A study to examine the importance of forecast accuracy to supply chain performance: A case study at a company from the FMCG industry

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ABSTRACT

Nowadays, managing global food supply chains is becoming ever more challenging and the increasing complexity in food supply chains calls for awareness in supply chain forecasting. Since forecasting is the starting point of all supply chain activities, its degree of accuracy plays a critical role in supply chain management. The purpose of this study is to examine the importance of forecast accuracy to supply chain performance. By collecting qualitative and quantitative data, a small case study has been conducted at a firm which is active in the FMCG sector. This study indicates that several determining factors influence the accuracy of the forecasts. By analysing three KPIs with significant mismatches between the forecast and actual values, it became clear that the forecast accuracy mainly is influenced by production related factors, information related factors, the human factor and technology & tools. The literature review aligns with these findings, however, the case study shows that organisational culture, new product development and supplier delivery performance must be considered as new determining factors, since their influence is significantly noticeable. Additionally, the literature review and case study have shown that forecasting and planning are both related with each other as well as the importance of forecasting in the decision-making process. It has been restricted in its time and scope, leading to an analysis on only three KPIs. It is advisable to study other KPIs, where significant mismatches between the forecast and actual values occur, with the same depth in order to fully understand the impact of forecast accuracy on supply chain performance.

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Keywords

Advisory, Decision-Making, Determining Factors, Forecast Accuracy, FMCG Industry, Performance Tracking, Planning, Supply Chain Management

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1. SUPPLY CHAIN PERFOMANCE INFLUENCED BY FORECAST ACCURACY: AN INTRODUCTION

In any business, forecasting is a crucial activity that drives operations, promotes efficiency and serves as a key metric of effectiveness in planning processes. Moreover, in the field of supply chain management (SCM) forecasting is often considered as the driving factor in planning and decision-making processes. When forecasting is based on partial or inaccurate information, forecasting is likely to be susceptible to errors and fluctuations, with dire consequences for the planning and decision-making processes.

This research is a combination of the knowledge areas finance & SCM and focuses on the forecast accuracy for Company X. Company X is a company that manufactures ice cream products and it is a subsidiary of Company Y. The only European plant of Company X is located in western Europe and is responsible for the supply of ice cream for the European market. The brand is an innovative leader in the premium ice cream industry and is committed to providing all natural, high quality ice cream with respect to environmental and social responsibility. Apart from the production of Brand A the plant is also responsible for the production of Brand B and Brand C.

Company X has a unique organisational structure. It has departments responsible for supply chain, including operation and line managers. This department focuses on the production of ice creams and this involves efficient operations in terms of using few resources as needed and effective in terms of meeting the customer requirements. Besides, the company has a planning & logistics department which is responsible for the procurement of raw materials and packaging materials, and the flow and storage of products from the point of origin to the point of consumption. The quality assurance department is responsible for preventing mistakes and defects in the manufactured products and deals with deliveries of products and services to the customers. The technology & innovation department consists of two divisions: the product introduction and engineering division. The product introduction division covers the complete process of bringing a new product into the plant, considering the different flavours, sauces and toppings. The engineering division focuses on improving the company's equipment by using incremental and modular innovations in their projects. The officers of the HRBP department ensures effective management and relations between business managers and employees, from strategic to operational level. The last department is the financial department, which is responsible for forecasting, organising, auditing, accounting for and controlling its company's finances. The department of finance acts as a guide to various departments in financial matters and monitors several financial allocations.

Since ice cream is generally considered as a seasonal product, several internal and external factors were found to influence the forecast accuracy and the company's financial performance. For the production of ice creams, the organisation tracks and monitors several key performance indicators (KPIs). In the financial forecast of Company X there is room for improvement. The forecast states its expectations and in reality, there are mismatches between the forecast values and the actual values. The consequence of these mismatches is visible in the financial budget. In the real world it is impossible to have 100% accuracy in forecasting, but by analysing these mismatches, there is the possibility to increase the effectiveness of the supply chain, reduce the uncertainty and to decrease the costs. According to the financial department, there are significant mismatches between the forecast and actual values in the following KPIs: utilities, labour productivity and the usage of the biodigester. These three KPIs are direct and indirect related to the supply chain and will be analysed.

