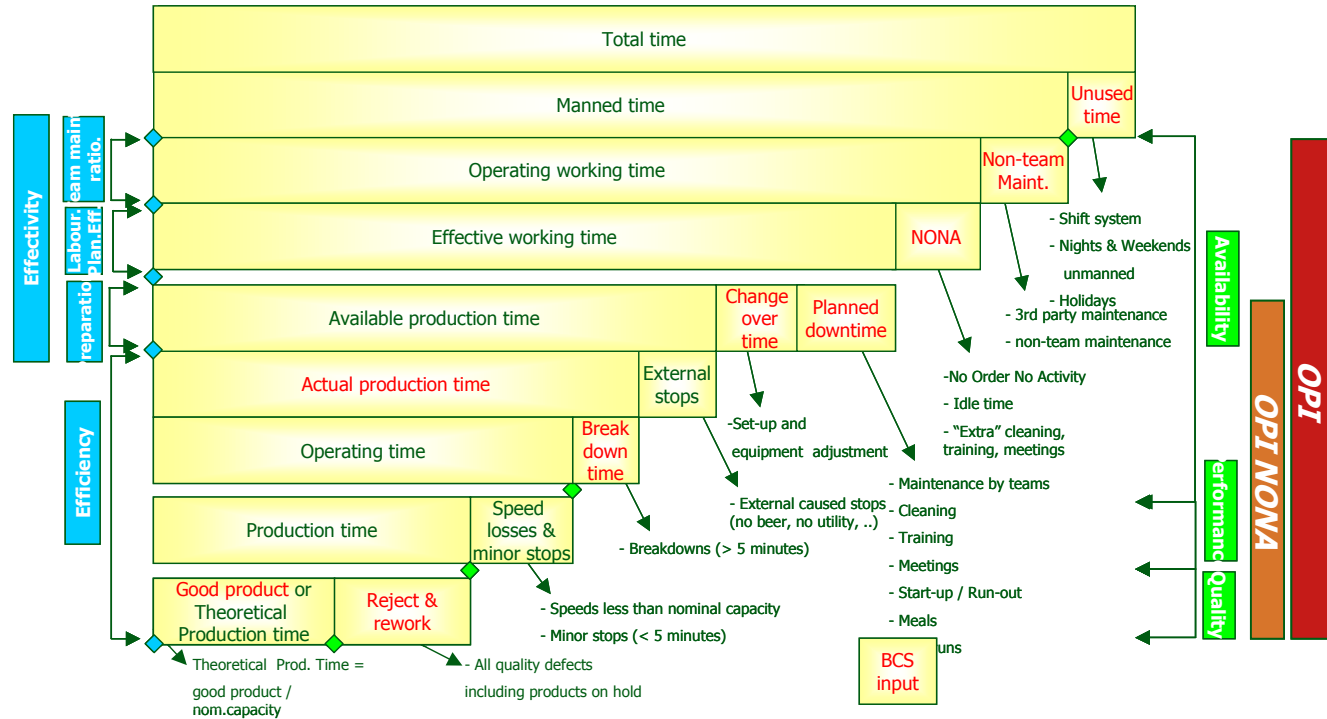
B: Objectives and sub-objectives of D&SM



To reach an optimal supply chain, maximum cost efficiency and customer service need to be reached

1. Maximum productivity is the utilization of people (HL/FTE)
2. Max asset utilization is the utilization of machines (HL/invested \$)
3. On Time In Full is the percentage of orders supplied correctly (%)
4. The other agreements in the Service Level Agreement with the customer need to be met or have to be superior (%)

C: Operational Performance Indicator (OPI) calculation



OPI calculates how much time of the available hours is used to deliver good product. It depends on the efficiency of operations like the time it takes to fix a breakdown. The effectiveness is based on the level of available overcapacity and how much time is used for changeovers. OPI is presented in a percentage (%).

