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Development of purchasing parameters

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<p>The aim of supply chain management is the delivery and service chain optimization, cost reduction, increase in sales and enhanced customer service. In the Nordic countries, where the distances are long, it is normally necessary to maintain inventories. Another reason for inventories is often uncertainty. Inventories must be maintained as customers want fast shipping, but do not tell in advance when and how much they are going to buy different products. The supply chain management is a very practical activity. It is not solved by using statistical models, or by the IT systems. The most important part of the chain, are the people. The employees should, however, use mathematics and systems to help improve the efficiency of the supply chain.</p> <p>The purpose of this work was to review old and define new purchasing parameters for Pernod Ricard Finland Oy and create a continuous process to define the parameters for the company by using mathematical and statistical methods. The goal of this research was to get better understanding of planning fluctuations and improve and define the planning parameters with fact based knowledge.</p> <p>An action research study was carried out during autumn 2012 and spring 2013. This work initially examined the various theories to improve purchasing parameters, in particular the management of the safety stocks, and determined what kind of planning method should be used for planning various types of products in order to generate the best possible forecast with right information to suppliers and other parties.</p> <p>Based on the theory new parameters for the purchase of Pernod Ricard Finland Oy were defined for certain products, implemented into system and the results were analyzed after few months. As the results of the research trial were promising the final result of the project was a new process and guidelines on how the purchasing parameters will be defined in the company.</p>	
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<p>Yrityksen kyky taloudellisesti tehokkaaseen hankintaan optimaalisen tarjonnan kehittämiseksi ja tuottamiseksi, on nykypäivänä tärkeää. Tavoitteena on toimituksen ja palveluketjun optimointi, mikä alentaa kustannuksia, lisää myyntiä ja tehostaa asiakaspalvelua. Pohjoisissa olosuhteissa, joissa etäisyydet ovat pitkiä ja kuljetuskulut isoja joudutaan yleensä pitämään varastoja. Toinen syy varastojen ylläpitoon johtuu usein epävarmuudesta. Joudutaan varastoimaan, koska asiakkaat haluavat nopeita toimituksia, mutta eivät kerro etukäteen milloin ja paljonko he eri tuotteita tulevat tarvitsemaan. Hankinta on hyvin käytännönläheistä toimintaa. Sitä ei kuitenkaan ratkaista vain tilastomatematiikan avulla tai ohjausjärjestelmiä kehittämällä. Tärkein osa toimivaa ketjua ovat ihmiset. Ihmisen kannattaa kuitenkin käyttää matematiikkaa ja järjestelmiä apunaan tehostaakseen toimintaansa.</p> <p>Tämän työn tavoitteena oli tarkistaa ja tarvittaessa määrittellä uudet ostoparametrit Pernod Ricard Finland Oy:lle ja luoda yhtiölle jatkuva prosessi parametrien määrittelyyn matemaattisia apukeinoja käyttäen. Työn tarkoituksena oli myös ymmärtää paremmin ennustevaihteluita ja niiden syitä.</p> <p>Opinnäytetyö toteutettiin toimintatutkimuksena syksyn 2012 ja kevään 2013 aikana. Työn aluksi tutkittiin eri teorioita ostoparametrien, erityisesti varmuusvaraston hallintaan liittyvien, arvojen määrittämiseen ja mitä ennustemenetelmää erilaisten tuotteiden ennustamiseen tulisi käyttää, jotta ennustaminen tuottaisi mahdollisimman oikeaa tietoa toimittajille ja muille osapuolille.</p> <p>Teorian pohjalta määriteltiin uudet ostoparametrit Pernod Ricard Finland Oy:n eräille tuotteille, implementoitiin ne systeemiin ja analysoitiin uusien parametrien tulokset muutaman kuukauden kuluttua. Tulokset olivat lupaavia, joten tutkimuksen lopputuloksena syntyi uusi prosessi ja ohjeistus ostoparametrien määrittelyyn.</p>	
Avainsanat	toimitusketju, toimitusketjun ohjaus, ostoparametrien määrittely, varmuusvarasto, ennustettavuus, luokittelu

Contents

Symbols and abbreviations	1
1 Introduction	2
1.1 Company presentation: Pernod Ricard Finland Oy	2
1.2 Research background, purpose and scope	3
1.3 Problem definition, purpose of the research and research questions	3
1.4 Research design, methodology and structure	5
2 Supply chain and inventory management	7
2.1 Product Classification methods	9
2.2 Product life cycle based categorization	11
2.3 Demand planning	13
2.3.1 Product evaluation - is the demand forecastable?	14
2.3.2 Qualitative and quantitative forecasting methods	14
2.3.3 Coefficient of Variation analysis	19
2.3.4 Forecasting error	20
2.3.5 Bullwhip effect	22
2.4 Inventory management	24
2.4.1 Planning the safety stock	25
2.4.2 Lead time	30
3 Changing the planning parameters	31
3.1 Research method	32
3.2 Collection of empirical data	34
3.3 Research Process	35
3.4 Target of the project	40
3.5 Metrics	41
3.5.1 Customer Service Level (CSL)	41
3.5.2 Finished Goods Stock for Distribution (STK DS)	41
3.5.3 Forecast Accuracy (FA)	42
3.6 Current State Analysis	42
3.6.1 Planning process	42
3.6.2 Forecasting error analysis	45
3.6.3 Order Process	47
3.6.4 Lead time	48
3.6.5 Life cycle	49

3.7	New Sales and Operations Planning process	50
3.8	New parameters	52
4	Research results	55
5	Conclusions and reliability of the research	64
	References	68

Symbols and abbreviations

APICS	the Association for Operations Management
B	Safety stock
COV	Coefficient of variation
CSA	Current State Analysis
CSCMP	Council of Supply Chain Management
CSL	Customer Service Level
σD	Standard Deviation of the demand
D	Average Period Demand/ Total Demand
DFU	Demand Forecasting Unit
FA	Forecasting Accuracy
HoReCa	Hotel, Restaurant, Catering channel
KPI	Key Performance Indicator
LT	Lead time
σLT	Standard Deviation of the Lead Time
MAD	Mean Absolute Deviation
MAPE	Mean Absolute Percentage Error
MLR	Multiple Linear Regression
MOQ	Minimum Order Quantity
MSE	Mean Squared Error
OF	Order Frequency
RMSE	Root Mean Square Error
SKU	Stock keeping unit
SL	Service Level
S&OP	Sales and Operations Planning
STK DS	Finished Goods Stock for Distribution
T	Time increment used for calculating standard deviation of demand
Z	Service level factor, Z-score

1 Introduction

In today's world, change is permanent and fast paced. Competition is global and customers are more demanding. In material control and purchasing areas companies must ensure enough goods are in stock to serve the customer requirements, but on the other hand with lowest possible cost and without excess and obsolete stock risk. Purchasing and supply chain management are having substantial impact on company's competitive power and financial results. Efficiency is the key factor to success. (van Weele 2010, 3.)

1.1 Company presentation: Pernod Ricard Finland Oy

This research is made for Pernod Ricard Finland Oy in Turku, Finland. Pernod Ricard Finland Oy is an affiliate to French Pernod Ricard group and is the second largest company in the Finnish alcohol business. The company is responsible for marketing, selling and distributing the products of Pernod Ricard Group, for example Absolut, Jameson, Martell, Mumm, Beefeater, Havana Club, Jacob's Creek, and many other internationally known wine and spirits brands in Finland. Pernod Ricard Finland also manufactures domestic alcohol beverages in their production facility in Turku. (Pernod Ricard Finland Oy 2012.)

Pernod Ricard group was born in 1975, when two traditional French companies Pernod (founded in 1805) and Ricard (founded in 1932) merged. In Finland, Pernod Ricard started its own business in 1994. Company's roots in Finland go back to year 1867 when merchant Anders Bernhard Nordfors from Turku got a permission from the Russian tsar to produce alcoholic beverages on basis of domestic fruits and berries. (Pernod Ricard Finland Oy 2012.)

Pernod Ricard Finland has its headquarters in Helsinki and logistics centre in Turku. The turnover in Finland was 60 million euros in 2011 and the company has almost 200 employees. The mother company, Pernod Ricard S.A, is the largest company in the Europe and second largest in the world in alcohol business. It has production in 70 countries, including Finland, and almost 19 000 employees. (Pernod Ricard Finland Oy 2012.)

The corner stones of Pernod Ricard Finland success are the resources of an international mother group combined with the long experience of the Finnish alcohol market. Pernod Ricard Finland does alcohol business in all the traditional channels: Retail (Alko), HoReCa (hotel, restaurants and catering), export, Duty Free and Travel Retail. The biggest individual client is Alko with 349 retail stores. HoReCa sales is made through wholesalers: 5 big and 10 smaller wholesalers sell the products to approximately 6000 restaurants and hotels licensed to serve alcohol in Finland. (Pernod Ricard Finland Oy 2012.)

1.2 Research background, purpose and scope

Also at Pernod Ricard the importance of fast reactions and cost discipline are noticed. They believe there is room for improvement, but need fact based knowledge to make the change in controlled manner.

The purpose of this research is to improve the supply planning accuracy by analyzing the current purchasing planning methods and update and implement improvements to the planning parameters. In addition the goal is to develop a product classification process from supply planning point of view in which efficiency, service quality and warehousing costs are taken into consideration. When making the product classification from planning point of view also the product life cycle is taken into consideration and multiple levels of analysis are defined.

The result can be implemented only to a certain products or product categories from certain geographical areas, or to all of the products from all over the world. Pernod Ricard's own production in Finland and export and tax free business is excluded from this study, although the findings and new processes implemented during this research will be implemented also to these areas.

1.3 Problem definition, purpose of the research and research questions

Currently the planning parameters are maintained mainly based on the proficiency of the supply planner. Actual delivery times from the supplier, inventory turnover reports and transportation cost information could be used better as support. Planning parameters are not regularly checked and maintained. There is not much variation in

the planning parameters in stock keeping unit, SKU, level, and no mathematical or any other theoretical evidence exist, that the parameters are on optimal level. Service level currently is on very good level, which gives indication, that there is a risk of too big safety stocks, which then increases the inventory costs.

Planning parameters are, at some level, defined in the system by the stock keeping units, but there seems to be harmonization and development needs, especially from the supply planning point of view. Reports could be used more effectively and the items could be classified, not only based on the marketing, but also forecasting accuracy and cost point of view. This classification side does not exist or is not in manageable format currently.

The goal of this research is to improve the planning parameters with fact based knowledge and to get more clear understanding about planning errors. To achieve the goal this research aims to answer following questions:

1. How the forecasting is performing?
 - a. How much there is forecasting errors totally, between the products, sales channels, product portfolio, lags etc.?
 - b. What are the reasons behind the errors and how the product life cycle effects to the forecasting?
 - c. What is the relationship between the forecasting accuracy and the stock coverage?
2. Is it possible to have a systematic way to define the planning parameters for all the SKUs?
3. How the planning parameters could be improved? Result is expected to be visible in the inventory turnover time and value.

Question one is answered by the current state analysis. It is giving deeper understanding about the forecasting parameters and hopefully showing areas which can be improved. The answer to question three is expected to be found by combining the theoretical framework with the current state analysis and by forming improvement suggestions, which then are implemented into practice.

A target of this research is to create a process and set of rules how to define the planning parameters for all SKUs and the assumption thus is that the answer to question two is yes, it is possible to create a systematic way to define planning parameters. Results of the implementation will be analyzed in more detail at the end of this research. Supply planners are also hoping the small volume items would not trigger purchase requests for a supplier after the new planning parameters are implemented.

1.4 Research design, methodology and structure

The research is performed as qualitative action research, with a spice of quantitative methods. In the research the planning parameters are redefined by the data analysis, calculations and group of experts working together and making decisions based on the data analysis and evaluation. As result of the research the planning parameter review process and tools are implemented.

The research contains five chapters which are illustrated in the figure 1. The first chapter forms a short introduction of the case company and to the research itself, which includes the background, purpose and scope of the research.

The theoretical framework of this research consists of the elements of supply chain and inventory management. In the chapter two, the elements, which are in main role when defining the planning parameters of the products in a supply chain, are described more deeply.

In the chapter three, the actual research is explored, including the process and goals. The theoretical framework is brought into practice and the empirical side of the research is described, including a short company presentation, process analysis and at the end of the chapter three, the suggestions for the new parameters are presented.

In the fourth chapter, the results of the research are evaluated and analyzed. In the fifth and last chapter, there is an assessment of the reliability of the research, the conclusions and the improvement suggestions for the future.

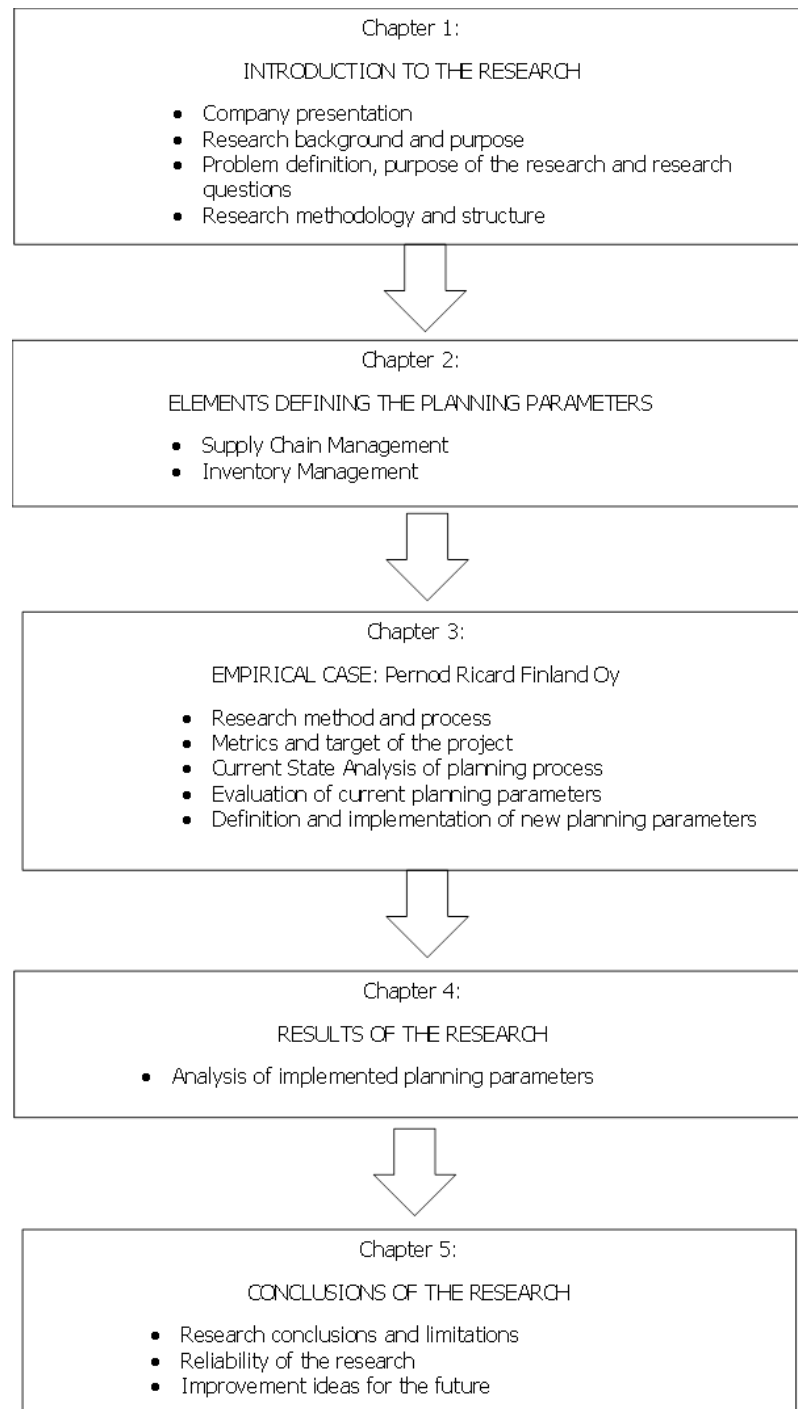


Figure 1 the Structure of the research

2 Supply chain and inventory management

The aim of this chapter is to open up the theories and models related to the topic of this research, including reviewing the prior studies of the research area and introducing mathematical formulas considered to be important for the inventory management and planning parameters.

In order to survive in the global competition, companies have moved from individual business to forming up supply chains. The purpose of the supply chain management is to make the entire supply chain work effectively. The scope of the supply chain is to optimize the material flows from the supplier (and supplier's suppliers) to the company. (van Weele, 2010.)

The term supply chain management has several definitions. A supply chain can be defined as a network of facilities that performs the functions of procurement of material, transformation of material to intermediate and finished products and distribution of finished products to customers. Replenishment control and delivery or production schedules are critical areas in the supply chain. (Lee & Billington, 1993.)

According to the Council of Supply Chain Management Professionals (CSCMP): "Supply chain management encompasses the planning and management of all activities involved in sourcing, procurement, conversion, and logistics management. It also includes the crucial components of coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies." (Council of Supply Chain Management Professionals.)

Sales forecasting and demand planning are among the few activities which are essential for company to success and playing major role in supply chain management. Although in this research the concentration is in demand planning side it is acknowledged that these two are interrelated activities. (Kugel, 2008.)

According to Kugel (2008) demand planning can be categorized into four levels: tactical, advanced, strategic and innovative as presented in figure 2.