The purpose of this report is to understand the whole picture of forecast accuracy and to identify the causes of the mismatches between the forecast values and actuals of the following KPIs: utilities, labour productivity and the usage of the biodigester. From practical perspective, this report will be an advisory on the process of forecasting and provides recommendations for solving these mismatches, in order to optimise the production process. From theoretical perspective, this research provides insights in forecasting and planning, and by analysing determining factors, this research highlights the importance of forecast accuracy to supply chain performance. Based on this research objective, the following research question has been constructed:

'In the financial forecast, which determining factors are the primary drives in causing mismatches between the forecast and actual values of the analysed KPIs, and which recommendations will solve these mismatches and will contribute positively to the forecast accuracy and supply chain performance?'

The structure of this paper is divided into four sections: first, a review of the literature based on forecasting and planning. Secondly will be the methodology part, including research design, data collection and research context. Research is based on the most recently available data from the first quartile of 2019, started from 1 January 2019 until 31 March 2019, and from the interviews with company's representatives. The following section will be the result section. This section is a summary of the data analysis and interviews. Discussion & conclusion is the next section, where the case will be compared to the literature review. Lastly, in the recommendation section recommendations will be provided to Company X in which they can solve these mismatches, optimise their forecast accuracy and supply chain performance.

2. LITERATURE REVIEW

2.1 The importance of forecasting and KPI management in SCM

According to a study of forecasting practices in SCM by Albarune & Habib (2015, p. 55), forecasting is by far the most beginning activity of SCM, which initiates all the other actions of SCM. Stevenson (2002, p. 72) defined that forecasting is the form of statement that reveals future value of interest for a specific time period that is used as prime output in the decision-making process of SCM. Forecasting has impact on the fulfilment of the customer requirements and is an ideal starting point for the supply chain process improvement. Besides, forecasting can be seen as the key driving factor in planning and making decisions in SCM (Reiner & Fichtinger, 2009, pp. 55-56). Furthermore, according to Reiner & Fichtinger (2009, p. 57), companies are highly dependent on true numerical values of the forecast for taking major decisions such as capacity building, resource allocation, expansion and forward or backward integration etc.

KPIs are normally used to measure the performance of the process in order to recommend appropriate future decisions. Executives define certain KPIs that best fit their business needs and utilise them in threefold: 1) to inspect the current company status and create a new action plan in case the metrics are

pointing to a bad future scenario; 2) to provide information that facilitates the understanding of the business progress; 3) to communicate to employees who are at the lowest hierarchical level about the company development (Andrade & Sadaoui, 2017, p. 1). According to Choi et al. (2017, p. 82), the combination of KPIs and business information turns out to be something natural in the corporate world, since they can be used to assess whether the business goals have been achieved or not. Plischke (2012, p. 188), mentioned that the importance of KPIs already has been justified in the literature, especially in the field of Business Intelligence, however companies are still using spreadsheets to conduct the analysis of their indicators. It is clear that this is not an efficient evaluation approach and there are some authors who focused their attention on this practice, but yet pointed out that KPI management should be enhanced. According to Parr et al. (1999, p. 1), having a system to manage business relevant data is a fundamental part of the competitiveness.