D: List of interviewees

Name, Position, date of interview:

- Joop Knulst, Manager Demand & Supply Management, 12-9-06
- Mart Stiekema, Consultant Corporate Distribution & Logistics 28-9-06 and 19-10-06
- Jose Martins, Market Supply Manager, Heineken USA, 20-10-06 and 7-12-06
- Leo Slappendel, Market Supply Manager, International 24-10-06
- Peter de Wit, Assistant Market Supply Manager, 26-10-06
- Mieke Kortekaas, Assistant Market Supply Manager, 26-10-06
- Caro van Beelen, Market Demand Coordinator, Caribbean, 26-10-06
- Peter Heemskerk, Market Supply Manager, Domestic, 2-11-06 and 7-11-06
- Sandra Vos, Market Demand Coordinator, Cental/Eastern Europe, 13-11-06
- Matt Smith, Logistics Controller UK, 23-11-06
- Tom Rogers, Warehousing Controller UK, 23-11-06
- Leda Jansen, Customer Service Coordinator, Middle-East & North-Africa, 30-11-06
- Mirjam Zeldenthuis, Coordinator Order Management, Middle-East & North-Africa, 30-11-06
- Ton Oostrum, Customer Service Team Manager, Duty Free, 30-11-06
- Esther Zwart, Customer Service Coordinator, North-West Europe, 30-11-06
- T.K. Donkor, Area Manager, East Africa, 5-12-06
- Magne Setnes (teleconference), Director of Supply Chain Management, Heineken USA, 7-12-06
- Jemmie Liu (teleconference), Supply Chain Coordinator, Heineken Taiwan, 7-12-06
- Marc Bekkers (teleconference), Customer Service Manager Asia-Pacific, 11-12-06

E: Example of a questionnaire

Introduction

1. Name & Position:
2. Subjects to discuss: Customer Service, Mono containers, Stock levels, OOS, Freshness and the Portfolio.
3. What are special characteristics/features of your market/countries?

Customer Service

4. How would you interpret customer service between HNS and your market?
5. Which of the following points would you identify as most important supply-factors from HNS to your market and why?
 - a. % OTIF (reliability)
 - b. Order lead-time (responsiveness)
 - c. Inventory/working capital
 - d. Trust/Commitment/Relationship
6. On what criteria do you evaluate the performance of HNS to your market?

Mono containers

7. What is your opinion on the introduction of mono-containers and how does this affect your market?

Stock levels

8. How does your market determine:
 - a. Safety stock levels?
 - b. Cycle stock levels/order volumes?
9. What is the average level of inventory in the market?
10. Are there any physical constraints on max inventory-size?
11. How valuable do you consider inventory compared to the rest of the operations?

Out of Stock

12. Have you ever experienced out of stocks in the DC or in market?
13. What are the consequences of an out of stock for your market? What happens and what cost are involved?
14. Is every SKU out of stock creating the same 'damage'?

Freshness

15. Do you involve any freshness constraints in your market apart from the standard expiry date?
16. Is there a difference in value between young beer (fresh), old beer (just under exp.) and over-aged beer (over exp.)?
17. What is worse/more expensive, out of stock or destroying old beer?

Portfolio categorization

18. Do you use a categorization for the SKU's in your portfolio, e.g. ABC-classification?
 - a. Most important and largest % of volume
 - b. Strategically important products (NPI)
 - c. Small seasonal/additional products
19. Do you have different expiry dates in your portfolio? 6,9 or 12 months?

Miscellaneous

20. If you could change something in the entire supply chain. What would it be?

F: Supply Chain Performance Attributes

Linking Supply Chain Performance Attributes and Level 1 Metrics

Performance Attribute	Performance Attribute Definition	Level 1 Metric
Supply Chain Delivery Reliability	The performance of the supply chain in delivering: the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer.	Delivery Performance
		Fill Rates
		Perfect Order Fulfillment
Supply Chain Responsiveness	The velocity at which a supply chain provides products to the customer.	Order Fulfillment Lead Times
Supply Chain Flexibility	The agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage.	Supply Chain Response Time
		Production Flexibility
Supply Chain Costs	The costs associated with operating the supply chain.	Cost of Goods Sold
		Total Supply Chain Management Costs
		Value-Added Productivity
		Warranty / Returns Processing Costs
Supply Chain Asset Management Efficiency	The effectiveness of an organization in managing assets to support demand satisfaction. This includes the management of all assets: fixed and working capital.	Cash-to-Cash Cycle Time
		Inventory Days of Supply
		Asset Turns

Spm9423 / Spm9435

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Reliability, responsiveness, flexibility, costs and assets are important supply chain attributes. Many of them have been utilized throughout the report. The definitions give a representation of their meaning in literature.