Levels of demand planning:

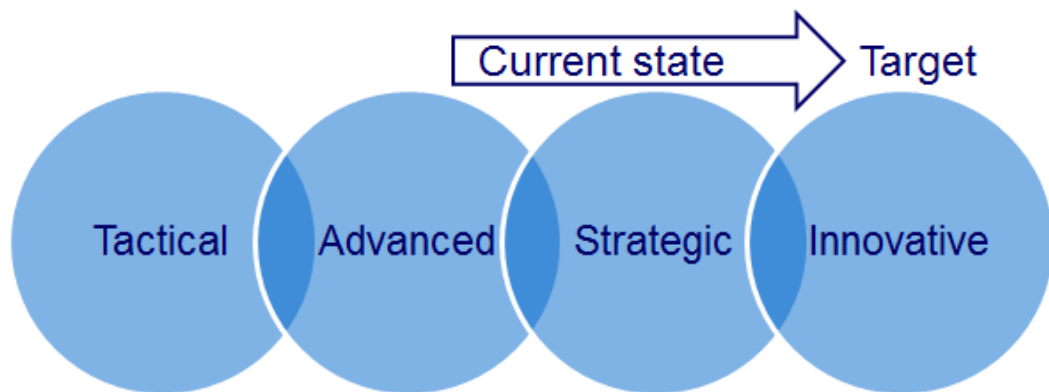


Figure 2 Levels of demand planning (Kugel, 2008).

Tactical – The Company does not have an integrated sales forecasting and demand planning process. Information is not very accurate or timely. (Kugel, 2008.)

Advanced – The Company has taken steps to make the process more integrated and incorporate a wider range of data in developing its forecasts and plans. Wider range of data is used in forecasting and planning. Right people are involved and the company has faster and shorter planning cycles. Yet, accuracy still lags. (Kugel, 2008.)

Strategic – The Company has integrated sales forecasting and demand planning. Process is highly accurate and importance of accuracy is emphasized by measuring it and rewarding it. Detailed information is collected to identify root cause for exceptions that occur. (Kugel, 2008.)

Innovative – The Company has a collaborative sales forecasting and demand planning process that incorporates the people who are most knowledgeable and best equipped to manage the process. Reforecasting and re-planning is made frequently with the shortest possible cycle time. (Kugel, 2008.)

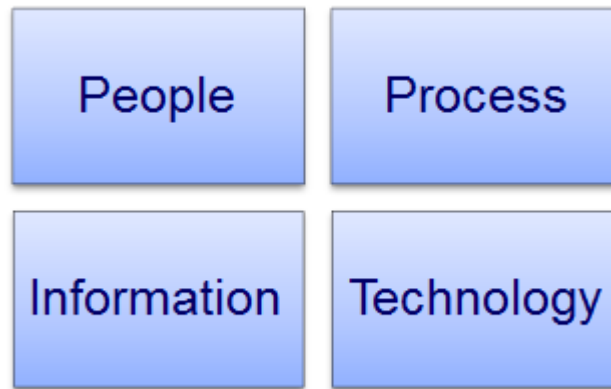


Figure 3 Key components for improvement (Kugel, 2008).

As described in figure 3 people, process, information and technology are seen as the key components of improvement. Ineffective use of information and technology has tangible impacts. Too little emphasis is placed on optimizing production, logistics and fulfillment which are important to the long-term success. IT enables companies to collect huge variety of information, which needs to be analyzed and distributed more widely. Organizations inside the companies do not often understand the possibilities of IT solutions in practice, so the opportunities to use the information, technology and collaboration more effectively to improve the planning are not seen and used as advantage. (Kugel, 2008.)

The current process of Pernod Ricard Finland is estimated to be in the advanced level, in some areas quite close to the strategic level. The goal of this research is to improve the planning process and help the company to see the opportunities and to move entirely to strategic level and as close to innovative level as possible.

This project is concentrating mostly on the process development and somewhat people and information sharing development. Technology development is scoped out as we cannot change the IT systems, but use the current ones perhaps more effectively.

2.1 Product Classification methods

Before deciding how much time and resources are used in forecasting of items, which are difficult to forecast, we would need to have an understanding how much profit

products are generating, is the product new or old. Product classification is used to gain this information and to provide important analytical framework for inventory organization and control. (Milliken 2006; Standford and Martin 2007.)

Classification of items is necessary as the number of units in the warehouse is growing, and the companies cannot use the same time in purchasing, forecasting and sales for all of the stock keeping units. The classification is supporting stock management and can assist determining the material planning strategy of the different items. Business operations are built from many parts. In trade business, the number of items is easily hundreds or thousands, so it is important to understand the internal dispersion when drawing the big picture as the big picture can be composed of very different elements. (Bruckner and von Wrede 1998 in the study of Scholz-Reiter & Heger & Meinecke 2012; Sakki 2009, 89.)

Different classification methods are used to determine how to divide the time and where to concentrate. Purpose of the classification is also to find deviations and fundamental potentials, which might not be visible when the averages of entity are counted and which could be easily corrected. Classification method used depends on the objective. (Sakki 2009, 89.)

Main techniques include the ABC analysis and the XYZ analysis. APICS dictionary defines ABC classification as "The classification of a group of items in decreasing order of annual dollar volume (price multiplied by projected volume) or other criteria. This array is then split into three classes, called A, B and C." (Blackstone & Cox, 2008.)

ABC analysis process is often used to determine the cost effective delivery methods and inventory levels of the materials. In ABC analysis the items can be ranked by many different ways, for example, according to the annual or periodic turnover of sales or consumption, demand value or demand volume, inventory value, annual cost of goods sold or sales margin. The XYZ-analysis is a modified ABC-analysis and is analyzing the usage regularity as well as further alternatives. (Iloranta & Pajunen-Muhonen 2008; Scholz-Reiter et al. 2012; Standford & Martin 2007.)

However, it is important to remember that the classification is made based on a certain value, and it necessarily does not always mean how important the product is for the

customers, or a part is for the production. In addition, ABC-analysis gives a historical picture, and obviously the future most likely is not the same. (Sakki 2009, 91-92.)

2.2 Product life cycle based categorization

In some situations the ABC categorization is not enough and the demand trend needs to be evaluated more deeply. For example:

- For new products it is difficult to find correct category in ABC –analysis.
- Old products leaving the product assortment need special attention and planning.
- Product life cycle and phase might be varying a lot. Some have very short life cycle and some products will be sold for very long time.
- For commercial or strategic reasons certain products are kept in stock although there might not be no need for that.

Products could be categorized with a combination of traditional ABC-analysis and product life cycle analysis. This is called Product Life Cycle based ABC categorization. (Salmivuori 2010, 38.)

The product life cycle represents the various market stage developments that occur for the majority of consumer packaged goods. From the inventory management viewpoint, the product life cycle is one of the major demand patterns along with seasonality or inventory that needs to be accounted for in order to maintain the desired service levels. (Salmivuori 2010, 27.)

Product life cycle is normally divided into following phases: introduction, growth, maturity, decline and withdrawal as presented in figure 4.

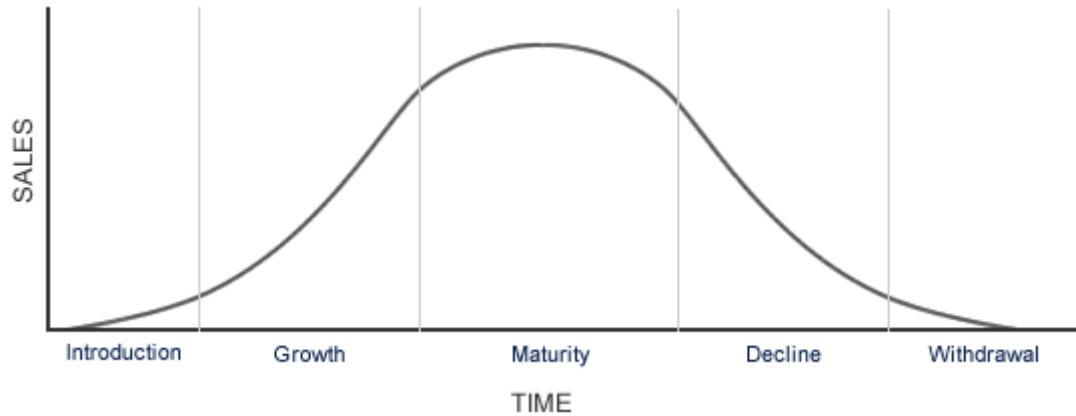


Figure 4 Product life cycle phases (Salmivuori 2010, 27).

- Introduction is the first phase, where there is only a limited awareness of the market for the product. Company does not know how the product will sell and marketing is playing a major role. There is a risk of excess inventory in case the demand is over-estimated. (Salmivuori 2010, 27.)
- Growth starts, when customers discover the product. Sales are increasing heavily and profit is good. At this point, competitors enter the market, and ultimately limit the growth. It is important to secure the availability and have enough safety stock. (Salmivuori 2010, 27.)
- Maturity is reached, when the growth is halted, but the sales remain steady because a market balance is found between the product and its competitors. This phase may last several years. Inventory management should be quite simple, but seasonal changes, campaigns and general economic status might cause some demand fluctuation. (Salmivuori 2010, 27.)
- Decline starts, when sales and demand are clearly decreasing. More competitive products gradually erode the sales. The decline can be accelerated if the product is actively phased out from the market. From inventory management point of view it is important to notice if the decline phase is rapid, and ensure there will not be any excess stock. The termination should be controlled. (Salmivuori 2010, 27.)

Unsuccessful product launches or successful marketing campaigns will have effect on the product life cycle (Salmivuori 2010, 27-29).

In the Product Life Cycle based ABC categorization the change in sales is added to the ABC categorization. Also forecasted sales could be compared with actual sales. Categories could be for example NEW (new products), SPE (special, e.g. customer specific or strategic products which must be kept in stock), ABC + (products growing over e.g. 10 % when compared to earlier period in ABC categories), ABC= (products which are selling steadily when compared to earlier period), ABC- (decrease over e.g. 10 % when compared to earlier period), ORD (only to be purchased when there is an customer order), EOS (end of sales). The main idea is to treat the different products from inventory and stock planning point of view differently, as the need for safety stock is different, and the risk of obsolete stock in some decreasing sales or ending products needs to be controlled. (Salmivuori 2010, 39.)

2.3 Demand planning

The demand forecasting and anticipation of the changes in sales is important in all business, as it is directly affecting to daily operations, like logistics or marketing. Over forecasting is causing waste in resources, like production, warehousing, labor and excess material costs. On the other hand under estimating the demand will cause delivery problems, poor customer service and lost sales. (Karrus 2005, 34-36, Sakki 2009, 120-122.)

Controlling the materials by steering the inventories is basic logistics tools. The information about ordering need is received from the warehouse. The method is suitable for products which are consumed continuously. Normally the inventory size is attempted to optimize so that the normal demand fluctuation can be handled. However, the normal random variation should be separated from actual changes in demand, like trends and seasonal variations, in order to achieve a correct picture of the demand development. (Karrus 2005, 34-36, Sakki 2009, 120-122.)

Demand forecasts are made for short, mid or long time frame. Short term, 1-3 months, forecasts are operational forecasts, which are effecting on the purchase decisions, resources planning and supply chain schedules. Historical actual sales outcome can be used as foundation when demand forecasts are made adjusted with the analyses of the

current state of the markets and expected change in the future. Information collection might also be difficult as demand information is sensitive and considered to be confidential. (Salmivuori 2010, 63, Konsynski B. & McFarlan E. 1990.)

2.3.1 Product evaluation - is the demand forecastable?

Demand planning combines human judgment with statistical forecasting, which is made based on history. Most companies use simple methods, which are easy to use and understand even though those might not be the most effective ones. The basic assumption is that the outcome, statistical or judgmental, will follow some pattern associated with seasonality, trend or causal relationships plus some random influences. Actual outcome = pattern + randomness. This means that even when the average pattern has been identified, some deviation will exist between the forecast and the actual. The goal is to minimize the deviations (errors) in the forecast by selecting the appropriate method. The problem usually is that companies rely only on one methodology although they should use several methods, whatever fits the best to the situation, to forecast the future. (Chase 1997.)

2.3.2 Qualitative and quantitative forecasting methods

Demand forecasting methods can be divided into quantitative, which rely on sales history and are called mathematical methods, and qualitative, also called judgmental methods. The used method depends on the nature of the demand, forecasting tools and resources and the accuracy of the forecast. The time frame of the forecast also affects to the method as in the short or mid horizon forecasting usually the quantitative methods are most useful. The demand can be collected from bottom-up, collecting the demand from point-of-sales and combining them together, or top-down in time the demand is changing as many matters are affecting to it. All products have their own life cycle and in different phases of the life cycle the demand is different. This means the forecasting method in use should be adjustable and possible to update when necessary. (Salmivuori 2010, 63-66; Kahn K. 1998; Chase 1997.)

When the qualitative methods are used in demand forecasting, the forecast is made by people, not with the computers like when quantitative methods are being used. In qualitative forecasting the expertise of specialists is utilized and in quantitative methods the

speed and calculation capacity of computers. Specialists can be employees working with the demand like sales or marketing personnel. Knowing markets and customers is very important skill for a person making demand forecasts. Also specialists, who are following the latest trends and phenomenon, can be utilized and quite often are found inside the organization. The major advantages of qualitative methods are their low cost to develop, as there is no need for expensive computer hardware and software. Forecasts can be develop fairly quickly and are often very accurate. But on the other hand, they might be biased towards the user group who develops them, are not consistently accurate due to subjective nature of the development and are not generally suited well with companies with a large number of products, SKUs. (Salmivuori 2010, 63-66; Chase 1997.)

Bias refers to any assumptions that affect the demand planning process. These assumptions can reflect an overly optimistic or pessimistic view of the future. Unrealistic expectations by individuals or groups with a stake in the outcome of the forecast are an example. Also second guessing, excessive reliance on past patterns that may be changing or a lack of vision to external factors which can affect future demand are also factors that contribute to bias. (Manugistics Inc. 2005, 18-7.)

A company can reduce bias, for example, by establishing and documenting standards and processes, assigning ownership and accountability to the forecast, producing new models based on the different parameters and providing feedback to forecasters. (Manugistics Inc. 2005, 18-8.)

There are two segments within the quantitative methods: time series, which can be referred as reactive or one-dimensional method, and causal, which can be referred as multidimensional or proactive method. A time series is a chronological sequence of observations on a particular variable. Time series are techniques built on the premise that future sales will mimic the pattern of past sales. In other words, the technique relies on the identification of patterns like seasonality, trend and cyclical within the past sales history. (Chase, 1997.)

The most basic time series method is called “naive” model as it assumes future sales will replicate the past sales. Another time series method is called “moving averaging” or “smoothing” models as they are leveling out small random fluctuations. The most widely used times series methods are called “exponential smoothing” in which the sales

volumes for the most recent periods have the more impact on the forecast and therefore should be given more weight. Examples of exponential smoothing models are: Brown's Double Exponential Smoothing, Holt's Two Parameter Exponential Smoothing, Winter's Three parameter exponential Smoothing, and Lewandowski method. A more advanced time series is called "decomposition" which is based on assumption that sales are affected based on four basic elements: trend, seasonal influence, cyclical influences and random/irregular influences. The most advanced time series technique is called Box-Jenkins, also known as ARIMA models that combine the key elements from both time series and regression models. (Chase, 1997.)

Holt-Winters and Croston use static smoothing parameters that remain constant during the smoothing process. Lewandowski uses adaptive smoothing, which allows certain parameters to auto-adapt during the smoothing of history. Lewandowski allows parameters to change in response to error signals measuring bias (forecast overshoot or undershoot) and precision (model fit). For this reason Lewandowski model tends to have the shortest lag times in adapting to changes in demand structure. Bias is the tendency for error to be persistent in one direction. Forecaster bias occurs when error is in one direction for all items and business process bias occurs when error is in one direction for specific items over a period of time. Forecast bias usually occurs due to human intervention to build unnecessary forecast. This bias results in increased inventories and higher risk of obsolescence. Business process bias can either be an over-forecasting or under-forecasting. This bias is hard to control. (Manugistics Inc., 2005; Chockalingam, 2012.)

The major advantages of time series methods are: they are well suited to situations where sales forecasts are needed for a large number of products; they work very well for products with fairly stable sales; they can smooth out small random fluctuations; they are simple to understand and use, and they are generally good at short-term forecasting. The major disadvantages of time series methods are: they require a large amount of historical data; they adjust slowly to changes in sales, and forecasts can have big errors because of large fluctuations in current data. (Chase, 1997.)

The basic premise of causal models is that the future sales are closely associated with changes in some other variables, for example price, advertising, sales promotions, and merchandising. Once the nature of the association is quantified it can be used in the forecasting. The most widely used causal methods are simple regression, multiple re-

gression, robust regression and econometrics. The major advantages of causal methods are: they are available in most software packages; they are inexpensive to run on computers; are familiar to managers; provide accurate short- and medium-term forecasts, and they are capable of supporting “What if” –analysis. The major disadvantages are: the forecasting accuracy depends on a consistent relationship between independent and dependent variables; an accurate estimate of the independent variable is crucial, and they tend to be more expensive to build and maintain. (Chase, 1997.)

Time series analysis is used to develop forecasting data, to estimate dynamic causal effects, and to evaluate what is the effect over time. Usually the observations are taken at regular intervals (days, months, or years) and data is collected on the same observational unit at multiple time periods. A lag variable has the value of another variable, which occurred a number of periods earlier. Production lead time, or like in the Pernod Ricard case, the transportation lead time dictates the forecast lag to be used. The longer the lead time is, the larger is the forecast lag. And the larger the lag is, the lower the forecast accuracy is. (Chase 1997; Chockalingam 2012.)

Quite often the quantitative and qualitative methods are being combined. The qualitative forecasts are produced with computer systems and reviewed by the specialists and corrected when needed. (Chase 1997.)



Figure 5 Product analysis to help selecting forecasting method (Manugistics Inc., p. 1-6).

The key factors to consider when choosing the forecasting method evolve around the completeness and stability of the data sets being forecasted. Incomplete data refers to having limited sales history for a particular item and/or not having all the required causal variables. Low stability refers to data having aberrations or being random with no distinct pattern associated with. High stability refers to data that has distinct pattern associated with it, such as seasonality and trend. Those products which have incomplete data and are unstable can only be forecasted using mainly qualitative methods. (Chase, 1997.)