By using KPI dashboards, organisations can access their success indicators in real time and make informed decisions that bring closer to achieving long-term goals. As defined by Clark et al. (2006, p. 19), Lehmann et al. (2006, pp. 7-8) and Wind (2005, p. 869), a dashboard is a relatively small collection of interconnected KPIs, and the underlying performance should be in common throughout the organisation's short- and long-term interests. The key elements of dashboards include the summarisation and integration of KPIs with underlying drivers to communicate performance throughout the organisation. According to LaPointe (2005, p. 99), managers mentioned at least three factors driving the need for dashboards: 1) poor organisation of the many pieces of potentially decision-relevant data; 2) the managerial biases in information processing and decision-making; 3) the need for cross-departmental integration in performance reporting practices and for resource allocation. Also, Krapp et al. (2013, p. 977) emphasise the importance of forecasting. He called that more research should be done on forecasting methods and models that increase the accuracy on the product quantity, timing and quality, which will improve the overall supply chain performance.

Nowadays, the increasing complexity of the physical connections along the food supply chain boosts the adoption of holistic and quantitative methodologies and tools by the SCM, which attracts researchers and practitioners (Georgiadis, Vlachos & Lakovou, 2005, p. 351). These approaches aim to manage the flow of materials throughout the network via data-driven planning and optimisation. As reported by Akkerman et al. (2010, pp. 863-864), in the food sector is the recent trend to focus on reaching a global optimum that incorporates actors and stakeholders, as well as economic, environmental and social sustainability goals. The key question in the supply chain forecasting is how to collaborate and integrate data from different supply chain levels, in such a way that the forecasts at different levels of the supply chain are consistent and provide required information to each single decision-making process.

According to Holden et al. (1991, p. 14), in financial markets, the relations between the present and future values of resources are important for the forecasts. Forecasts of the future state of the economy are an essential input into the decision-making process. Financial forecasting is one of the important aspects of management. Knowing or having a close estimation of firm's financial situation overcoming time will help the firm to revise its business decisions and strategy for the future. Financial forecasting is a time-consuming process which requires being patient. It is necessary that information for assumptions need to be collected carefully for the reliability of the forecast, including clarifying all variables. Once forecasts have been completed, it should be reviewed periodically. An updated forecast can enable you to see if the goals in the past reached or not (Abu-Mostafa & Atiya, 1996, pp. 206-207). An accurate financial forecast can be extremely helpful, while making wrong financial forecast can result in high costs such as excess staff or inventory.

As mentioned earlier, companies are highly dependent on true numerical values of the forecasting activities and a well-defined dashboard, including KPIs, will encourage to make informed decisions. In order to obtain effective output and to optimise the resources, forecasting must be shared among partners, suppliers, third-party logistics (3PL), financial departments and also within the supply chain department. It is usual that there might be forecast errors as actuals differ from the forecasted values, especially in the FMCG industry, which is impacted by volatility. Volatility can have an impact on the process and control side of the organisation, and on the supply and demand that a company faces (Yang & Burns, 2003, p. 2082). One of the main causes of uncoordinated forecasting is the bullwhip effect, which will be described in detail in the volatility section below.

2.1.1 SCV as critical factor in forecast accuracy

Managing global supply chains is becoming ever more challenging, leading to calls for new concepts to deal with the accompanying turbulence. Supply chain volatility (SCV) is one of the most prominent challenges for supply chain managers (Christopher & Holweg, 2017, p. 3). According to Yang & Burns (2003, p. 2082), almost every company, especially within the FMCG industry, is impacted by volatility on a daily basis. Tachizawa & Thomsen (2007, p. 1115) emphasise that many companies face an uncertain environment which is highly turbulent and volatile. In general, SCV is understood as a multidimensional construct that originates not solely from shifts in customer demand, but also from several other sources, such as short product life-cycles, increasing lead times, governmental regulations, competition, raw material price variations, and other factors (Christopher & Holweg, 2011, p. 77-78). An often-researched type of volatility is production volatility, also called output volatility. This type investigates the uncertainty in the supply chain. A reduction in this uncertainty will help to improve the performance in the supply chain and to increase the value (Ewing & Thompson, 2008, p. 553). Another type of volatility is demand volatility. Demand volatility is related to SCM and focuses mainly on the bullwhip effect.