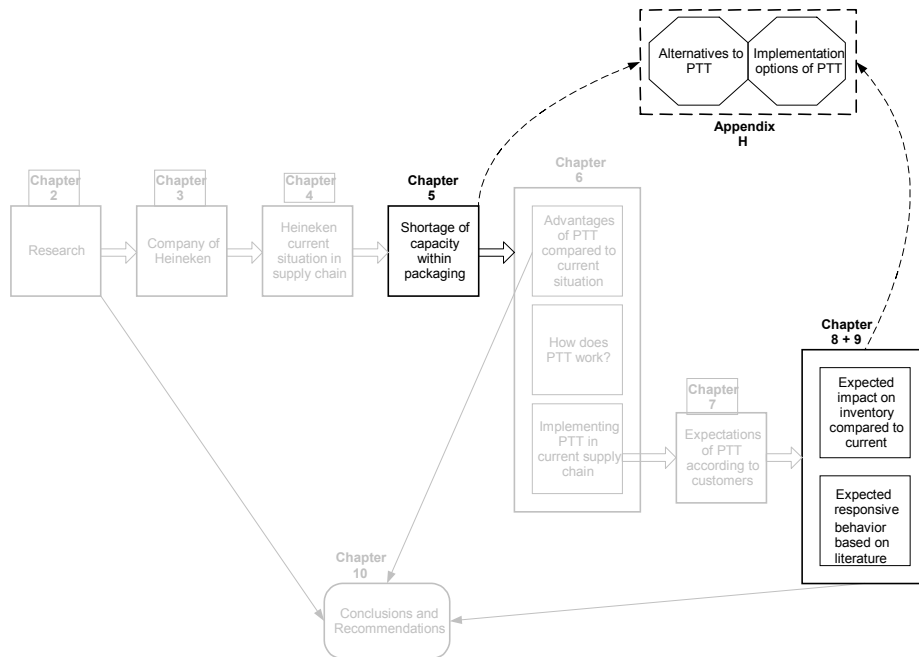
Source: Delft University of Technology, 2005.

G: Overview of the Production Time Table constructed by CDL

This picture cannot be shown due to confidentiality issues. The figure shows all productgroups/families and their cycle of 1,2,4 or 8 weeks

Every product is categorized in a family. Within the family, changeover times are minimal. Every family has received a cycle of 1,2,4 or 8 after calculation by CDL. This cycle indicates how often the family is scheduled for production. Once every week, every 2 weeks, every 4 weeks or every 8 weeks.

H: Strategic review and worked out recommendations



Based on the results of chapter 8 and 9, this additional appendix chapter is included in the report to review alternatives to PTT for the issue from chapter 5. Chapter H can be seen as a first set-up for future researches.

First, this chapter will generally review alternatives that might also be used as a remedy to the capacity and demand issue of paragraph 5.5. Second, different implementation options of PTT are discussed. These implementation options are based on the scenarios of maximum cycles of 8 or 4 weeks and on sending the product directly to the market or keeping it on stock at the brewery following a MTS concept (see paragraph 4.3.3). The alternatives and implementation options are visualized in the figure below.²⁵

Alternatives		
Extra production line		
Overtime		
Extra shifts		
PTT	OK	Implementation options
Harmonization		
Replenishment		PTT 4-8
TPM		PTT 4
European sourcing/NPI		PTT MTS 4-8
Max demand		PTT MTS 4
Evaluate transfer price		

²⁵ The list of alternatives and implementation options of PTT has been created in coordination with the management team of D&SM.