Smoothing methods are generally used for nonstationary demand. Stationarity exists, if the data series were divided into several parts and the independent averages of the means and variances of each part were about equal. If the average of each mean or variance were substantially different, nonstationarity would be suggested. Smoothing methods look forward in time to determine the best fit and are more reactive in nature. Lewandowski is best-suited for highly nonstationary demand patterns, seasonal or non-seasonal, that may be subject to impacts of data driven events (for example sales and marketing events). The Croston method specifically targets non-seasonal, intermittent

demand patterns. Intermittent refers to randomly distributed demand with a high zero content mixed in. Holt-Winters is a general purpose exponential smoothing algorithm which complements regression algorithms to address nonstationary seasonal demand. (Manugistics Inc., 2005.)

Seasonal demand fluctuations of some products are making accurate forecasting more difficult. At Pernod Ricard Finland the peak seasons are Christmas, New Year, summer and especially midsummer, Easter, 1st of May and other holidays when people are gathering together with good food and drinks. The products of different seasons are varying as well. Some of the products have very long delivery times from overseas and planners must use early demand forecasts which might change during the long lead time.

To deal with the seasonal demands the planners need to be very professional and careful when buying goods, and in addition they need to keep larger safety stocks. These activities increase costs and reduce operational efficiency. Forecasting of such demand may need advanced data analysis and operational statistics. An update of the forecast very near to the beginning of the peak season based on the early season demand information might improve the accuracy of the long delivery time products. (Chen & Chang 2007, Rahman & Sarker & Escobar 2011.)

2.3.3 Coefficient of Variation analysis

By studying the ratio of the Demand Standard Deviation and Average Period Demand we can gain a better understanding mathematically how forecastable the demand is. According to Milliken (2006) the Coefficient of variation (COV) is measured as:

$$COV = \frac{\sigma D}{D}$$

σD = Standard Deviation

D = Average Period Demand

Variability coefficient is calculated by dividing the mean absolute deviation ratio with the mean. It is measuring how big the error is when compared with demand volumes. The higher the coefficient is the more difficult to forecast and the more there is variation in the demand. (Milliken 2006.)

According to Milliken the Coefficient of Variation limits are:

- $COV \leq 0.8$ the demand of an item is forecastable and the best forecasting model should be selected (Milliken 2006).
- $COV > 0.8$ the demand of an item is unforecastable and one should look for alternative ways to manage the item. (Milliken 2006).

When calculating COV, the minimum of 12 months of data should be used. COV helps to identify how forecastable or unforecastable products are. There might also be products with high COV which are forecastable. Seasonal products are an example of products which might have a high COV, but can be forecasted with the existing forecasting models that account seasonality. (Milliken 2006.)

2.3.4 Forecasting error

Companies target to use the best model in forecasting, but in some cases the assumed best model is not the best. It is inevitable that forecasting errors occur when the demand is random, but the magnitude of the error should be monitored so that the proper forecasting method and parameters can be chosen and modified when needed. Sporadic or intermittent demand is difficult to forecast as there might be demand peaks and in turn periods when there is no demand at all. (Milliken 2006, Sakki 2009, 137-141.)

The purpose of measuring the forecast accuracy is to monitor the forecasting process and provide feedback to the forecasters and other members of the organization who provide significant input to the forecasts. In this research the forecasting accuracy is used also to determine the need to adjust the planning parameters and safety stock value. The goal of the forecast accuracy management is to provide feedback to the forecasting process to minimize bias and enable continuous forecast improvement. (Manugistics Inc. 2005, 18-6.)

Forecast validity is an ability to produce a forecast that is consistent with the business environment. The forecast must be in the correct units, for the correct time period and in the correct scope. Invalid forecasts might occur if information about a promotion is applied to the wrong period. Mistakes are also possible in case market intelligence is

more weight on big errors. MSE and RMSE are statistics that can help to determine how closely the model matches history. (Sakki 2009, 138-139.)

$$RMSE = \sqrt{MSE} = \sqrt{\frac{\sum_t (Actual_t - Forecast_t)^2}{n}}$$

Root Mean Square Error is showing the standard deviation of the forecasting error and by using it in the safety stock calculation the safety stocks can be estimated more specifically. Follow up of forecasting error development could be arranged, for example, by comparing the latest error with the average of the errors of certain time period. Safety stock's function is to balance the variable demand and coefficient and these indicators may be used when the safety stock is defined. (Sakki 2009, 140-141.)

The mean absolute percentage error, MAPE, is a measure of accuracy used specially in trend estimation. It expresses accuracy as a percentage. MAPE is commonly used in quantitative forecasting methods to produce a measure of relative overall fit. The absolute values of all the percentage errors are summed up and the average is computed. (Stevenson 2009, 76-77; Kahn 1998.)

$$MAPE = \frac{100\%}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right|$$

A_t is the actual value and F_t is the forecasted value. MAPE is emphasizing errors relatively. (Stevenson 2009, 76-77; Kahn 1998.)

2.3.5 Bullwhip effect

The bullwhip effect, also known as the Forrester effect, on the supply chain occurs, when the changes in the consumer demand causes the companies in a supply chain to order more goods to meet the new demand. Forecasting is one of the main causes of the bullwhip effect. The bullwhip effect usually flows up the supply chain, starting with the retailer, wholesaler, distributor, manufacturer and then the raw materials supplier. This effect can be observed through most supply chains across several industries; it occurs because the demand for goods is based on demand forecasts from companies, rather than actual consumer demand. (Sakki 2009, 110.)

When companies enter new products into the marketplace, they estimate the demand of the goods based on current market conditions. Most companies in the supply chain, order more than they can sell, attempting to prevent shortages and lost sales. This extra inventory begins to increase or decrease during the normal market fluctuations of supply and demand. When demand increases, the companies closest to the consumer will increase inventory to meet the consumer demand. When the demand falls, the front-end of the supply chain will decrease inventory, amplifying the extra inventory on each company up the supply chain. (Sakki 2009, 110.)

One cause of the bullwhip effect is normally driven by management behavior at the front-end companies of the supply chain. Sales management never wants to have a stock-out, leading to higher orders from the wholesalers. This eventually squeezes each company in the supply chain and creates decreases in inventory. (Sakki 2009, 110.)

Another major behavioral effect is the ordering of too much inventory when consumer demand has fallen for an item. Inventory levels may have been raised to avoid a stock-out, but are now met with goods that cannot be sold quickly. This creates overstock of inventory for each company in the supply chain. (Sakki 2009, 110.)

The main operational cause of the bullwhip effect comes from individual demand forecasts from each company in the supply chain. This causes an increase in demand from companies in the supply chain, but not the actual consumers who will purchase the goods. A lack of communication is also prevalent during operational causes; companies do not supply enough correct information up the supply chain regarding current market conditions, causing wrong levels of inventory. (Sakki 2009, 110.)

Theoretically, the bullwhip effect does not occur, if all orders meet the demand of each period. Careful management of the effect is important. It is necessary to extend the visibility of the customer demand as far as possible. The almost perfect visibility of the customer demand and inventory movement throughout the supply chain leads to better inventory positioning and lower costs throughout the supply chain. Barriers to the implementation of a demand-driven supply chain include the necessary investment in the information technology and the creation of a corporate culture of flexibility and focus on customer demand. Another important matter is that all members of a supply chain rec-

ognize that they will gain more if they act as partners, which requires trustful collaboration and information sharing. (Sakki 2009, 110.)

2.4 Inventory management

Inventory has the role of balancing the production and demand. Stocks are kept by inventory through forecast by business to shorten the lead time in order to satisfy customer's demand. There are two contradictory objectives in this approach: to lower cost of inventories and to satisfy customers demand. (Su Chwen-Tzeng & Wong Jui-Tsung 2008.)

Inventory stock depends on essentially two factors:

- Demand: the amount of items that will be bought by customers
- Lead time: the delay between reorder decision and renewed availability

Those two factors are, however, subject to uncertainties:

- Demand variations: customer behaviors can evolve in rather unpredictable ways.
- Lead time variations: suppliers or transporters may be faced with unplanned difficulties.

As seen in figure 6 inventory variances might be caused by variability in the demand or lead times, or both.

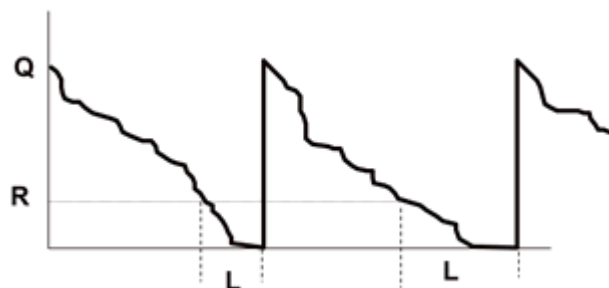


Figure 6 standard inventory variance (Sakki 2009, 124-125).

Q= quantity, R = re-order point, L = lead time

Inventories might also form, because the purchase lots are bigger than the sales in certain period of time. It is more cost efficient to buy in bigger lots because purchasing price is smaller, transportation and handling costs are lower. When the transportation time from supplier to warehouse is long, bigger inventories secure the customer demand in case the delivery from supplier is delayed. (Salmivuori 2010, 12.)

Inventory creates several kinds of costs for the company: capital costs, space related costs e.g. heating, electricity, insurance, activity and labor related costs like machines, salaries, product related costs e.g. loss, wastages, depreciation (Salmivuori 2010, 9).

2.4.1 Planning the safety stock

Safety stocks are needed when the future demand is not exactly known and the replenishment time varies. In practice, there is no separate safety stock, but in the calculations it is added to the cycle stock needed during the replenishment lead time to cover the uncertainties in the process. One of the main goals of this thesis is to improve the inventory turnover and decrease the safety stock. The safety stock is forming a buffer which ensures the good customer service in cases where the demand increases suddenly or delivery from supplier is late. Safety stocks are not the only way to ensure the customer satisfaction and service capacity. Mathematically it might be possible to show that the safety stocks are improving the customer service levels, but in real life safety stocks often are slowing down the inventory turnover, increasing the turnaround time and warehousing costs. (Sakki 2003, 87; Sakki 2009, 121.)

Daily follow up, planning and co-operation are the key factors when improving the customer service. Information sharing from customer, inside the company and towards the supplier is playing important role also in safety stock improvement activities. Supplier needs to know all the information company has for both actual and forecasted sales, which means the company should require this information from the customers as well. Company should also try to improve the delivery time and fasten the delivery rhythm. The inventory control and sales reporting must be continuously monitored. (Sakki 2003, 87.)

In case the only variability is the demand, the safety stock can be simplest estimated based on the standard deviation of the demand multiplied by the Z-score which is a statistical figure also known as standard score (Sakki 2009, 122, King 2011, 34).

$$B = Z\sigma_D\sqrt{LT}$$

B = safety stock

Z = service level factor, Z-score

σ_D = standard deviation of the demand

LT = lead time

The service level expresses the probability that a certain level of safety stock will not lead to stock-out. Naturally, when safety stocks are increased, the service level increases as well. When safety stocks get very large, the service level tends to be 100% (i.e. zero probability of encountering stock-out). However, there needs to be a balance between the inventory cost and customer service, and companies must find the balance. (King 2011, 33.)

Table 1 Service level safety factors, Z-scores (Sakki 2009, 122; King 2011, 34)

Desired Service level	50 %	75 %	84 %	85 %	90 %	95 %	97 %	98 %	99 %	99,50 %	99,90 %	99,99 %
Safety factor	0	0,67	1	1,04	1,28	1,64	1,88	2,05	2,33	2,57	3,09	3,72

Fixed Z-score is not recommended and the classification methods should be used regularly to determine the correct service levels for each product or product group so that the product groups having most value to the business will have more safety stock. Safety stock determinations are not intended to eliminate all the stock outs, just majority of them. Typical goals for the service levels fall between 30 and 98 percent, and statistically a cycle service level of 100 percent is unattainable. (King 2011, 34.)

The reorder point is the amount of stock that should trigger an order. If there was no uncertainty (i.e. future demand being perfectly known and supply being perfectly reliable), the reorder point would simply be equal to the total forecasted demand during the lead time, also called lead time demand as seen in figure 7.

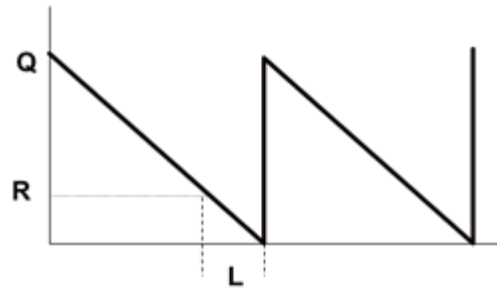


Figure 7 standard inventory variance (Sakki 2009, 124-125).

$R = \text{re order point } D * LT$

$D = \text{demand per time period}$

$L = \text{lead time}$

However, as noticed earlier in this thesis, that normally is not the case, and both demand and lead time are varying and there might be additional issues like Minimum Order Quantities leading to more complex stock calculations (Sakki 2009, 122-123).

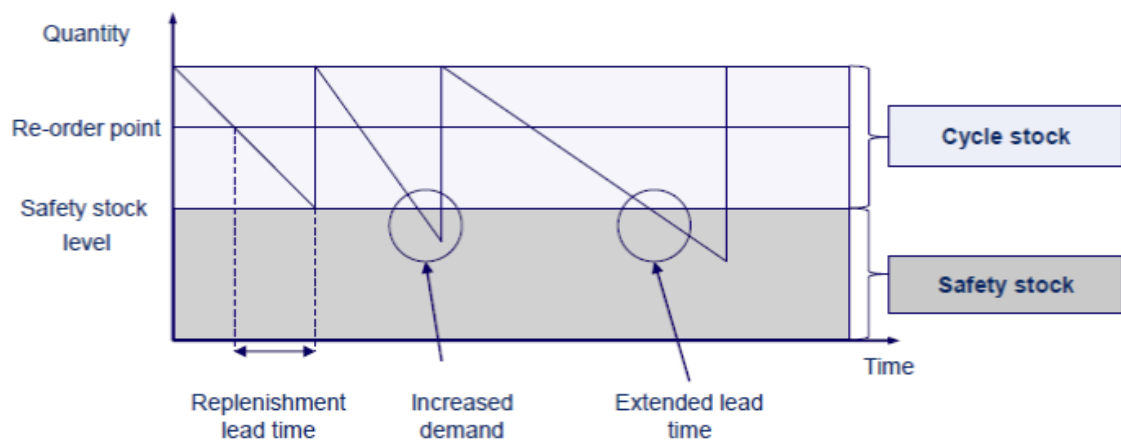


Figure 8 Standard inventory target calculation at Pernod Ricard Finland Oy

Cycle stock formula of calculation:

$$MAX\left(\frac{D}{2 \times OF}; MOQ\right)$$

D = Total Demand

OF = Order Frequency

MOQ = Minimum Order Quantity

When the demand periods are not equal to the total lead time, the standard deviation should be calculated based on the periods equal to the lead time (King 2011, 34):

$$\sqrt{\frac{LT}{T_1}}$$

LT = Lead time

T_1 = Time increment used for calculating standard deviation of demand

Taking the demand periods into consideration and the lead time is not varying the safety stock equation is (King 2011, 34):

$$\text{Safety stock} = Z * \sqrt{\frac{LT}{T_1}} * \sigma_D$$

Z = Z-score

LT = total lead time

T_1 = Time increment used for calculating standard deviation of demand

σ_D = Standard deviation of the demand

The total lead time may be called also the performance cycle which includes the time needed to perform functions such as deciding what to order, communication to supplier, processing the order, delivery and storage as well as any additional time required to start the next cycle (King 2011, 34).

When the variability in lead time is the main concern the safety stock equation is (King 2011, 34):

$$\text{Safety stock} = Z \times \sigma_{LT} \times D_{avg}$$

Z = Z- score / safety factory of service level

σ_{LT} = standard deviation of the lead time

D_{avg} = average demand

When both demand variability and lead time variability need to be taken into consideration, statistical calculations can combine to give a lower total safety stock. In cases, when the demand and lead time variability are independent and influenced by different factors and both are normally distributed the equation is: (King 2011, 34.)

$$\text{Independent variability safety stock} = Z * \sqrt{\left(\left(\frac{LT}{T_1} * \sigma_D^2\right) + (\sigma_{LT} * D_{avg})^2\right)}$$

When the demand and lead time variability are not independent of each other the safety stock is the sum of the two individual calculations (King 2011, 34):

$$\text{Nondependent variability safety stock} = (Z * \sqrt{\frac{LT}{T_1}} * \sigma_D) + (Z * \sigma_{LT} * D_{avg})$$

Alternative safety stock formula of calculation taking forecasting errors into account is (King 2011, 34):

$$\text{Min}(z_{SL} \sqrt{(\sigma_D^2 LT) + (\sigma_{LT}^2 \bar{D})} : z_{SL} \sqrt{\left(\left(\frac{\pi}{2} MAD^2 LT\right) + (\sigma_{LT}^2 \bar{D}^2)\right)}$$

SL = Service Level

D = Average Demand

σ_D = Demand Variability (standard deviation of the demand)

MAD = Forecasting error (Mean Absolute Deviation)

LT = Lead time

σ_{LT} = Lead time Variability (Standard deviation of the lead time)

Forecasting error is inevitable. Development of safety stock calculations based on the actual variability of the demand with the help of statistical techniques provides truer information about the level of protection required. To convert the statistical variation to applicable safety stock, the mean absolute deviation (MAD), is used. Also the replenishment lead time must be taken into notice. The square root of the lead time, expressed in the same time units as the forecast interval, is therefore considered as a factor in the final equation. Service factor multiplier is used as a factor in the safety stock calculation formula. (Krupp, 1997; Krupp 1997.)