Lee et al. (1997, p. 546) described the bullwhip effect as the demand variance amplification while moving through to upstream echelons from downstream echelons. Wang & Disney (2016, p. 691) notice that the bullwhip effect refers to the phenomenon where order variability increases as orders move upstream in the supply chain. The term bullwhip effect was first coined by Procter & Gamble (P&G) in the 1990s to refer to the order variance amplification phenomenon observed between P&G and its suppliers. Interestingly, a similar phenomenon between P&G and its wholesalers has been documented during 1910s (Schisgall, 1981). Lee et al. (1997, pp. 549-555) identified four main causes for the bullwhip effect: 1) all players in the supply chain base their forecasting on orders they received from the succeeding player in the chain. Increasing orders will lead to higher forecast which will lead to increase order quantities at the proceeding link in the supply chain. When demand decreases, it works the other way around; 2) rationing and shortage gaming effects. In periods of shortage, a manufacturer will ration their products to the retailers in proportion of their orders. When this is recognized, retailers will order more than they actually need to

ensure they can cover the demand of their customers; 3) order batching. A retailer faces continuous demand from its customers. However, it is unlikely that the retailers will also place continuous orders at a manufacturer, often due to fixed order costs, agreed lead times or distribution efficiency. This results in higher price variability in the orders the retailer places than in the demand the retailer experiences; 4) price fluctuations. Promotions or other cost changes can upset regular buying patterns, will increase the variability in demand. Buyers want to take con discounts offered during a short time periods, which can cause uneven production and distorted demand information.

Overall, SCV affect the forecast accuracy, inventory levels, production plans and outputs, service level and even the product prices (Germain, Claycomb & Dröge, 2008, p. 560). This results in an ineffective coordination and high supply chain costs. According to Balakrishnan et al. (2004, p. 163), downstream supply chain members spread their volatility upstream, resulting in high capacity and inventory costs. When demand becomes more volatile, there will be a greater demand for inventory to have a buffer available that enables a manufacturer to deliver the requested products at all the time. A stable demand will lead to a smaller safety stock. For this reason, an increase in volatility can lead to inventory build-ups, and increasing inventory will result in higher costs (Pindyck, 2004, p. 1030). Nowadays, supply chains are forecast driven, this means that manufactures periodically revise their supply chain plans base on a forecast of future demand over a specified planning horizon. According to Hendricks & Singhal (2009, p. 511), the poor forecast and related inefficient operations schedule can result in either excess stock or out of stock situation, both indicators of a demand-supply mismatch.

2.1.2 Other determining factors in forecasting

Besides volatility, other determining factors play a role on the forecast accuracy. Sébastien Thomassey (2010, pp. 481-483) studied forecast systems in the clothing industry, comparable with the FMCG industry. Both industries are dealing with volatile demand, strong seasonality of sales, wide number of items with a short product life-cycle, frequent and unpredictable changes or lack of historical data. As pointed out by Thomassey, the existence, relevance and reliability of data contained in the information system are the key factors that influence the forecast accuracy. These elements can be translated as following; existence is related to the availability of data, which come from the share of information. Relevance is related to the range of information and reliability of data is related to the quality of information.

Since forecasts are based on the available information at the time of the forecasting activity, with so many uncertainties presenting among the demand, supply and manufacture process, it is apparent that the forecasts could easily become inaccurate. Gathering the latest information and sharing with the relevant parties will minimise the impact of uncertainties and increase the chances of adjusting the forecast close to a real-time manner, which can be used to reflect on the current situation. According to a study in the franchisor-franchisee supply chain, Yan & Wang (2012, p. 1171) found out that information sharing increases forecast accuracy, which enables firms to respond to customer demand in a real-time manner. Their model has demonstrated that by sharing information, forecast accuracy significantly increased and both parties benefit from such an improvement. Besides, information sharing contributes significantly in reducing the bullwhip effect. According to Ali & Boylan (2010, p. 5), without sharing information between supply chain participants, but only passing through individual forecast from downstream customers to upstream customers, adjustments are done at each hand over of the forecast based on separate assumptions which effects the forecast accuracy and becomes a total different picture from its original version. Sharing information creates more transparency (among partners) and improves the forecast accuracy and supply chain performance. Finally, Zhu et al. (2011, p. 284) developed a model that illustrates the relationship between forecast effort and profitability under several different information sharing scenarios, and it has been found out that sharing information between supply chain partners improves the forecast accuracy and the profitability of the organisation.