H-1: Alternative projects to Production Time Tables

Paragraph 5.7 states the main case for action. This initiative is based on the following three projects that HNS wants to perform:

1. Hold sufficient capacity to accommodate future demand as cost efficient as possible
2. Achieve a constant increase in OPI
3. Achieve a more balanced packaging plan over the weeks

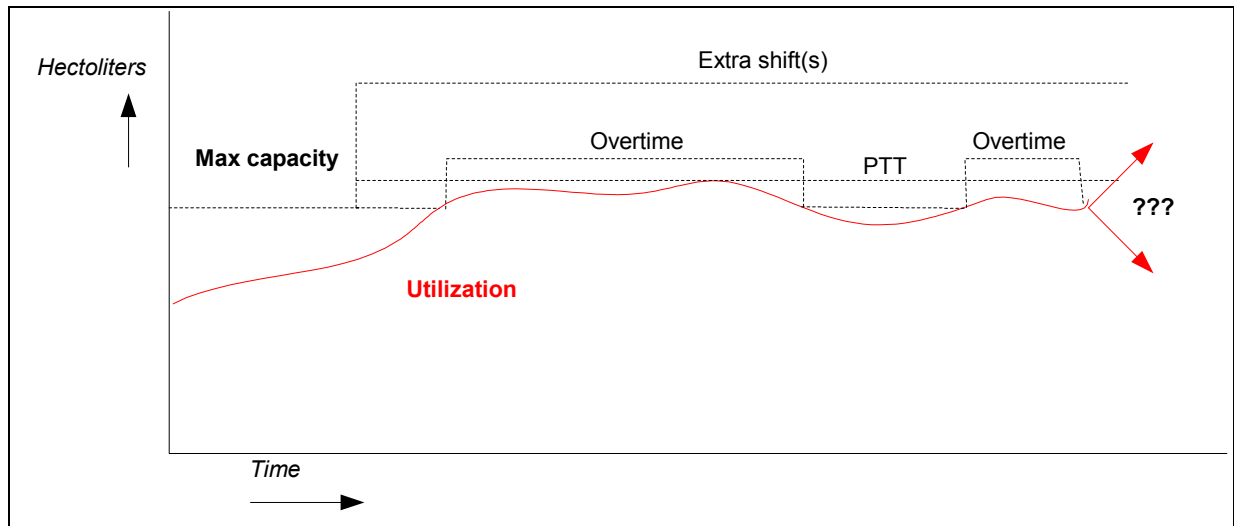
All three projects have to be connected to the main objective to produce as cost efficient as possible against a high service level. The urgency is the highest for the first project, because demand comes very close to exceeding maximum capacity already in 2007. All alternatives will be discussed next with a description, advantages and disadvantages.

Extra production line. HNS has currently 28 production lines in three breweries. Investing in a new production line can increase maximum capacity by a large step. A new keg, bottle, can or specialty (Draughtkeg, Magnum, Beertender) line has a large financial impact and always needs to be approved by the executive board. Apart from the assets that have to be bought, the line needs to be manned as well. Mostly a new line starts with a 3-shift system. Adding a new production line with a 3-shift system increases capacity with a very large step.

Overtime. Three-shift production lines create output from Monday through Friday for 24 hours per day. Normally, Saturday and Sunday the line is closed. If there is excessive demand, HNS can choose to work overtime. Overtime is more expensive than regular work hours, but is a direct instrument to accommodate the extra demand. Of course, lines that are operational in five-shifts cannot conduct overtime, because the lines are already manned from Monday through Sunday. Overtime is restricted. Together with labor unions it is decided that overtime can only take place on Saturday for two shifts. This creates 16 hours (2 shifts of 8 hours) of additional output capacity per week. Overtime of only 1 shift is very unusual, because in that case the additional demand is mostly pushed back to the following week. The advantage is that planning overtime is very flexible. Only when you need the extra capacity, you can implement the alternative. This can be decided from week to week.

Extra shift(s). It can be decided to hire extra shifts to man the production lines. A 4-shift system works Monday-Saturday and a 5-shift system operates every day. The advantage of a 5-shift system over a 4-shift system is that you do not need to switch off the lines in a 5-shift system, because it produces continuously. The costs to hire extra shifts are very high, because if you switch from 3 to 5 shifts, a large amount of overcapacity will exist what is not cost efficient. Unlike overtime the extra capacity is continuous. In low season HNS has even more amounts of overcapacity with 5 shifts. HNS has just downsized in the last few years from 5 to 3 shifts. Upscaling to 5 or 4 shifts again is strategically possible, but on an operation level there are more hurdles to take. There will be a complex personnel situation looking at the recent downsize. Another disadvantage for a 5-shift system is that there is no additional overtime capacity beyond the maximum capacity.