The final formula for calculation of safety stock (Krupp, 1997):

$$\text{Total Safety stock} = Z\text{-score} * \text{MAD} * \sqrt{\text{Lead time in months}}$$

2.4.2 Lead time

The lead time is important factor when trying to perform inventory optimization. The classical safety stock model assumes that the lead time is a constant that gets factored into the calculation of the optimal reorder point. In practice, lead times, when measured, are typically varying. (King 2011, 34.)

During the discussions with the supply planner of Pernod Ricard Finland I learnt that there might be several reasons for the varying inbound lead time. For example, the supplier might have one or two closed days every week, e.g. no delivery during the week-end. Transportation schedules can increase the lead time for several days, as there might be only certain weekdays when vessels are loaded. When transported longer distances, it is very possible for the shipment to be late from a feeder vessel from mainland Europe to Finland.

Other possible causes:

- Capacity limitations
- Equipment shortages (e.g. rail cars, especially for shipments into ports in the west that are moved via rail to the east)
- Inspections/customs
- Misrouting
- Data errors that delay processing

- Weather conditions
- Labor issues
- Security

National holidays can also increase the discrepancy between calendar days and business days. It is also possible that there is a stock-out on the supplier side and they need to wait for replenishment to do the shipping.

Variability in lead time performance leads to excess inventories, inventory shortages, or both, impacting the bottom line significantly in either case. Lead time variability has also impact on variety of the supply chain cost and performance metrics, the impact of variability is actually greater the more efficient a company's supply chain is. (King 2011, 34.)

3 Changing the planning parameters

The different channels are having different kinds of consumption behaviours and this is causing challenges to demand planning. In this research the HoReCa and Alko channels are studied. Especially the HoReCa channel sales are difficult to predict. Alko channel usually is more stable, but economical situation and increased number of competitors are increasing challenges in demand planning are also in that channel. Competition is tough and costs must be cut down and accurate demand planning is ensuring results.

Finnish alcohol market is adding its own flavor to the alcohol business in Finland. The legal drinking age is 18 years and purchase age of strong spirits is 20 years. Alcohol marketing is regulated and advertising in medias is accepted only for products below 22 % of alcohol. Spirits marketing is heavily restricted. Most important alcohol sales regulation instrument is state taxation. It has been used in several occasions during the latest years, and is object to continuous social discussion.

Total alcohol sales in Finland was in 2010 appr. 630 million litres, of which almost 85 % in retail. The only retail channel for products above 4,7 % alc. vol. is the state monopoly Alko. Alko manages its assortment through product searches and de-lists products with poor performance. Price regulations are possible quarterly. HoReCa sales are made

through wholesalers and almost 6,000 licensed restaurants. (Pernod Ricard Finland Oy 2012.)

3.1 Research method

Research methods can be divided into quantitative and qualitative methods. In practice this research is using both of the approaches and they are supporting each other. A qualitative research method is suitable approach for this study, which investigates and improves the quality of the planning accuracy. Qualitative research takes a comprehensive perspective in order to achieve a deep understanding of the studied phenomenon. On the other hand quantitative research methods are used when planning parameters and accuracy are analyzed and re-defined. A qualitative study answers questions “what, why and how?” (Hirsjärvi & Remes & Sajavaara 2001, 123-126; Holme & Solvang 1997, 92.)

This research is a case study as it is investigating detailed information about relatively small case of Pernod Ricard Finland Oy. A case study provides a systematic way of looking at events, collecting data, analyzing information, and reporting the results. (Hirsjärvi et al. 2001, 123.)

This thesis is carried out as action research as it aims to improve the current practices and ways of working by implementing changes to the current process. The roots of action research are deep in the pragmatism. Pragmatism is a philosophical tradition linking empiricism and theory. It describes a process where theory is extracted from practice and applied back to practice. In all action research projects the information is produced through thinking, action and empirical observations. In figure 9, the knowledge formation phases are illustrated in the different phases of action research cycle. Rationalism is emphasized in the planning and evaluation phase when thinking is required. Information is formed pragmatically especially in action phase and in observation phase the information is formed empirically. (Heikkinen & Rovio & Syrjälä 2006, 197-200.)

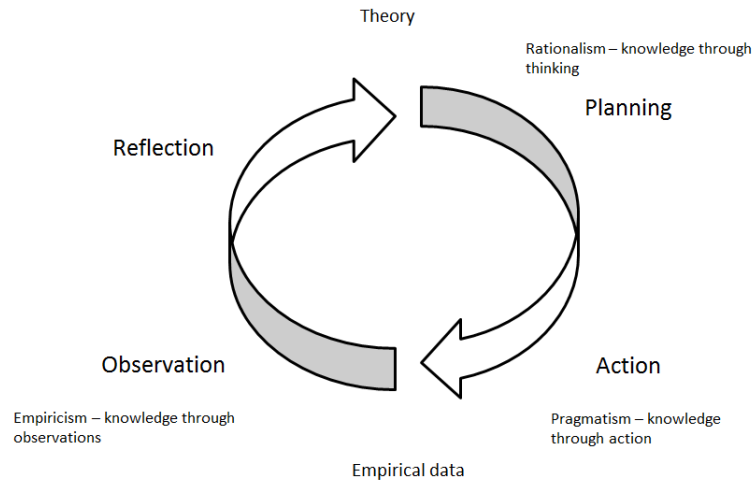


Figure 9 Origin of the information in the cycle of an action research (Heikkinen et al. 2006, 197-200).

Orientation to pragmatic, practical issues, aiming towards change and involvement of people under research to the research process are common factors for action research. However, the applied theories or theories being developed might be very different and the subject of an action research can be almost anything related to human life. (Kuula 1999, 10-11.)

Action research is defined as based on intervention, practical, participatory, reflective and social process. In traditional view the researcher is trying not to disturb the target of the research and making himself invisible. In action research it is thought, that in case the social truth is attempted to change something new will show up. The research is basing on intervention. There is no end in the cycles of development and the better practice is always temporary. Action research is combining theory with practice. The researcher is activating and developing action, participating and trying to make sure the organization or community is also participating in all phases of the research. Also the action research is trying to improve the interaction and communication of different parties in order to develop the action. In action research the improvement of action is also sought through reflective thinking. This means that a person is observing his own thoughts, experiences and himself as realizing and experiencing object. The person is taking distance from himself and seeing his thinking and doing from new perspective. There is a lot of tacit knowing in action and the learning is potentiated when people are consciously thinking of tacit knowing and when they are able to discuss it. In reflective process people are learning from moving between tacit and verbal knowledge both

during the action and outside it. Action research is a process and during it the understanding and interpretation are gradually increasing. In traditional research the attention is paid to how things are. In action research it is studied how things are and into which direction they are going to. (Heikkinen et al. 2006, 27-36.)

Action research is categorized normally as qualitative research, but like in this research also quantitative methods can be used in action research. Heikkinen et al are stating that action research is not a research method at all, but an approach or state of mind in which the theory is engaged with development of action. It is natural to combine quantitative and qualitative methods in action research: mixed methods, combined designs. (Heikkinen et al 2006, 36-37.)

3.2 Collection of empirical data

The historical demand and forecast data used in the analysis in this research is collected and combined from the monthly reports of Pernod Ricard Finland. Data is collected from full calendar year 2012 and is presented in monthly intervals. This data is used for current state analysis of the planning parameters, demand and inventory data. In the future process the data will be used as rolling 12 months.

Unformal face to face discussions and interviews with demand planners, supply manager and warehouse manager are used to understand the planning process, reasons and causes behind the numbers and warehousing cost elements. Discussions are used in current state analysis and also at the end of the research, when the results are analyzed. Interviews are creating a possibility to clarify and deepen the understanding of observations gathered during the current state analysis. With direct questions the answers to the research questions might be found. Specific questions may be addressed to correct employees and time is saved. The interview method of this research is theme interview or open interview as the topic of the interview is defined, but questions are not as accurate as in formal interview. The discussion is proceeding with the terms of the interviewee and interview is forming, based on the answers. Normally individuals are interviewed, but also couple or group interviews are useful in actions research. (Heikkinen et al. 2006, 109-110.)

In this research a team of experts was formed to further analyze the data, make decisions based on the analysis to implement the new parameters. Team of experts

consists of the researcher, supply chain manager and a supply planner. Questions are asked and answered in face to face meetings, telephone conversations and by e-mail.

3.3 Research Process

As an external action researcher I will be activating and developing the process by discussions with both managers and the employees of the organization. I will explore the work activities and planning parameters, make observations and try to promote a dialogue in order to get the opinions of all parties are taken into consideration. I will ensure that the people in the organization are actively participating into all phases of the research with me. All employees are treated as equal. Also I am trying to improve the interaction and communication of different teams in supply chain during the research.

Reflection is used in discussions and employees are encouraged to think and discuss about the planning process and their own ways of working. Tacit knowing in action is collected and brought into daylight. The action research cycle is followed as the new parameters are first planned and then implemented. The implementation is reflected and observed and then the cycle can be started again.

Formal knowledge about the topic is gathered from the theoretical part of the study and professional knowledge from the supply planners and other employees of the company. The theory used in this research is gathered by the researcher and the relevant theories for the project are introduced to the team for decision making purposes as described in figure 10. This process was created by the researcher.

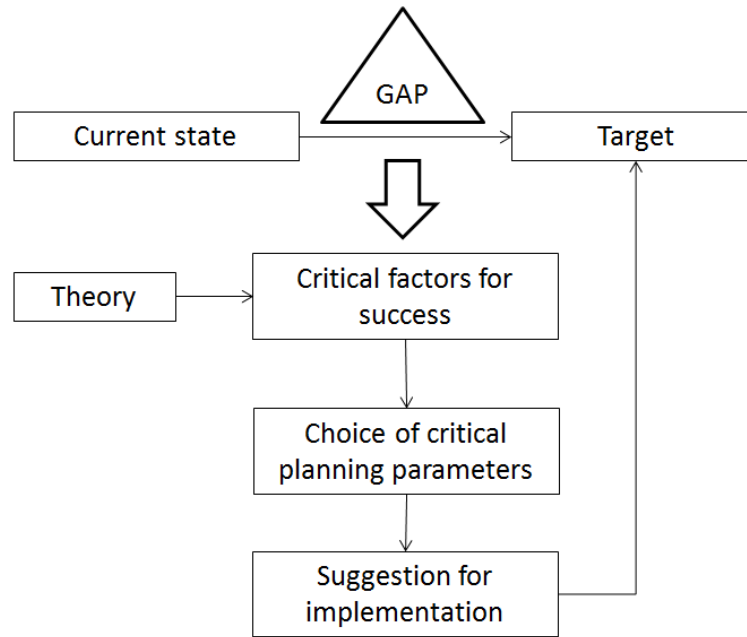


Figure 10 Decision making process for the team of experts in this project.

The empirical part of the research was started in September 2012 with current planning process review by discussions with the planners, planning manager and warehousing manager and comparing the information to the process description. Also the current planning parameters and process how those are defined were studied, this included also the metrics measuring the performance.

At the Pernod Ricard Finland the supply planners have not used any mathematical formulas or other theories for defining the purchasing parameters in their planning process and tools, so the suitable theory how to define parameters and which are important factors in seasonal demand and products with long lead time had to be found. Based on that, the critical factors or critical planning parameters for reaching the target needs to be agreed in the team of experts formed for this project.

The factors which are considered to be critical for this research are explained in more detail in chapter 2 of this study. The empirical part of this research starts with the product classifications and ABC analysis made by marketing department and basing on the yearly sales gross margins of the products. A–category has the biggest yearly sales gross margins and thus brings most money to the company. Also in most cases the volume of the products in A category are biggest although volume is not the key

element, but concentration is on the quality and profitability. This is a strategical decision of Pernod Ricard company. These categories are then updated into the master data of the products and supply planners know which items are most critical for the sales. This also indicates which service level is desired for the product. The categories are checked two times in a year.

Service level is between 97% and 99.5% which is quite narrow band. In A-category the service level is 99.5%, in B-category 99% and in C category 97%. Thus, the safety factor is not expected to have very big impact on the safety stock levels.

Life cycle phases of products are checked by the planners and updated into the system. Different phases have their own codes in BAAN system. These are explained in more detail in the current state analysis of this work.

As next step in this research process, I have analyzed the forecastability of the different items by calculating the coefficient of variation (COV) and evaluated the forecasting deviation and errors with MAD, MSE, RMSE and MAPE calculations. For these analysis I have combined the data of the different channels, Alko and HoReCa, for the same SKU in to the same excel spreadsheet. I have also made the time series analysis from different lags and evaluated the impact of different sales channels. In addition I am also evaluating, if a product group or a SKU should be planned by qualitative and quantitative forecasting methods, by making a product or product group evaluation described in chapter 2.3. I am also evaluating could different forecasting methods be used simultaneously for an item at Pernod Ricard Oy in order to improve the forecasting accuracy, which then is expected to improve the demand estimation and allow us to set the safety stocks more accurately. Bullwhip effect is analyzed by me and a decrease of the effect is expected after the process improvements.

Based on the forecasting variability (COV) calculations the products are classified by the researcher into three groups of low variation, medium variation and high variation. This step is named LMH categorization in the new process. In this work and in the new process the limits of the different categories are slightly tighter than in the Milliken's model, because we wanted to ensure the items with low variation really are suitable for statistical forecasting. In low variation the variation factor is less than 0.5, medium factor is over 0.5 but less than 1 and high variation is when the factor is bigger than 1. L-categorized items have low variation and can be forecasted by the system. For medium

or high variation items alternative (e.g. manual) forecasting methods should be considered. The effect of different lags to LMH categorization results is analyzed by the researcher as well.

For safety stock analysis and calculations, the safety factor, lead time, demand, minimum order quantities, forecasting errors must all be separately calculated and evaluated what is the impact to the planning parameters. Until now the safety stock limits have been set by the gut feeling of the supply planners. Formulas which are described in more detail in chapter 2.4.1 in the theory part of this work will be used for the calculations and analysis, and the most suitable safety stock calculation formula for the Pernod Ricard is selected and implemented.

Minimum order quantities are known and set by the supplier, supplier location/distance from Finland, and/or transportation method and they are assumed to be correct in the planning tool.

Lead times are externally determined by the suppliers and structure of the supply chain, but they might vary quite a lot due to several reasons explained in more detail in chapter 2.4.2 of this work. Improvement in estimation of the lead-time and decreased variability is expected. As I have written in the theoretical framework, the variability in lead time and demand might have a significant impact on the safety stock levels.

In this work, however, it is difficult to calculate the actual (statistical) variation in delivery time as the tool used to record the lead-time gives only ordering date, the date when the purchase order has been made, and delivery date which is the date when the warehouse personnel have taken the goods into warehouse system. Usually the time difference of those dates is a lot different than the actual delivery time, which includes the supplier lead-time and transit time. But, as noticed in the theoretical part of this study, the more variable the delivery time, the larger buffer stocks are needed. Based on the knowledge and experience of Pernod Ricard planning personnel and analysis I have made in this research I am counting the safety stock requirements with following rule: lead-time < 30 days -> we add 10% of the days into safety stock calculation, 30 < lead-time >60 -> 15%, lead-time > 60 -> 20%. In other words, in case the actual lead time is 21 days I will calculate 10% of that which gives 2.1 days extra to be added to the safety stock due to lead-time. In case the lead time is 67 days I calculate 20% of that which is 13.4 days addition to the safety stock.

The first phase of implementation will be made to four companies to test the new parameters. Companies are Supplier 1 from Ireland, Supplier 2 from Sweden, Supplier 3 from France and Supplier 4 from South Africa. Companies were selected by the team of experts.

Supplier 1

- From Ireland transported by container
- Strategic supplier
- Delivery term DDU
- 40-foot container, always 30 pallets
- Delivery time 14 days
- Sound supplier, no delayed shipments, flexible, items possible to get from other Nordics warehouses, for example Pernod Ricard Sweden, if needed
- 27% A, 9% B and 64% C category products
- Expensive products
- Sales estimates well in place
- One of the most important suppliers
- If needed possible to buy items faster than the agreed lead-time

Supplier 2

- From Sweden by truck
- Strategic supplier
- Delivery term DDU
- Minimum order quantity 15 pallets
- Delivery time 2 days
- Sound supplier, no delayed shipments, flexible, items possible to get from other Nordics warehouses, for example Pernod Ricard Sweden, if needed
- 10% A, 30% B and 60% C category products
- Sales estimates quite well in place
- One of the most important suppliers
- If needed possible to buy items faster than the agreed lead-time

Supplier 3

- Wine from France by truck

- Delivery term EXW
- Approximately 1 months demand purchased at a time
- Delivery time 7 days, transportation capacity well available
- Quite sound supplier, not many delays
- 100% B category items

Supplier 4

- Wine from South-Africa by container
- Delivery terms FOB
- 40-feet container at a time, approximately every 6 weeks
- 50% B and 50% C category items
- Delivery time about 28 days including customs clearance
- Good sales estimates

These suppliers were selected, because they are important suppliers for Pernod Ricard Finland, sales plans are in good level, and there is enough historical data of good quality from long period of time available, suppliers are flexible and reliable and the transit times are fairly short. There are no big risks with the selected suppliers and as back up it is possible to get fast support, for example, from the warehouse in Sweden in case something happens. No big risks taken at the beginning of the project implementation phase. As the turnaround times are fairly short also results of the improvements are expected to be visible fairly soon. Suppliers 1 and 2 are strategic suppliers of Pernod Ricard company.

3.4 Target of the project

The target of this work is to specify the parameters of items: ABC categorization, life cycle coding, forecastability, safety stock level. Clear instructions and rules for the process should be created after the project. With the actions taken a clear impact is expected to be visible in the key indicators: Customer Service Level, Finished Goods Stock for Distribution and Forecast Accuracy.