Besides information sharing, the quality of information plays a critical role in the final level of forecast accuracy (Chen & Wolfe, 2011, p. 70). Chen & Wolfe found out that information quality is affected by the number of relays and handlings from its origin to its destination. For example, the exchange directly between two parties ensures higher quality, while multiple handlings along several parties, the quality tends to decrease due to manipulation along the way such as formant change, data conversion and inappropriate interpretation and communication which makes the information less visible or more difficult to understand. Lastly, the type of information to be shared, the range of information, is an additional factor contributing to the forecast accuracy. The type of information shared should include a good range of both internal and external data as well as direct and indirect data. A combination of both internal and external data will result in a better forecast, according to a case study by Ramanathan (2012, p. 78).

Sharing the right and relevant information in a wide range with the highest possible quality does not automatically lead to an accurate forecast outcome. Information analysis, interpretation and utilisation are some critical determinants in producing an accurate forecast. The human factor, technological systems and tools also play an important role in the forecast capability. Singh (2014, p. 5) mentioned that the forecaster is the leader in the forecasting process for making the right adjustments and the right decisions and that the forecasting capability is mainly depending on the forecaster's competence, such as experience, skills and even their personalities. Additionally, the fact that information technology becoming an essential part of today's businesses, various systems and tools are now consisting a major part of forecasting capability (Fildes & Hastings, 1994, p. 16). They make it possible to store and exchange large quantities of data, enable fast and complex analysis and produce and efficient forecast. As stated by Wang & Pervaiz (2007, p. 27), the combination of information technology and ability to effectively use the organisational resources can create a unique and sustainable competitive advantage.

Finally, apart from volatility and the information related factors, factors such as globalisation, seasonality and fast-moving data influence the forecast accuracy, especially in the FMCG industry. According to Lee (2002, p. 105), the increasing globalisation and market competition have forced companies to expand their business networks, moving from local to more complex and vulnerable supply chains. Evidence from literature suggest seasonality as another major drives to demand volatility (Gupta & Maranas, 2003, p. 1219). Seasonal effects are periodic fluctuations that occur on a certain base or on certain seasons. During these periods, companies experience demand fluctuations which may lead to gains or significant losses in sales. According to Wong & Hvolby (2007, pp. 407-408), the influence of seasonality can be reduced by designing a coordinated

responsive supply chain. Lastly, a study by Petropoulos et al. (2014, p. 152) found out that forecast accuracy is influenced by fast-moving data and concluded that fast-moving data has a negative effect on the forecast accuracy. The lack of data traceability is partly responsible for this negative effect.

2.1.3 Types of forecasting

Different forecasting methods and/or approaches influences the forecast accuracy. The type of forecasting is related to the human factor, and technology and tools, both associated with the forecaster's capability. Various forecasting techniques, based on quantitative and qualitative data, exist. Two common and different forecasting methods are time series analysis and causal/explanatory models (Kilger & Wagner, 2015, p.125). Time series approaches assume that demand exhibits certain pattern over time. Therefore, the aim of these forecasting methods is to derive a forecast by identifying and estimating that pattern from historical data. The next step is that the future forecasts, based on the observed pattern, are calculated. According to Kilger & Wagner (2015, p. 127), one of the major advantages of time series analysis is their unique reliance on the history of demand. Silver et al. (1998, p. 46) and Mentzer & Moon (2005, p. 74) mentioned that common data pattern are level, trend and seasonal models. Related forecasting techniques for time series analysis are: simple moving average (SMA), exponential smoothing and autoregressive integrated moving average (ARIMA) among others (Brockwell & Davis, 2013, p. 17). Kilger & Wagner (2015 pp. 127-128) conclude that the main advantage of time series analysis is to use historical data to identify and extrapolate a pattern or trend.