PTT. The alternative of Production Time Tables is extensively discussed in this report. The advantages of the project are that productivity wins can be realized without actual investments in the brewery. A predictable production should also create stability in planning and therefore in the entire supply chain. The disadvantages of the project are discussed in chapter 6. The additional inventory for the customers implies costs, inflexibility and freshness risks. Furthermore, the impacted volume is even larger than just the 10% by introducing this project closely after mono containers.



In the figure above, the three alternatives of overtime, extra shift and PTT are shown. Overtime creates momentary increases of maximum capacity, where PTT and extra shifts increase the maximum capacity continuously. The advantage for PTT is that there are no additional costs for the brewery, where an extra shift(s) is a very costly alternative, but on its turn creating more capacity and have no direct implications for the customers, the main disadvantage of PTT. One of the most important questions, considering the alternatives, is if demand will increase or decrease on the long-term.

Harmonize & Rationalize. The project of harmonization and rationalization is to reduce the complexity in the portfolio of customers. Complexity is the differentiation caused by special labels, bottles, crows, codes etc on the product of a customer. This can make the product unique for one customer. There are also products with, for example, five different languages on the label so that it can be sold to many customers in various countries. Harmonization is that multiple SKUs with minor differences are combined to create a new SKU. The process where specific SKUs are replaced by more general SKUs that already exist is called rationalization. The low hanging fruits of this project are already collected in the last few years where the amount of SKUs has been reduced from 1500 (2001) to less than 1000 (2006). Nevertheless will HNS keep removing unnecessary complexity from the portfolios to maximize batch sizes. The extent, to which harmonization and rationalization can be performed, is of course limited. Not only is there a commercial importance to specify products for customers, but also there is often strict governmental regulation that makes special text/codes/volumes mandatory (for alcoholic beverages).

Replenishment. If all markets would be replenished, HNS would have more control over production. The stability would be larger in the production process, because HNS can decide for themselves if they want to produce a certain product. If stocks in the market are high, HNS can choose to delay the production of a certain SKU for two weeks, without jeopardizing the OTIF towards the customer. With replenishment, HNS agrees min and max stock levels with the customer. If all markets would be supplied according to the replenishment concept, the organization en coordination of production would be in hands of HNS. Currently, the MTO orders require that planning and production can react very ad-hoc. The disadvantage of replenishing all markets would be the cost of the project, because every customer would need to have an account manager/team that constantly reviews the stock levels at the destination. Another potential disadvantage is that customers will have to work closely with HNS. No information is currently available on that matter.

TPM. TPM stands for Total Productive Management. This project is currently applied in all HNS breweries and is a very time consuming process. The concept is that by paying more attention to the work process, fewer mistakes are made and quality of production increases. TPM has a positive influence on OPI. Referring to the figure on the previous page, TPM raises the maximum capacity.

European sourcing/NPI. Heineken has several breweries in Europe. There are also many independent bottling and canning companies throughout the country. An alternative to cover under-capacity is internal or external sourcing.

Internal sourcing is when a certain portfolio or SKU is transferred to another Heineken brewery that has spare capacity. The success of internal sourcing depends on the availability of overcapacity in the foreign Heineken brewery. Commercial departments should be involved as well, because some countries demand that Heineken beer actually comes from Holland and not from France, Spain, Italy or Greece.

External sourcing is when beer is transported in a truck from HNS to a bottling or canning facility where final packaging is performed. Again it is important that the facility has enough packaging capacity and commercial departments are made aware.

The third option of sourcing is to package New Product Introduction (NPI's) at different locations. A NPI can be a very specific SKU with a small volume that causes long changeover times.

Both internal and external sourcing is already performed for XXXX HL of can volume in 2007 over 4 different locations.

Max demand. A more rigorous alternative is to simply reject any demand that exceeds the maximum capacity of the brewery. Maximizing demand is not only to reject demand from regular customers, but it can also be the denial of sourcing volume. For example, if a Heineken brewery in Africa wants to transfer a certain volume to HNS.