A target is also that by making the new rules work, it would result that no so-called small item would trigger a purchase request but items with big volumes would trigger the impulse for purchase and small items would be purchased along. In this way the

inventory turnover should be better and shortages minimized with improved efficiency in the transportation capacity and costs.

3.5 Metrics

At the beginning of the research it is assumed that the current Key Performance indicators (KPI's) can be used to measure the results of the research and no new indicators needed. In case it is found during the study that new metrics are needed it is possible to implement those, but the goal is not to find new metrics. Currently the supply chain is measured by following the delivery accuracy (customer service level), forecasting accuracy, inventory value, inventory coverage. Also other issues than the planning parameters might have effect on these KPI's and I have not been able to find out a metric that would measure only the parameters effect, but by interviewing the planning personnel I can open up all the other issues having effect on the metrics, later in the result chapter of this work.

3.5.1 Customer Service Level (CSL)

Definition: percentage of calculated lost sales liters in relation to total sold liters + lost liters per month per SKU. This is because customer stops ordering after stock out situation, so no new orders coming before goods are available again in stock. All markets and channels are included in the indicator. Volumes (forecasted, actual sales and loss) in litres, CSL in %. Target of this research is to keep the customer service level on the same level as it is now.

3.5.2 Finished Goods Stock for Distribution (STK DS)

Definition: average volume of end-of-month total finished goods stock during the 3 months of the quarter divided by all SKUs regarding domestic market + borders + duty free (export and bulk excluded). All stocks are counted even if they are stored in different locations (external warehouse, factory, third party, bonded warehouse etc). Measured in in 1000 of litres (klitres). Target of the finished goods stock for distributions depends on the supplier and SKU and will be individually determined for each SKU. On average the target is to improve the stock levels by 10-15 %.

3.5.3 Forecast Accuracy (FA)

Definition: accuracy of forecast is measuring the error between forecasted and actual sales. For month M, forecasted sales at month M-lag vs. actual sales is measured. Lag depends on SKU lead time, value is smaller when lead time is shorter. For example Lag is one, sales will be compared to forecast ,which published one month earlier. Indicator is measured for all SKUs, regarding domestic market + export (bulk and Nordic internal sales excluded). This indicator is currently recorded by sku, by family, by brand, by channel, by month. Volumes (forecasted and actual sales, absolut variance) in litres, FA in %. The target of this research is not to improve the forecasting accuracy so it should remain on the same level. Assumption is that the forecast accuracy might improve during the project as more attention is paid to it.

3.6 Current State Analysis

The current state analysis is estimated to give a clear picture of the forecasting accuracy and show indications in case the planning tool and it's parameters are too sensitive to react on historical data. Also it might show statistically the planning differences of Alko and HoReCa sales and give low hanging fruits from which more effective cycle times and cost savings might occur.

During the discussions it was found that the ABC analysis had been done some time ago by marketing and not regularly updated into the planning tool. Thus it was asked already in early phase of the study if marketing could do the analysis again for all the products. Marketing did the ABC analysis and used the yearly sales margin as parameter for categorization as products bringing most of the margin are most important for the sales. After the first categorization a new process was agreed to regularly define the ABC categories twice in a year. Demand planning team will do this and the results are used in addition to planning parameter calculations also for strategic decision making, for example which of the items will be ramped down and which need to be continued even they are in C category.

3.6.1 Planning process

In figure 11 the current planning process is described.

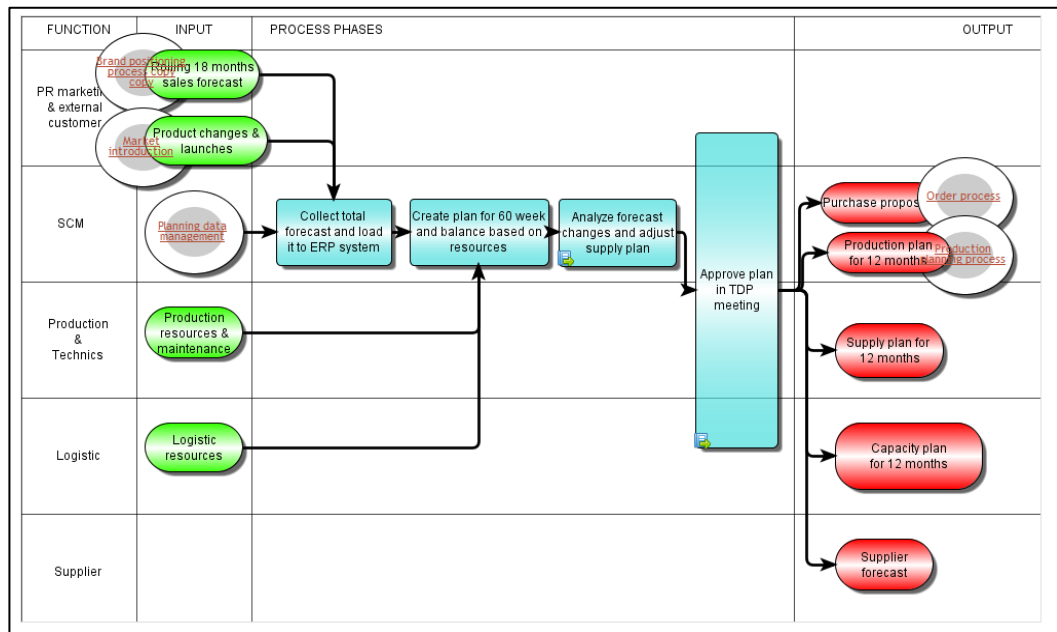


Figure 11 Planning process of Pernod Ricard Finland

The new sales forecasts are updated into Lean system from Manugistics system once in a month. The product managers are updating their sales forecasts into Manugistics manually when needed, but most of the items are in automated planning mode which means statistical forecasting based on historical sales.

Historical sales data is collected for 1.5 years until the statistical planning is started. From Alko channel the sales format is quite known and estimates are easier to make as Alko is telling how many stores the product is delivered to and what is the area of coverage. HoReCa channel sales is resulting more from the sales success of the salesmen and marketing.

There are five quantitative, statistical forecasting algorithms available in the Pernod Ricard's forecasting system, Manugistics. Fourier and Multiple Linear Regression (MLR) are known as linear regression methods and the Lewandowski, Holt-Winters and Croston are known as exponential smoothing methods.

In Manugistics system the Lewandowski algorithm is used for all products in statistical planning mode. Planning cycle of Manugistics system is described in figure 12.

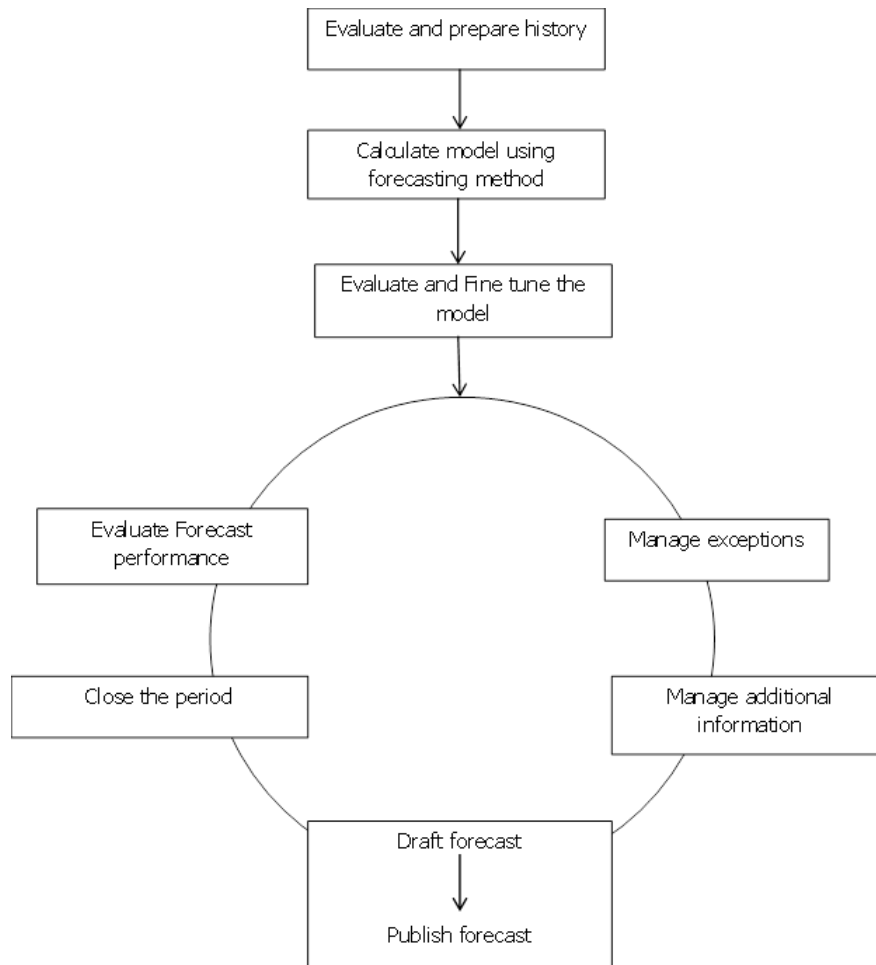


Figure 12 Demand planning cycle in Manugistics system (Manugistics Inc., 2005).

Demand planning includes eight major steps divided into two groups: a set up phase and cyclic phase. Set up phase evaluates and prepares historical data. In this phase historical data is also mapped into higher level product groupings. After preparations a statistical method is chosen from one of the following forecasting methods: Fourier, Multiple Linear Regression (MLR), Lewandowski, Holt-Winters or Croston. As mentioned earlier, the Lewandowski method is used in Pernod Ricard Oy planning system. (Manugistics Inc., 2005.)

In cyclic phase the model is evaluated and fine-tuned. Then the exceptions, additional information including promotions, one-time special occurrences, new product forecasts, targeted forecasts and the forecast data reconciliation between the various product groupings are managed in the system. After the system is ready the new forecast can be published. Then the forecast is closed after importing the new history and storing

the previous period's forecast. New cycle is beginning. Forecast performance is evaluated periodically. (Manugistics Inc., 2005.)

3.6.2 Forecasting error analysis

Figure 13 shows how much there was percentage difference between the forecast and actual demand for some suppliers during 2012. This analysis shows there is a place for improvement in planning side although that is not the target of this research.

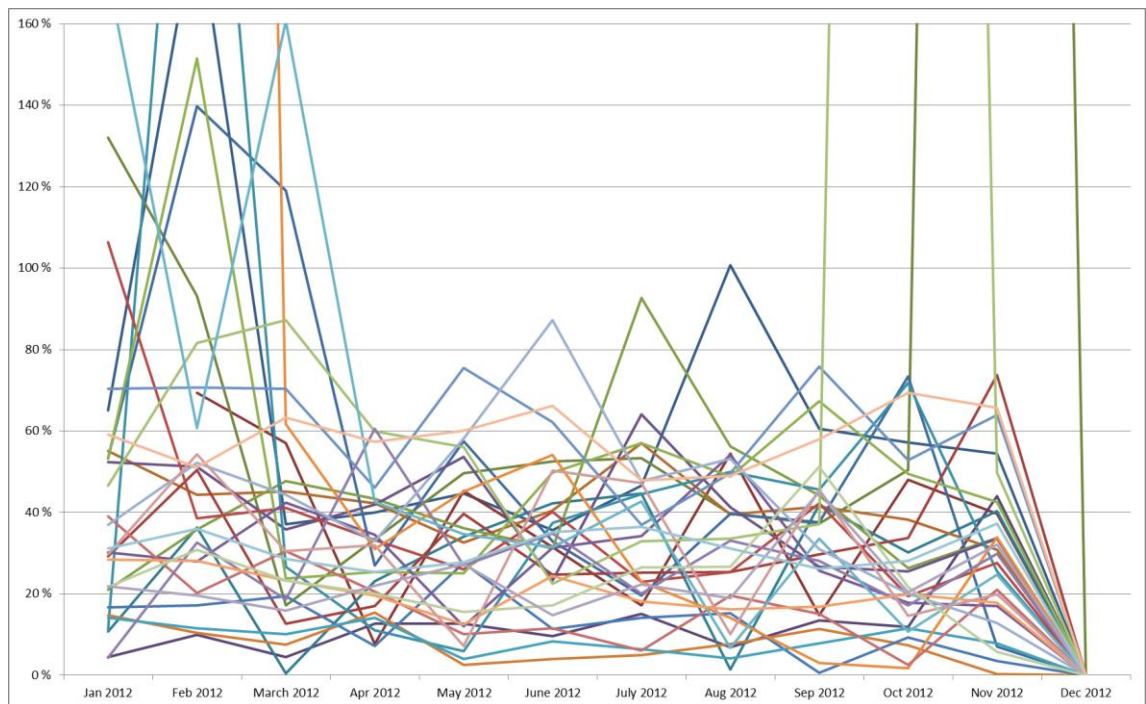


Figure 13 % fluctuation between forecast and actual demand per certain suppliers.

In figure 14 the variation in different time lags are shown. Lag 1 is comparing the actual to forecast from 1 month ago and the items having lead time less than a month are belonging into this lag. Lag 2 is comparing to forecast from 2 months back and lag 3 comparing to forecast from 3 months ago. From the picture 9 we can see that the accuracy of forecasting is worst in lag 3 and also varies between the different months mostly.

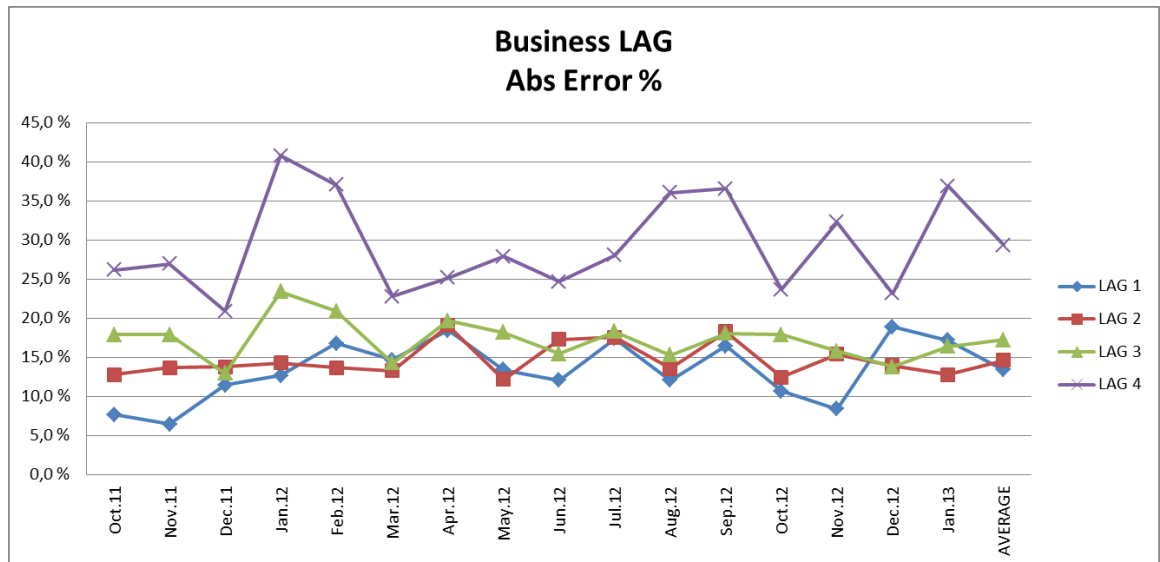


Figure 14 % fluctuation of the forecast and actual sales in different time lags.

Lag analysis shows how the forecast for a particular Demand Forecasting Unit, DFU, changed over time. The lag determines how far in the future the forecast is being used to plan. In this case the forecast time buckets are monthly, and lead time is 1-4 months. It is very understandable and visible in the analysis that lags which have long lead time have most of the variation as there is no possibility to made adjustments once the goods have been shipped, and in many cases marketing team knows the changes and more accurate estimations quite late. Longer the lead time, larger is the forecast lag and larger the forecast lag, lower is the forecast accuracy. This needs to be taken into account in the planning parameters. (Manugistics Inc., 2005.)

It is clearly visible in the analysis, that the items which have large % of Alko sales have better forecast results. Alko channel's demand is more predictable than the demand of HoReCa channel. Average MAPE of Alko share over 80% is 22% and average MAPE of Alko share less than 20% is 42%. HoReCa channel variability is clearly visible also in suggested safety stock parameters and planning is proposed to be made manually for the items with large HoReCa channel share.

Surprisingly, it seems that there is not much correlation between the lags and forecastability, especially in the lags 2-4. In lag 1, 80% of the items are L-items which can be forecasted by statistical methods. In lag 2 and 3 60% are L category and 30% M category. In lag 4 with the longest lead time all items are M-category items.

Forecaster bias occurs when the error is in one direction for all the items and it occurs due to human intervention to build unnecessary safety stocks. The current forecast analysis shows that for many items the forecast is continuously bigger than the actual sales. The reason could be organizations natural tendency to over-forecast as they want to serve their customers well and avoid stock-outs. Items specific to a few customers in HoReCa –channel are slow to respond to changes in forecasts. Over- and under-forecasting happens. This results in increased inventory and higher risk of obsolescence. There are differences between the responsible persons in forecasting accuracy, but this might also be caused by the product portfolio. Different products are easier or more difficult to forecast due to the share of different channels, seasons etc. (Manugistics Inc., 2005.)

Bullwhip –effect can be seen in the process too, especially it is a problem for new items and during the first year. More time would be needed for analysis and planning how the launch will go. Historical data of similar items could be used for analysis. It is not the main task of this project to reduce the bullwhip –effect, but expectation is that as more attention is paid to the forecasting during this project also there might be less bullwhip-effect in the supply chain.

3.6.3 Order Process

In figure 15 the current order process is described.