On the other hand, causal models imply that the forecast is modelled by certain known factors. According to Kilger & Wagner (2015, pp. 131-133), this forecasting approach is an estimation of parameter values and an investigation of causality between dependent and independent variables. They both mentioned that qualitative, or also known as judgmental forecasts, do not use calculations, but individual or group-based estimations. Wright & Goodwin (1998, p. 23) describe the procedure for the judgmental forecast as follows: 1) considerations are made on the relevant data, suitable for the underlying forecasting activity; 2) the decision on the forecasting approach is made; 3) the final judgement is about the outcome of the forecast. In general, causal models are beneficial as external factors are considered, however a much higher level of data is generally required. Furthermore, qualitative methods consider the business environment, when generating a forecast, as an important aspect for recognizing information related to specific events (e.g. promotions, customer feedback on new products) and changes in demand pattern, which are not perceived by statistical models. The obvious and popular forecasting techniques for causal models are multiple regression models, econometric models and multivariate autoregressive integrated moving average (MARIMA) models (Kilger & Wagner, 2015, p. 135).

Diverse studies focus on understanding qualitative and quantitative methods, and their advantages related to forecasting. Some studies reveal that judgmental forecasts are preferable over statistical techniques because of the highly variable nature of data series and environmental uncertainty, which is only knowledgeable via human expertise. Moreover, research in the fashion industry, by Nenni et al. (2013, pp. 1-6) document how poor performance is more likely be caused by statistical techniques in case of highly volatile demand. Other researchers suggest that further variability and forecasting biases are caused by behavioural decisions in qualitative methods (Zotteri et al., 2005, pp. 480-481). Evidence from literature suggests that a combination of quantitative and qualitative forecasting techniques overwhelm the benefits obtained from one single method and allow getting a more accurate and reliable forecast (Chase, 2009, p. 7). Combining the benefits of both worlds seems preferable to capture and reduce variability and uncertainty.

2.1.4 Decision-making influenced by forecasting

The importance of forecasting can be seen in the decision-making process. Several researchers conclude that a strong forecast, including relevant, reliable, qualitative and valuable data, has influence on the forecast accuracy and next to that, on the decision-making process. Krapp et al. (2013, p. 977) already demonstrated with his generic forecasting framework that an accurate forecast will contribute to a more accurate decision-making process, and at the same time present decision makers the impact of forecasting errors. According to Reiner & Fichtinger (2009, pp. 55-56), forecasting can be seen as the key driving factor in planning and making decisions in SCM. For taking major decisions such as capacity building, resource allocation, expansion and forward or backward integration companies are highly dependent on true numerical values of the forecast. From financial perspective, Holden et al. (1991, p. 14) highlight and express that in financial markets, the relations between the present and future values of resources are important for the forecasts. Forecasts of the future state of the economy are an essential input into the decision-making process. As already known, financial forecasting is one of the important aspects of management. Knowing or having a close estimation of firm's financial situation overcoming time will help the firm to revise its business decisions and strategy for the future.

Polat (2008, pp. 419-424) analysed in greater detail that forecasting can be used as a strategic decision-making tool. His research paper points out the potential internal and external decision areas, where forecasting can extensively be used for strategic decisions as an essential support tool. Besides, the paper pointed out the central role of the forecasting function as regard to how it provides the critical needs of information for the strategic management, which is the key to strategic managerial decisions. He found out that forecasting has a capability to be used in almost in every step of strategic and functional management. Forecasting has substantial potential in terms of capabilities Being different from many other decision tools, its main capability lies in producing and providing information about the future, which is directly related to the most of the strategic decision processes. The forecasting process contributes significantly to building up a background and stand for strategic decisions. In this sense, forecasting is more like a collection of essential support procedures in the background, which feed the information required by strategic managers. It can be generally concluded that forecasting has a major role and the potential capability to use in many of the functional and strategic decision-making areas.