Evaluate Transfer price. The final alternative is the re-evaluation of transfer prices. The transfer price is the price per HL that the customer pays to HNS. The re-evaluation will translate the complexity of a product into the transfer price. Very common SKUs that are produced in very large batches will become cheaper and SKUs that are specific and produced in small batches become more expensive. With this method the customers can make their own evaluation of the portfolio. Either they pay more for the specific SKU or they choose a more general product that is cheaper.

This alternative is interesting for productivity, because the new transfer prices could give an incentive to customers to choose more generic SKUs, what will generate fewer changeovers on the production lines, what results in higher OPI. Higher OPI increases maximum capacity.

H-2: Implementation options of Production Time Tables

First, the MTS option will be described and an initial indication of the size of the potential storage facility will be given. Then, the differences of a maximum 4-week cycle are explained. Finally, the 4 different implementation options are compared.

The MTS variant is similar to PTT, but all impacted products from cycle 4 and 8 are stored near the brewery. The advantages of the MTS option compared to the current situation in the supply chain without PTT are:

- 3% OPI and a more predictable production. This advantage is similar to the advantage of regular PTT.
- Shorter lead-time for the customer. The normal Drumbeat is not applicable for the customer anymore, because the ordered product can be supplied directly from stock. This means that the ProdT is zero. There is only TransT for the customer's order. A reduction of three weeks in lead-time causes a lower safety stock for the customer. This will be between 18% and 37% less safety stock for the SKUs in cycle 4 and 8.²⁶
- The products could also be stored in full containers. This makes handling easier compared to conventional storage in pallets. This option needs different calculation methods however, which are unknown at this moment. Containers need to be rented for a longer period.

The disadvantages of implementing the PTT MTS variant are:

- A new storage point in the supply chain is created. Products are not only stored in the warehouse of the customer (the customer will still need to order full containers), but also at the brewery in the new MTS storage. The additional handling and storage in the supply chain creates extra costs compared to the current situation.
- A freshness risk occurs. In previous chapters it is said that if a customer orders fresh product once every 8 weeks, freshness will be guaranteed at final consumption. However, if this customer for example receives product once every 7 weeks from the MTS stock, this batch is not necessarily fresh. It can be up to 8 weeks old already. In this case, freshness cannot be guaranteed anymore.
- Drumbeat and MTS lead-time are in conflict. The Drumbeat for products in cycle 1 and 2 will be unchanged. This results in the fact that products from cycle 4 and 8 have a shorter lead-time for the customer than the large, general products from cycle 1 and 2.

To get an indication of the size of a new MTS storage point with conventional palletized storage for cycle 4 and 8 SKUs the following calculation can be used²⁷:

²⁶ Calculated with the same method as in § 7.3.1

²⁷ The input of general assumptions come from P.J. van Kooten (Project leader Logistics DCS)

- Average cycle stock 4 week products =
 - $0.5 * (XXXX / (52/4)) = XXXX \text{ HL}$
- Average cycle stock 8 week products =
 - $0.5 * (XXX / (52/8)) = XXX \text{ HL}$
- Total of XXX HL/ (6*2,7) = XXX ground pallet places pure cycle stock
- Plus 2 and 4 weeks safety stock → XXX GPP
 - 70% Occupation → XXX GPP
 - 60% Product, rest is driving lanes → XXX GPP
 - = **XXXX M²** (1 M² = 1 GPP)

First, the average cycle stocks of cycle 4 and 8 products are calculated. This is equal to half the average order size. On average, there is 6 HL of beer on one pallet. In normal circumstances, the pallets are placed in stacks of 2,7 pallets (average). A ground pallet place (GPP) is the term for the amounts of surface that one stack of pallets occupies. In the MTS concept there has to be safety stock to cover uncertainties in demand. For this example safety stock is set on half a cycle of demand. But, XXX GPP will not be sufficient for realistic use.