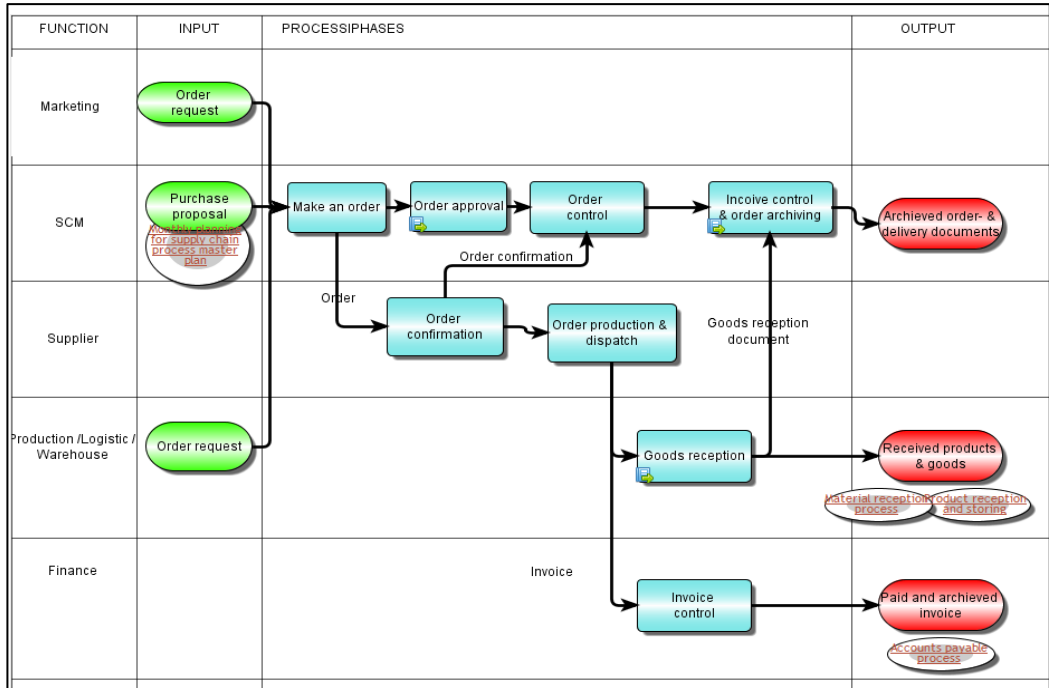


Figure 15 Order process of Pernod Ricard Finland

Supply planners are making the actual purchase orders based on the purchase proposals from Lean system. However, they are also following the actual sales versus forecasted sales and making decisions about delaying or forwarding the purchase order. Supply planners are taking seasonality into consideration and noticing, for example, how the Easter time is taking place yearly.

Suppliers are asked to confirm the order within three days from receiving the purchase order and supply planners are monitoring the confirmation and updating the system with correct arrival dates, if necessary.

3.6.4 Lead time

Total delivery time is affected by several issues. The greater the distance the more variation in total delivery time as there are several variables along the way. The system is recording only the actual purchase order creation date and actual receiving date into the system. There are several reasons why the actual delivery time cannot be calculated based on these dates.

When the supplier has finished the product and confirms the delivery to the transportation company, a delay may occur in case the transportation company has no equipment or depending on when the next vessel is departing. In some cases one day delay at supplier side means embarkment after a week. In intermediate ports, usually the big ports in Europe, the shipment must reach the feeder vessel to port of Turku in Finland. Weather conditions cause often delays at sea which might mean again a week's addition to the delivery time. In addition to the weather harbours often have strikes, delays in customs and other document handling and schedule changes at ports might again delay the load. At Pernod Ricard warehouse in Turku the receiving into the system might happen a day or two later in case there are several containers in the same vessel, as the warehouse only has one container loading dock or other rush at the warehouse. Containers are waiting unloading at the port of Helsinki, Rauma or Turku.

In some cases the planner might advance or delay the shipment based on the actual sales situation. Sometimes the suppliers are delivering late due to lack of wine or packaging materials. In case suppliers have maintenance or vacations, purchase orders must be made and sent to suppliers earlier, sometimes up to a month in advance, which means the purchase order creation date is too early and delivery time calculated based on the system dates will get much longer than the actual lead time is. Mathematical analysis would give us huge safety stock in these cases.

In this research the lead time is treated as endogenous variable which means that it is not a random variable. The impact of the lead time is used in the planning parameter definition process and safety stock calculation.

3.6.5 Life cycle

Product life cycle is taken into consideration when the planning mode is defined. Different product life cycle phases are first updated in the Baan system by sales and when the product is ready, transported into Lean and Manugistics tools. When this project started the demand planners did not update the modes in the Manugistics planning tool regularly as it must be made manually.

Table 2 Product life cycle codes

Code	Name	Comments
001	Budget product	Budget product, for finance use only
002	Terminated	Product terminated. All financial bookings done and inventory 0.
003	Product unfinished	New product. Product information not ready.
004	To be phased out	Alko has informed they will end selling this product.
005	To be terminated	No purchase of this item.
006	Service product	Sales channel known. Will be sold out and new purchase only per customer order.
100	ACTIVE in Alko	Product is in active Alko sales
101	ACTIVE Export	Product is active only in Export sales
102	ACTIVE Elsewhere	Product is not active in Alko channel but sold in other channels.

The new products have manual forecasting unless the company has very similar item which history is expected to be similar, but also in this case the product manager needs to check forecast very carefully and adjust manually, if needed. Products which are mature and have enough sales history are in statistical planning. Product managers might do manual corrections in case they know promotions, or other sales events are coming, but in principal the planning is working automatically. Products which are at the end of their life cycle are taken into closer monitoring and manual planning with extra observation on stock levels.

3.7 New Sales and Operations Planning process

The new sales and operations planning process is described in figure 16. The purpose of the S&OP is to enable decision-makers to reach consensus on a single operating plan that allocates critical resources purposefully to reach corporate performance targets.



Figure 16 New Sales & Operations Planning cycle

Product Review includes following steps: New product launch and Product change management for Alko process, other customers and authorities. Product life cycle code management, which includes Alko performance and slow movers follow up and listing effects. ABC classification is made twice per year by demand planning team, based on the yearly gross margin inside defined group (own production, imported spirit, imported wine). 80% of gross margin is A category, 15% of gross margin is B category, 5% of gross margin is C category. Classification includes action proposals for C products and service level promise based on ABC classification.

Demand Reviews include short effective meetings with brand managers in which the responsible planner participates too. In these meetings the forecast deviation report is reviewed. Performance follow-up per demand forecasting unit, DFU, (SKU/Channel combination) and biggest deviations are corrected immediately during the meeting to the Manugistics - planning system. Stock out effect is corrected to the forecast also. Phase in/out forecast is reviewed and it includes forecasts for new/coming items which do not yet have forecast from customers. Benchmarking from other similar products is made. Forecast for phase out items is created and a plan how to manage the use of the rest of the stock and how to avoid slow movement. LMH categorization is made twice per year based on rolling forecast accuracy metrics of last 12 months. LMH cate-

gorizations are taken into account in the new planning parameter definition process and safety stock calculations.

Supply Review is a quick performance follow-up in which KPIs, service levels, early warnings, forecast accuracy, slow movers, and Alko's performance are reviewed. Supply plan based on latest forecast upload is reviewed and resource plan to factory and logistics is updated. Project follow-up includes status updates of ongoing and coming projects. Participants are coming from all interest groups; marketing, production, logistics, purchasing, technics, R&D and supply chain management which ensures all information about projects is shared in one meeting to everybody. New process of calculating and defining the new parameters for planning and safety stock calculations is updated twice per year based on latest ABC and LMH categorization, forecasting accuracy and lead time analysis. Service level and coverage time KPI's are monitored.

Decisions and questions from the different review meetings are brought up to Sales and Operations Planning meeting. From the meeting also strategic decisions are rolled out to review meetings and into practice.

3.8 New parameters

The new process, developed by the researcher, of calculating and defining the new parameters is shown in figure 17.

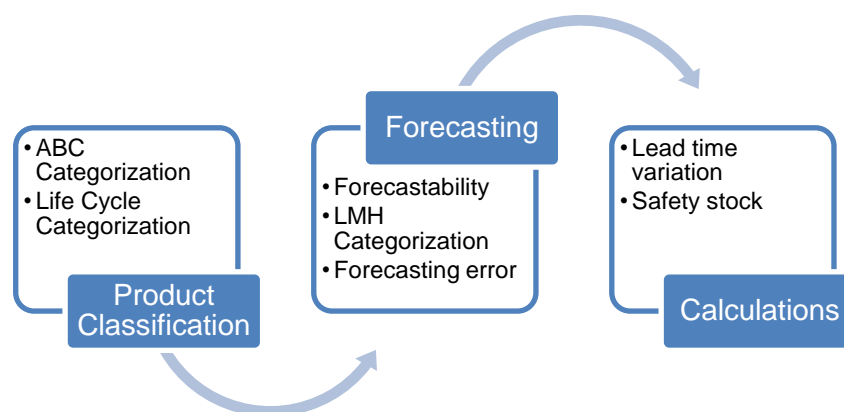


Figure 17 Planning parameter definition process

ABC categorization was based on yearly sales gross margin; A-category brings most money to the company. 80% of gross margin is from A category, 15% from B category, and 5% from C category. In the new process described in chapter 3.7 the ABC categories will be updated twice per year and also used for strategic decision making, for example which low gross margin products will be kept and which ramped down.

Mathematical forecastability of each SKU is estimated by coefficient of variation calculation. Items are categorized based on their forecastability L = Low variation < 0.5, M = medium 0.5 < variation > 1, H = High variation > 1. Low variation can be forecasted with a planning system, automatically, based on the statistical, historical data of the item. In case medium or high variation alternative forecasting methods should be considered. The LMH categorization of items is made twice per year.

After analyzing the current state and possible ways to calculate the safety stock the team of experts of this project chose to use following formula suggested by the researcher for the new safety stock calculation:

$$\text{Total Safety stock} = \text{Z-score} * \text{MAD} * \sqrt{\text{Lead Time in months} + \text{lead time variation}}$$

Required service level for A-category items is 99.5%, B-category 99% and C-category 97%. This means the Z-scores are A-category items 2,57, B-category items 2,33 and C-category 1,88 as seen from table 1. Safety stocks are not intended to eliminate all the stock outs, just majority of them. Service level of each SKU might change twice per year in accordance to the ABC –categorization.

The formula is a modified version from the safety stock formulas as in this project the Mean Absolute Deviation, MAD, of the forecasting error is used in the formula instead of standard deviation of the demand. In this project it was seen that as the demand is fluctuating significantly, forecasting error has more meaning and using the MAD in the formula gives more accurate result. The inventory is separated into cycle stock and safety stock. Cycle stock covers the demand and in safety stock the forecasting uncertainty and mistakes are more important issues and must have more weight when safety stock is calculated. This was also checked with trial calculations and approved by the demand planners and their manager.

Forecasting error, MAD, is calculated from rolling 12 months for each item

$$MAD = \frac{\sum_t |Actual_t - Forecast_t|}{n}$$

Lead times remain the same and the lead time variation was taken into account in the formula when the new parameters were calculated. There is an interaction effect between the safety stocks and lead times. Actual lead times cannot be exactly measured due to system limitations. Thus we have taken in the lead time in safety stock calculations either as 1 month, 2 months or 3 months. Month is used as the format as the components in a formula must have same time format.

Additional lead time stock due to lead time variation is added into the safety stock by using a following rule: lead time < 30 days -> add 10% of the lead time in days into safety stock calculation, 30 < lead time >60 -> add 15%, lead time > 60 -> add 20%. This is done as long sourcing lead times are deep sea transportations and the risk of delays is more probable than for the short sourcing lead time products.

With this information we calculated the new safety stock parameters for the selected suppliers mentioned in detail in chapter 3.3. Suppliers are from Ireland, Sweden, France and South Africa.

New safety stock parameters were mostly decreasing the safety stock minimum days. For supplier 2 the average decrease was 4.2 days, for Supplier 1 decrease was 7 days, for Supplier 3 decrease was 10.4 days and for the Supplier 4 decrease was 13.5 days. In some cases the minimum days were increased and those items mostly were in manual forecasting, small selling items or new items which had no parameter in the system previously.

Based on the LMH categorization and product life-cycle state the set-up of planning mode was updated into the planning system for each SKU:

MTS_MATURE (STAT) – stable and mature product, statistical forecasting used

MTO (NON-STAT) – manual forecasting

MTS_LAUNCH (NON-STAT) – new product, manual forecasting

MTS_DECLINE (STAT) – ending product, statistical forecasting used

Statistical forecast is based on Lewandowski algorithm and manual forecasting is made by product managers. Life cycle parameter in BAAN system also defines what can be done for the item and who can update and do actions for the item in the system.

A decision was made not to implement any new metrics, but follow the current once. It is noted that also other issues influence these metrics but it seems to be common issue with inventory related metrics. The supply planners are interviewed after each month to check which issues might have had effect on the metrics also.

It has been noted by the researcher and the company, that as the safety stock formula is very basic and simple it does not respond to seasonal and other variations of the future. That is why the safety stock parameters are not permanently fixed, but will be checked and re-calculated twice per year.

4 Research results

After two months of trial time it seems that the new planning parameter definition process is delivering promising results. Results of the different suppliers after three months in total for all items are presented in figures 18-21. January in the figures is the starting and comparison point. As February was so close to the start no results was expected and that month is left out from the comparison. Analysis and charts are made by the researcher.