2.2 The importance of planning on forecasting: CPFR and S&OP highlighted

Although information sharing is essential in forecast accuracy, only information not enough. How to share the information and how to best utilise the shared information for the optimal result are the two main questions for an organisation. If each party in the supply chain still does their own forecast with a focus to maximise their own benefit, sharing information adds no value to the overall forecast accuracy and supply chain performance.

Viswanathan et al. (2007, p. 5059) mentioned that the only way to bring out the value in sharing information is to draw a unified focus from all supply chain participants into one single forecast, where participants work collaboratively on this single forecast with the aim to achieve the best for the whole supply chain. According to Gupta & Maranas (2003, pp. 1220-1221), effective integration of various functionalities is the primary objective of supply chain planning. One managerial activity which is closely related to forecasting, is planning. Planning is often confused with forecasting. Forecasting is about what the world will be look like, while planning concerns what it should like (Armstrong, 2000, p. 1). The three critical stages of supply chain planning are the following: 1) operational planning; 2) tactical planning; 3) strategic planning. These three stages are all vital to the efficient and effective functioning of supply chains, with strategic planning being at the highest level and operational planning being at the lowest level. According to Ahumada et al. (2009, p. 1), the increasing complexity of food supply chains and their attempt to match seasonal food production to a global demand has encouraged the adoption of more systemic planning. Optimisation of the complete supply chain is accomplished in the form of efficient planning decisions. Within this section, important approaches such as collaborative planning, forecasting and replenishment (CPFR) and sales & operations planning (S&OP) will be addressed.

2.2.1 CPFR: focus on collaboration

According to Vlčková (2008, p. 337), CPFR is an approach based on strong environmental collaboration and it brings all concerned parties in the supply chain together to create a shared information system and manage a single shared planning, forecasting and replenishment process in their supply chains. In 1966, the first pilot of this approach was done between Wal-Mart and Warner-Lambert on the Listerine products. The relevant data was exchanged timely and adequately to support the single co-managed planning, forecasting and replenishment process. The effect from this pilot can be seen in the increasing number of sales, better fill rates and reduction in inventory. Since then, a considerable number of other similar pilots on CPFR have gained success for leading businesses from different industries, such as P&G, Levi Straus and Heineken (Aviv, 2001, p. 1327). According to Attaran & Attaran (2007, p. 394), the underlying result of the CPFR process is the improvement in forecast accuracy which ensures the successful and sustainable business operations. The main advantage of CPFR is that it is not limited to certain industries or sectors and is widely used by retailers and manufactures. CPFR has some challenging issues which are identified by many researchers. Albarune & Habib (2015, p. 56) mentioned the most common challenges: 1) lack of trust; 2) lack of internal & external forecast collaboration; 3) availability & cost of technology; 4) fear of collusion; 5) lack of training & skills. Aviv (2001, p. 1327) support this and pointed out that high level of collaboration, willingness to share adequate information and strong technical support are crucial factors that influence the success of CPFR.

2.2.2 S&OP: focus on strategy

For achieving a better performance of the business, Thomé et al. (2012, p. 360) described S&OP as a process of integrating all functional plans into a unified tactical plan over a time horizon, from less than three months to 18-24 months, that strategically directs a firm's operational planning and related activities. Aviv (2001, p. 1327) & Ramanathan (2012, p. 78) emphasised both that collaboration is important to improve the forecast accuracy, which in the end improves the supply chain performance. Oliva & Watson (2009, p. 140) describe S&OP as an integration process used in business organisation to ensure efficient coordination among different functions for aligning company strategy with the supply chain planning. The S&OP process requires management involvement in all the three business levels: 1) strategic level; 2) tactical level; 3) operational level. Stahl & Wallace (2012, pp. 29-33) mentioned that the senior management is the key to a successful S&OP process, and they worked out ten principles for the success of S&OP. To encourage high level commitment from all parties in the whole planning process, a united focus from top-down and maximum alignment between strategic planning, tactical planning and day-to-day operational planning is necessary. This will result in a platform for proactive information sharing. including the most available and high-quality information. Together with justified investment on relevant forecasting systems, as well as the most capable forecasters, accurate forecasts can be delivered. These high-quality forecasts will assist the management in decision-making and will contribute the overall supply chain performance.