Every SKU has a certain designated area where the product can be stored. This area has between 0% (out of stock) and 100% (right after a production run) occupation. Because the stock of every product fluctuates through time, there is a general assumption that, on average, 70% of the areas are occupied. XXX is that 70%, so that there is a need for XXX GPP for the stacks of pallets. In order to be able to handle the products and drive forklift trucks through the storage, there is a need for driving lanes and handling surface. The general assumption is that 60% of the total warehouse space is for storage purposes and the rest is for driving and handling. This means if XXX is 60% of the warehouse, the total surface of the needed MTS warehouse is XXX GPP. 1 GPP is assumed to be equal to 1 square meter. As a reference, the storage facility for the entire domestic market of Heineken (approx 6 million HL) that is also supplied via MTS is XXXX square meters. The batches for the domestic market are mostly produced in cycle 1 or 2.

The implementation option of PTT MTS could create a possibility, but it needs to be further researched. Not only the cost, but also the exact impact on freshness should be investigated. If it is concluded that the productivity gains are larger than the costs for additional storage, the project can be implemented. It can be decided that either the customer will pay for the additional storage or HNS will take the cost and subtract it from productivity gains. The final result on the mother company needs to be reviewed.

The other direction of implementation options is to maximize the largest cycle to 4 weeks instead of 8 weeks.

With the two discussed directions of options, four implementation options can be analyzed. An overview is shown below.

Option	Impacted volume	%	Safety Stock Customer	Cycle Stock Customer	MTS Warehouse
PTT 4-8	XXX HL	10,5%	11-18% on XXX HL 29-48% on XXX HL 17-25% on XXX HL	Increase by less flexibility and bigger batches	N/A
PTT 4	XXX HL	9,8%	11-18% on XXX HL	Increase by less flexibility and bigger batches	N/A
PTT MTS 4-8	XXX HL	9,7%	-18 -37 % on XXX HL	No sign change	XXX M2
PTT MTS 4	XXX HL	9,0%	- 18 - 37% on XXX HL	No sign change	XXX M2

In the most left column, the four different implementation options are shown, where PTT 4-8 is the original implementation idea that has been research in the thesis.

The second column shows the impacted volume. SKUs that go from cycle 4 to cycle 8 are not impacted if the maximum cycle remains 4. In the MTS scenarios the replenishment volumes that go from cycle 1 to cycle 2 are not taken into account as impacted volume, because these products will not be stored in the MTS concept.

The third column is the percentage of the entire Den Bosch volume (can and one-way bottle).

The fourth column indicates the percentage of change in safety stock. The MTS options have a reduction of safety stock, which is a result of the shorter lead-times for cycle 4 (and 8) products compared to the current situation.

In the fifth column, the effect on cycle stock is given. For the MTS options, the cycle stock of the customer is indicated with ‘no significant change’. However, this can be a point of discussion, because on the one hand, the customer will still need his cycle stock to supply his market, but on the other hand, there might be a lower cycle stock if customers decide to decrease their order volume compared to the current situation with mono containers (for example: from 2 containers to 1 container per order).

The last column shows the predicted size of the warehouse in case a MTS options is considered. Of course the size is smaller if products are produced in a maximum cycle of 4 weeks.

It is recommended that the exact calculation of the other implementation options need more attention in the future. The overview can be used as an indication. For example, it cannot be determined at this moment how necessary it is to harmonize SKUs if a MTS option is considered. Another thought for the MTS option is to load the products in containers directly after production and store the SKUs in a container park. Probably, this will need less space than to store all products by the pallet.

H-3: Conclusion

This additional chapter has not been intended to be an integral part of the original research. This chapter is considered as optional to increase the review of possible projects and to emphasize the importance of supply chain thinking.

The different alternatives that have been discussed in this chapter are compared in the matrix below. The main objective of HNS to produce as cost-efficient as possible at a high customer service level is included in the overview matrix together with the impact on maximum capacity and an indication of the cost of the alternative. The cost of the alternative is rated for the supply chain and not only for the brewery. This is

because projects like PTT will not implicate costs directly to the brewery, but the additional inventory will indeed create costs in working capital in the supply chain.