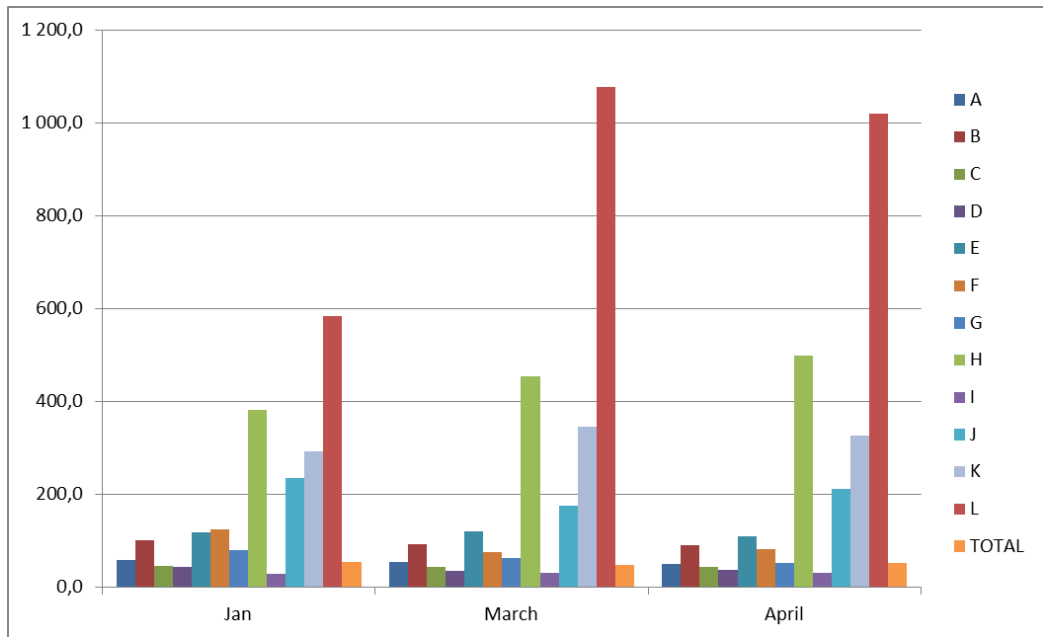


Figure 18 Results of all items in total, supplier 1

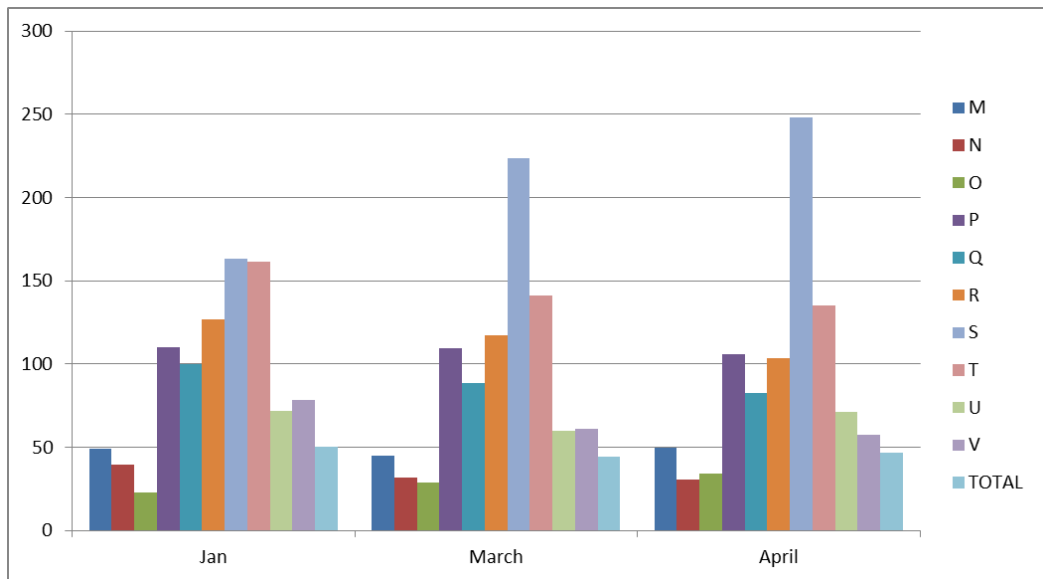


Figure 19 Results of all items in total, supplier 2

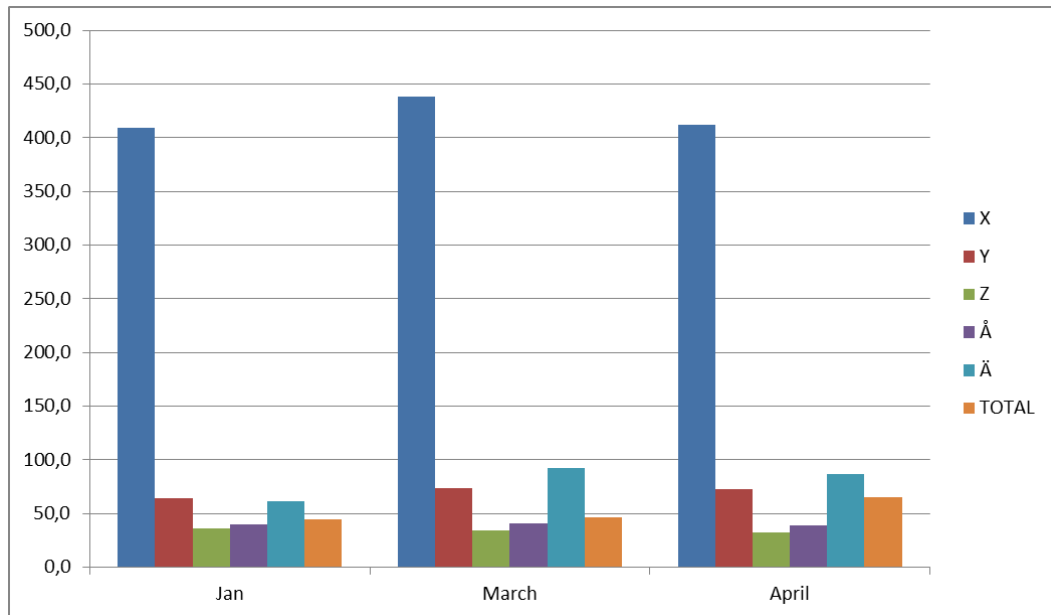


Figure 20 Results of all items in total, supplier 3

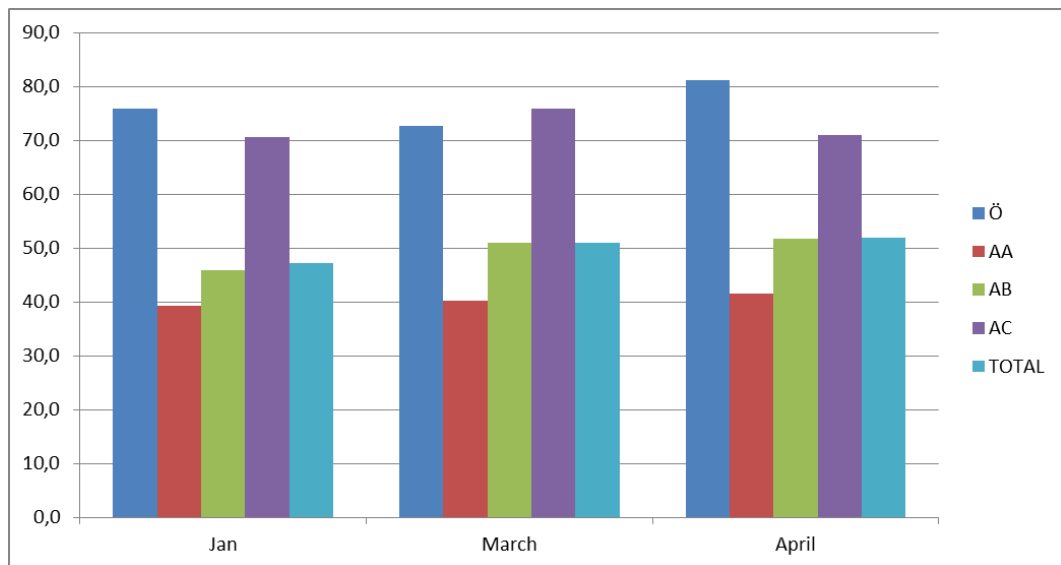


Figure 21 Results of all items in total, supplier 4

To show the improvement more clearly I have separated into own charts the statistically forecasted items, figures 22-25, and manually forecasted items, figures 26-28 of all supplier separately. Statistically forecasted are usually mature items which are selling well. Manually forecasted mostly are new or ending items, items sold only for HoReCa channel or otherwise difficult to forecast and thus also planning parameters are more difficult to define. In this way we can estimate results of the trial better.

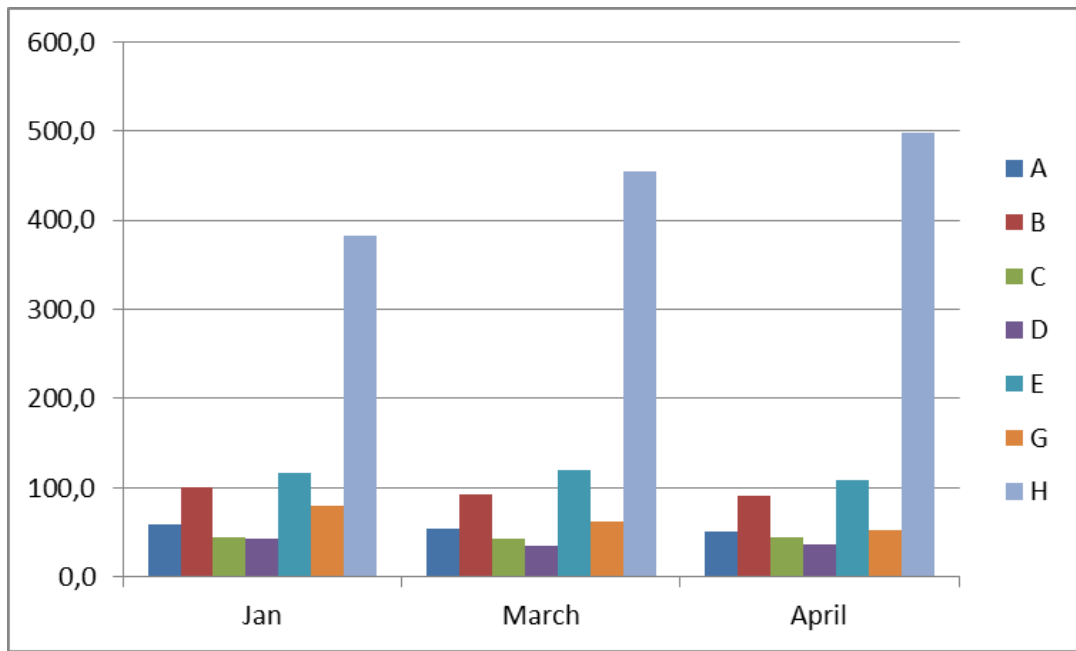


Figure 22 Results of statistically forecasted items, supplier 1

In figure 22 the highest peak is a product which has not been selling well in ages. The results are showing it should not be statistically forecasted and further analysis tell it is C item which now is suggested to be phased out. Actions are taken in the product review part of the S&OP process cycle.