It can be concluded that there are many different alternatives to choose from. The management team of HNS needs to take many factors into account. For example, if demand in high season in the following years will be only a little higher than maximum capacity, overtime and sourcing can be good solutions. However, if demand grows fast, overtime will not be sufficient. Hiring extra shifts can be dangerous. If demand grows and all lines are manned with the 5-shift system, there is no more room for overtime. Also, shifts cannot be added and removed over the time of years. This is very cost inefficient. Adding production lines are very large investments and create an immediate large step in maximum capacity.

The PTT project, in every implementation option is not as costly, but also does not increase maximum capacity as much as extra lines or shifts. At first it is considered as a cheap project that does not cost money to the brewery. However, the additional inventory creates additional costs in the supply chain. The destructive act theory increases the risk for losing market share in the whole world. The impact to customer service of regular PTT should not be forgotten. Storing the additional capacity near the brewery creates extra costs. It is important to know if the advantages of PTT are considered larger than the costs of the impact.

Solution categories	Alternatives	Impact customer service	Cost-efficient production	Maximum capacity	SC Cost of alternative	Comments
Invest	Extra production line	none	--	+++	\$\$\$\$\$	Overcapacity
						Long term growth solution
Extra Hours	Overtime	none	+	+	\$	Impact on personnel
						No long-term solution
	Extra shift	none	--	++	\$\$\$\$	Personnel issues
						No more space for overtime
Increase effectiveness packaging	PTT 4-8	high	++	+	\$\$\$	High (freshness) risk
						Stock cost in market
	PTT 4	high	+	0	\$	High (freshness) risk
						Stock cost in market
	PTT MTS 4-8	none	++	+	\$\$\$	Additional storage point
						Direct high cost
	PTT MTS 4	none	+	0	\$	Additional storage point
						Direct high cost
	Harmonize & Rationalize	low	++	+	\$	Feasibility
						Commercial value
Increase efficiency packaging	Replenish	low	+	+	\$\$\$	Feasibility
Outsourcing	TPM-project	none	++	+	\$\$\$	Long process
Reject	European breweries	low	+	+	\$\$\$	Availability
						More expensive production
	NPI	low	+	+	\$	More expensive production
						Feasibility
Harmonization by pricing	Maximize demand	high	0	0	\$\$\$	Missed sales
						Block growth
	Evaluate Transfer Price	low	+	+	\$	Governmental specifics
						Financial complexity

Long-term development is of importance again. To produce cost-efficiently, it means that demand from the market is produced for the lowest price. If demand falls in the coming few years, no investments should be made to increase capacity, because you will not need it. If demand rises in the coming few years, HNS needs to take the right measures to be able to meet demand. Currently HNS produces very cost-efficiently. This will only stay the same if demand stabilizes in the coming few years.

The management team of HNS has decided that the implementation option of MTS 4 should receive more attention. I believe in the future potential of this option. You can create a more predictable production and a rhythm in the chain. The customer will not be faced with higher stocks. Cycle 8 creates too much danger for freshness. An addition to the option is to forward the extra cost for storage of cycle 4 products in the MTS concept directly to the customer. Now the customer can decide if he wants to pay more for the specific product or pay less for the more general products. This is in line with the re-evaluation of transfer pricing alternative.

I: List of abbreviations

The following abbreviations are used in the text.

CDL	Corporate Distribution & Logistics
CS	Cycle Stock
D&SM	Demand & Supply Management
DA	Destructive Act
DC	Distribution Center
DP	Demand Point
ETA	Estimated Time of Arrival
EOQ	Economic Order Quantity
FAS	Fygir Advanced Scheduling
GDR	Group Discussion Room
HL	Hectoliter
HNS	Heineken Netherlands Supply
HUSA	Heineken United States of America
LE	Last Estimate
MSM	Market Supply Management
MTO	Make-To-Order
MTS	Make-To-Stock
OEE	Overall Equipment Effectiveness
OPI	Operational Performance Indicator
OPI Nona	Operational Performance Indicator No Order No Activity
OTIF	On Time In Full
PDS	Personal Draft System
PTT	Production Time Table
RSM	Run Size Model
SKU	Stock Keeping Unit
SLA	Service Level Agreement
SS	Safety Stock
SSCP	Strategic Supply Chain Planning
TPM	Total Productive Management
TSCP	Tactical Supply Chain Planning
VMI	Vendor Managed Inventory