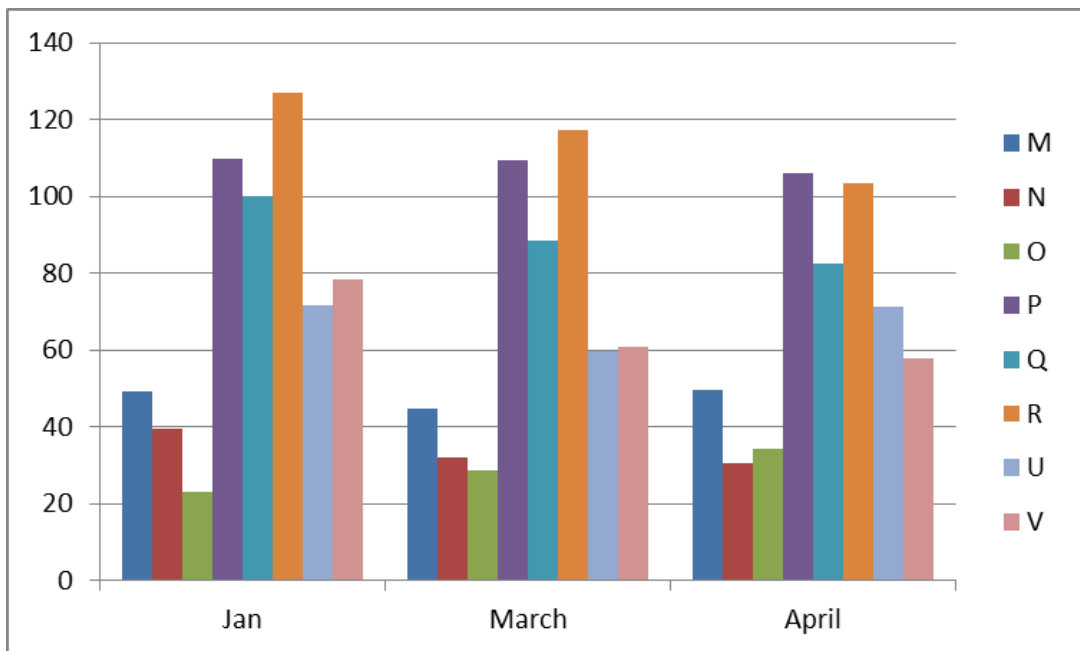


Figure 23 Results of statistically forecasted items, supplier 2

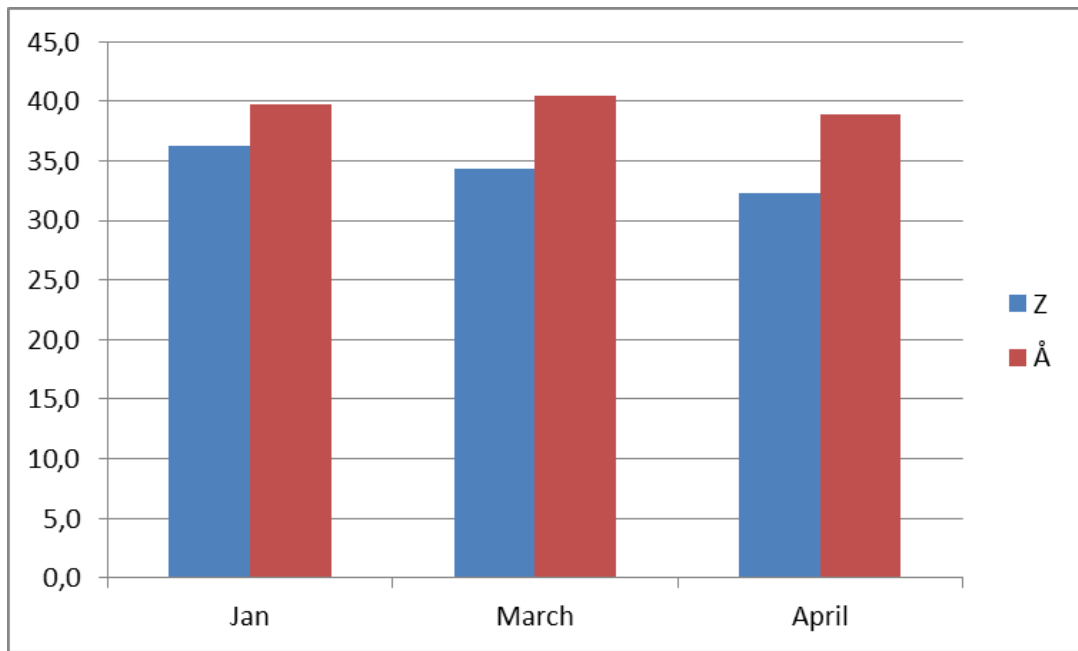


Figure 24 Results of statistically forecasted items, supplier 3

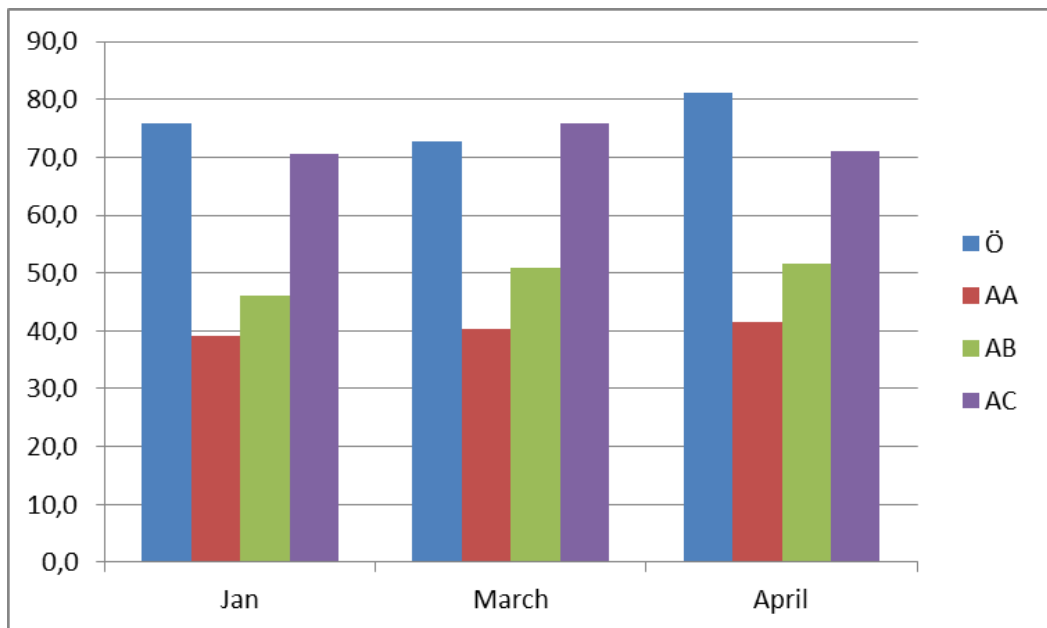


Figure 25 Results of statistically forecasted items, supplier 4

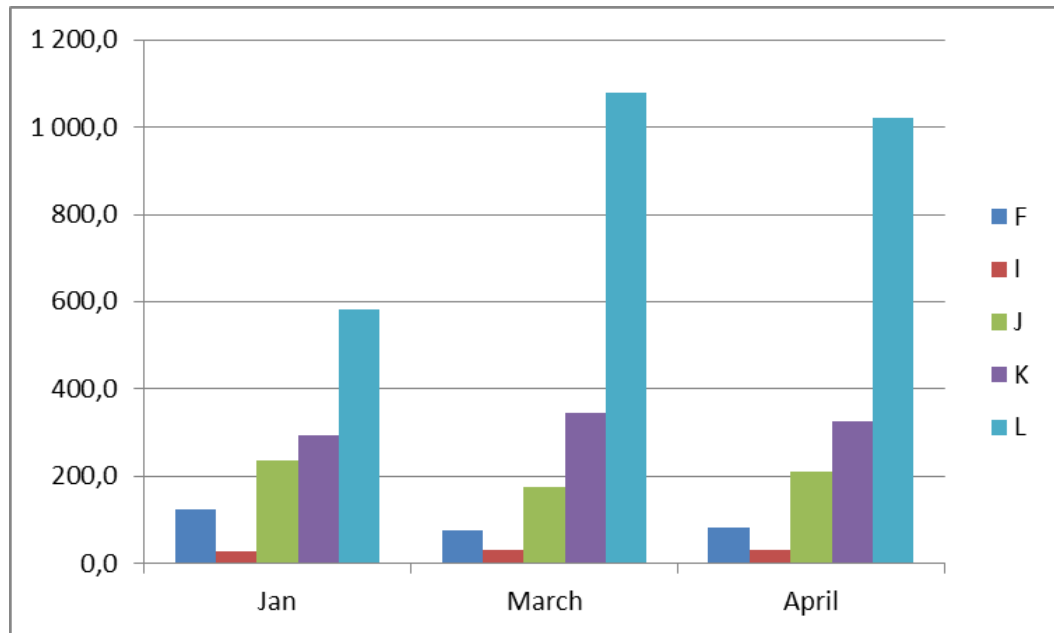


Figure 26 Results of manually forecasted items, supplier 1

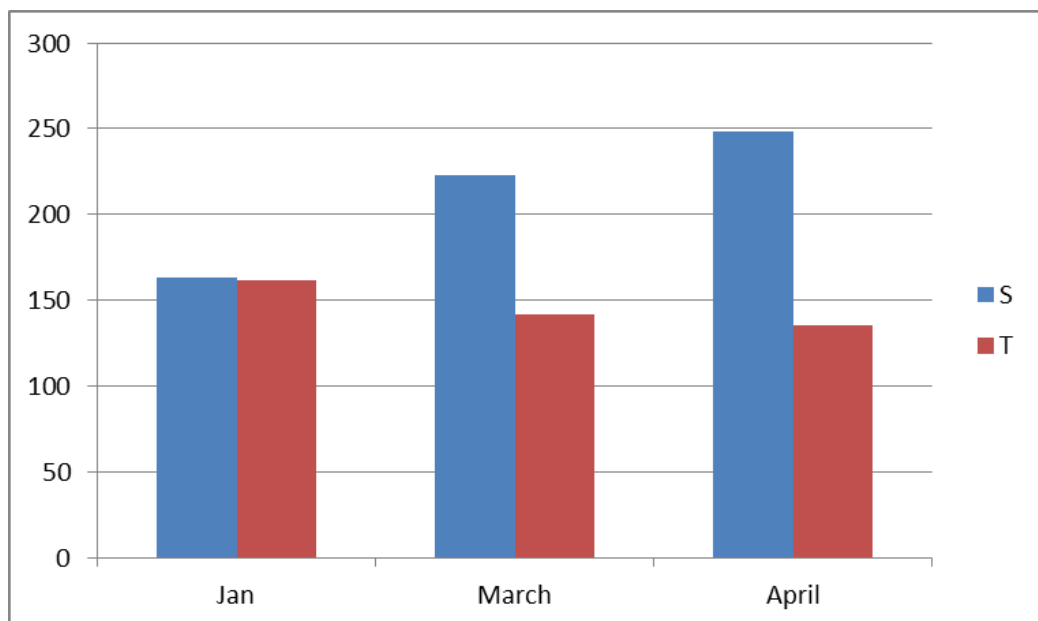


Figure 27 Results of manually forecasted items, supplier 2

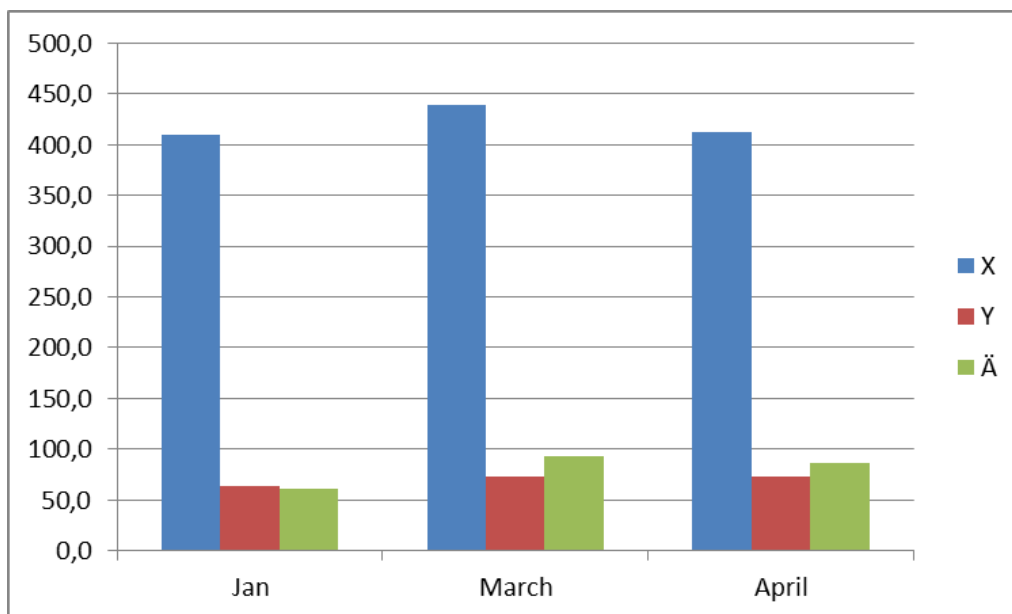


Figure 28 Results of manually forecasted items, supplier 3

The strategic suppliers 1 and 2 are showing total improvement of 12% for both suppliers during the first two months of implementation. The improvement in the biggest volume products was 18-19%. The actual sales have been less, for most of the items, than the forecast and the planner does not recall any other factors either which could have cut down the inventory so it shows the changed parameters are resulting in less inventory. At the end of April for some items there was slight increase in stock visible for some items but strategic, important items were decreasing still. The items which had stock increase are selling less than forecasted so it takes some time until the change in parameters is visible in the metrics. Items which are showing big increase in stock coverage are selling very much less than forecasted and thus the stock is consumed very slowly. The minimum order size for some Supplier 2 products is a pallet and this is causing increase in April results for few items as the pallets were received at the end of month and sales volume of these items is not big.

Unfortunately in the Supplier 3 wines there has been a quality problem which has caused inventory to increase with an item but also with this brand the highest used product has 5% improvement in inventory but in this case sales has exceeded the forecast so it has effect also to the inventory level improvement. The forecasting accuracy of these wines has been improved as the calculations are suggesting smaller safety stocks now than calculated at the end of January.

With the Supplier 4 wines there is no improvement visible as the transportation time from the supplier is a month and orders are sent every six weeks. A container is ordered each time and as the sales have been below the forecast so the inventory has not been consumed like estimated when the parameters were calculated.



Figure 29 Finished Goods Stock for Distribution (STK DS). Comparison of May and April results to the starting point

In figure 29 the results of finished goods in stock metrics are presented in % format. In this chart the plus percentage is improvement, less stock, and negative is worse, increase in stock. Both March and April results have been compared to the starting situation, at the end of January. Out of 31 trial items 17 have improved this metric and the stock value is less than in the beginning. Out of these 17 items 12 have been improved over 10%. During these difficult times this result is very promising. The review period has been three months and partly due to that, the results are not visible that clearly. It must be also noticed that for some items, which are difficult to forecast and sale is unstable, the safety stock parameter was calculated to be bigger, which means the increase in safety stock was expected as a result. Although, the review period was quite short, I do not believe adding more months, especially during summer, would give bet-

ter results to this project work. New process has been developed and implemented and it is working.

The safety stock comparison analyses are confirming that the manual forecasting is definitely needed with some items. Also when the implemented safety stocks are compared with the safety stocks the calculations are suggesting at the end of March and April, they seem to be on right level especially for the A- category and L –category items, giving evidence that the calculation methods and formula chosen are correct.

After the categorizations have been made 2/3 of all the items are using automated statistical forecasting. Of the Alko channel items ¾ of all the items are automated and only ¼ is manually forecasted which makes the process efficient and should give product managers and planners time to concentrate on manual forecasting and information sharing on special topics. Items forecasted manually are usually special gift boxes, mini dollys, new product launches, ending products and seasonal products.

Deviation in forecasting has improved each month for almost all of the items after the new process has been implemented. This indicates the forecasting accuracy has been improved or at least stayed in same level. In figure 30 we can see the correlation between the forecasting accuracy and stock coverage. This is true for most of the products. Few items, however, are not correlating that well or at all, examples seen in figure 31.

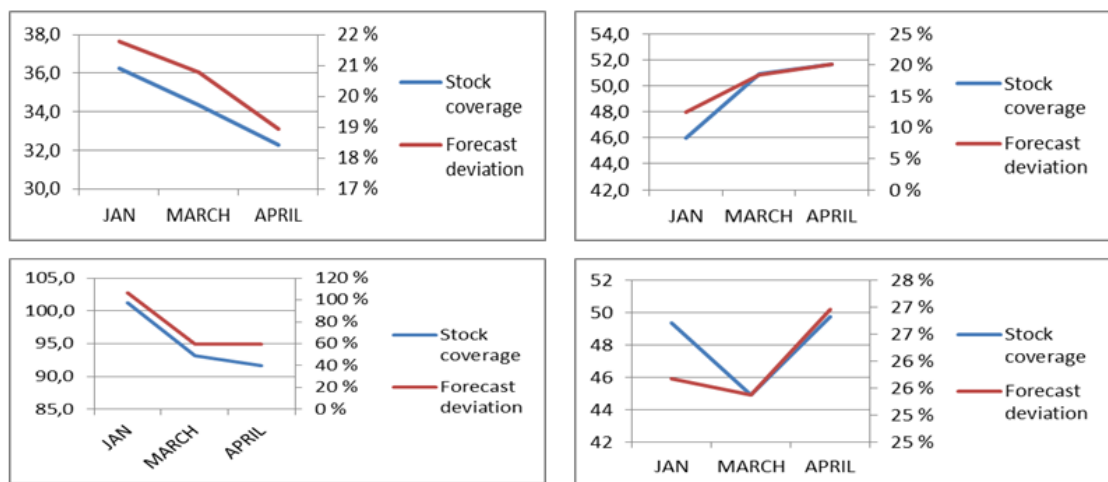


Figure 30 Stock coverage and forecast deviation comparison – with correlation

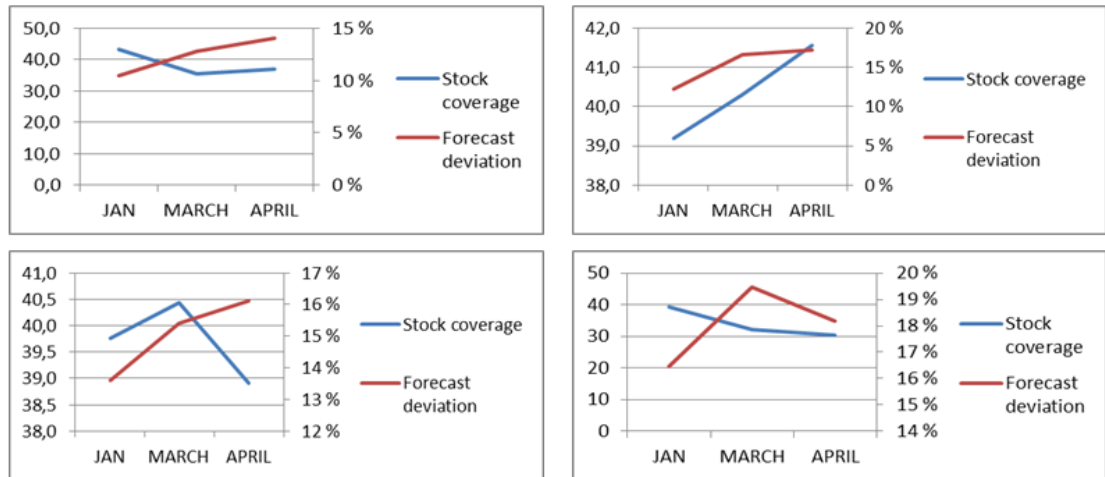


Figure 31 Stock coverage and forecast deviation comparison – no correlation

The trial shows also the importance of information flow and fast actions. A product included in the trial is known to end sales in Alko channel, but active decisions have not yet been made and there is an increase visible in the amount of inventory.

Customer service level has been on the same level for all other items except the wine which had quality problems. Small orders have not been triggering purchasing requests but to ensure this a system set up change would be needed. As the result of the project a guidebook has been created for planning personnel, appendix 2. Also I combined an excel spread sheet from several excel spread sheets used in the company to make the forecasting error and safety stock calculations. It, however, requires more automation, made by excel experts of the company, in order the supply planner could use it easily in their work.

5 Conclusions and reliability of the research

Coordination of the safety stock requirements is important. In this work the used models are kept simple so that the new process would be easy to use and would not require deep mathematical knowledge to understand the formulas used. Nevertheless, the improvement results have been very satisfactory. Very rare companies have time, money and training resources to use for more laborious methods, and it is also important that the actual users do understand how the process and formulas work and

what they mean in practise. This ensures they will also notice possible mistakes or other sudden changes and can react faster. In this research, the trial was made only with four suppliers and the time frame was quite short. However, the chosen methods are well suitable for permanent process and for all product groups and channels of Pernod Ricard Finland. I believe, the additional time used for reporting results recording would not have made any difference to the conclusions.

Typically the consumer demand of alcohol products is very random and seasonal and it makes it difficult to forecast. The key element in making effective supply chain and lower the inventory costs is the use of correct demand forecasting method and parameters. The effect of inaccurate forecast is seen later in the supply chain. In case the historical demand or lead time data is incomplete or unreliable, an experienced planner can usually provide a pretty reliable estimate. Putting in place the analytical inventory targets is an important part of inventory management.

Some types of products will produce more accurate forecasts than others, based on certain characteristics of the product or the market in which it is sold. The higher the volume of product sales, the more accurate the forecast usually will be. Attaining accurate forecasts for low volume products is difficult. However, aggregating the sales history of low volume products and then generating a statistical forecast can lead to improvement in forecast accuracy.

Accuracy will also improve closer to the time of sales. As the time of sale approaches the most up-to-date customer data and market intelligence is applied to the forecast. New products with little or no history are more difficult to predict than more mature products with a steady history stream. Forecast error is a key driver of safety stock strategies. Safety stock needs to be adjusted to match the error contributed by the bias.

The minimum order sizes are set for the items and for suppliers which means increase in stock levels and makes it harder to systematically define the purchasing parameters. Experienced supply planner can take this into account but the risk of excess stock is increased.

Also in this research the known theory is proven, that the more information is shared in the supply chain the more effective the chain will work. Small changes in the forecast

might cost a lot in the warehouse and distribution, and also be visible later as increased prices and delivery problems.

Sound mathematical approach to the safety stock will justify the required inventory levels to management and also balance the conflicting goals of maximizing the customer service and minimizing the inventory cost. Safety stock is an effective way to mitigate demand uncertainty and lead time variability, but the appropriate levels of the safety stock and what degree of protection they provide must be well understood.

Validity; theories and models explain the research process and provide depth and perspective into it. Theories and models are widely and deeply studied from different perspectives and changes to parameters can be validated from the theory. Multiple theoretical sources have been used in this research. Theories used are explained how they help to solve the problem. Correct operational measures have been selected for meaningful and interpretable research findings. This research is answering to the need of the company and is giving new tools for the supply planner. Company's plan is to continue the implementation of the process and way of determining planning parameters for more suppliers latest after the summer holidays.

Reliability; metrics are measured similarly each month and the data is taken from the same system in similar way each month. Research process is described as clearly as possible. Several employees, related to the research area, have been interviewed and the results have been compared with them. Verification; results are carefully documented and are visible in daily activities.

This research has been made to a company I did not work for myself and this has brought both advantages and disadvantages for the project. Working as an external consultant has given me an opportunity to ask questions with new eyes. All the processes and ways of working have been new to me. This might have given a new perspective and ideas for the improvement project and for the company as well. On the other hand not knowing the ways of working has required much more work and time to learn and understand the current state and processes. Also it has required a lot of patience and time from the team I worked with and I am very grateful for all the help they have happily provided to me. Working with the research has been very challenging and interesting. I have learnt a lot and enjoyed the time.

For further research and improvement projects I would suggest studying more forecasting accuracy and improvement of it as well as information flows in the supply chain and how to make that even more effective, faster and automated through the whole supply chain. The increased interaction and coordination with channel partners on forecasting and planning will have a positive impact on performance.

In addition a research of transportation cost versus warehousing cost analysis would be useful for the company as in this project the optimum order size was not investigated and especially for small volume items it has impact on stock coverage and thus to warehousing cost as well. In sea transportation the 40 feet containers are much cheaper than 20 feet containers, but filling up the container often means increased stocks. Could company's Nordic countries, for example, do co-operation in this area?

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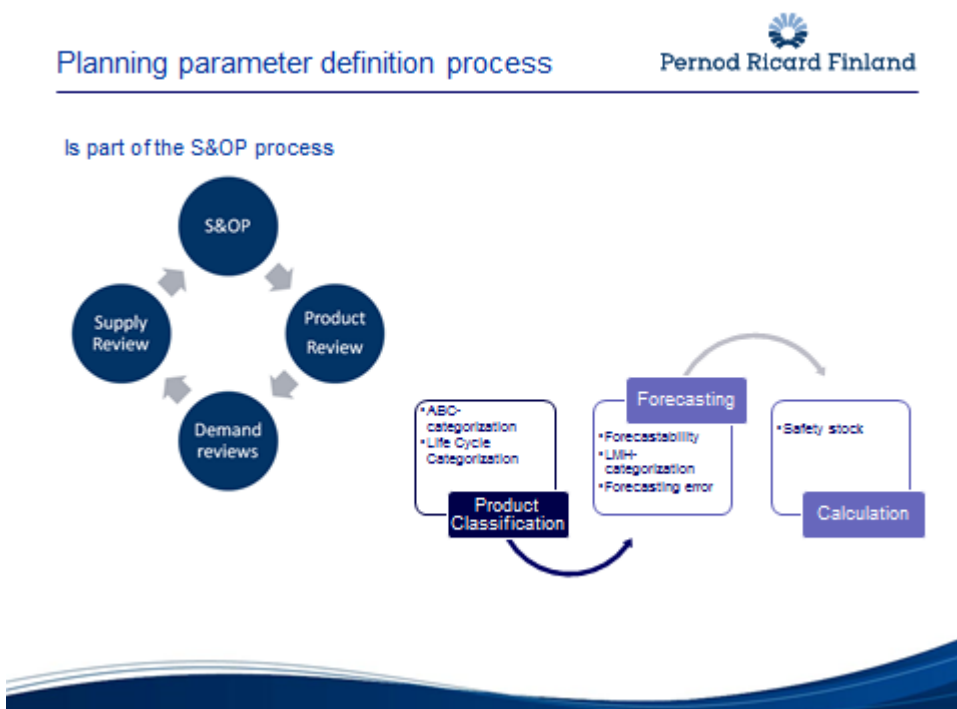
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Meetings, interviews, teleconferences with Pernod Ricard Finland OY during the project work

Date	Subject	Method
mid-June to mid- October	Problem statement, company introduction, process introduction, Current State Analysis by the researcher.	Working at Pernod Ricard Finland Turku, discussions with personnel at supply planning, warehouse, logistics development, factory tour
18.10.2012	Theory introduction, proposals, CSA continues by the researcher.	Meeting at PR (supply planner & supply chain manager)
8.11.2012	Theory, calculations, CSA by the researcher.	Meeting at PR (supply planner & supply chain manager)
15.11.2012	Theory, calculations, CSA by the researcher.	Telco with supply planner & supply chain manager
23.11.2012	Theory, calculations, CSA by the researcher.	Telco with supply planner & supply chain manager
11.12.2012	Theory, calculations, CSA by the researcher.	Meeting at PR (supply planner & supply chain manager)
18.12.2012	Suggestions for the formulas by the researcher.	Meeting at PR (supply planner & supply chain manager).
24.1.2013	Agreed the new planning parameters and pilot suppliers. Implementation in 1.2.2013.	Meeting at PR (supply planner & supply chain manager).
7.2.2013	Checked the implementation.	Telco with supply chain manager
4.3.2013	Status check from supply planner.	E-mail with supply planner
7.3.2013	Discussion about first month results. Looking good.	Telco with supply planner & supply chain manager
8.4.2013	Status check.	Telco with supply chain manager
16.4.2013	Results of first two months. Very promising.	Meeting at PR (supply chain manager)
20.5.2013	Results of April.	E-mail discussion with supply chain manager

23.5.2013	Results of trial, guide book and final discussions with the team.	Meeting at PR (supply chain manager and supply planner)
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Process description and user guide made by the researcher for systematic way to define planning parameters



Rest of the slides of the guidebook removed from the public version.