2.3 Armstrong's framework: relationship between forecasting & planning

Research by Armstrong (2000, p. 1) highlights the distinctions between forecasting and formal planning. Planning provides the strategies, given a certain forecast, whereas forecasting estimates the results, given a plan. Planning relates to what the firm should do, while forecasting relates to what will happen if the firm tries to implement a given strategy in a possible environment. Armstrong (2000, p. 3) developed a framework for planning and forecasting. Exemplified, the relation between formal planning and forecasting is shown in Figure 1 below.

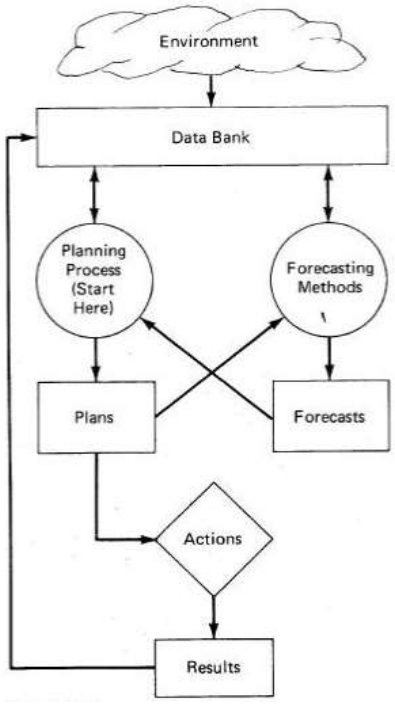

Figure 1. Framework for formal planning and forecasting (Armstrong, 2000, p. 3)

In this framework, the environment is free-standing. Scanning of the environment yields relevant data for the so called 'Data Bank'. This data bank (or information system) contains data such as government regulations, industry sales, the resources of the company, information of available technologies etc. Ideally,

these data would be assembled in a central location, such as a filing cabinet or computer. The framework suggests to start with formal strategic planning. According to Armstrong (2000, p. 4), formal strategic planning calls for an explicit written process for determining the firm's long-term objectives, the generation of alternative strategies for achieving these objectives, the evaluation of these strategies, and a systematic procedure for monitoring results. This process is summarised in Figure 2.

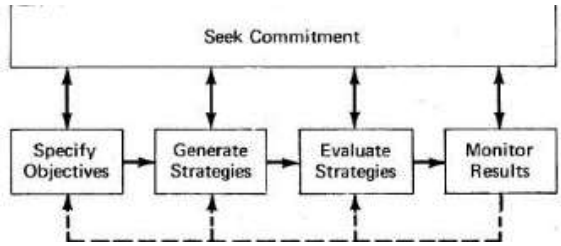

Figure 2. The planning process (Armstrong, 2000, p. 4)

Formal planning starts with the identification of the ultimate objective of the organisation. The stakeholder approach and the strengths and weakness analysis should be conducted, to ensure a comprehensive analysis of the objectives. The next step is to generate alternative strategies, which helps to recognize that the objectives can be achieved in different ways. Alternative strategies can improve the adaptability of the organisation in two ways: 1) by explicitly examining alternatives, it is likely that the organisation will find that they are superior to their current strategy; 2) the environment might change and if alternative contingency plans have been prepared, the organisation is in a better position to respond successfully. The evaluation part is a procedure by which each alternative plan is judged for its ability to meet the objectives. Finally, monitoring results is an important activity to see if objectives are met and to provide feedback to the management team. It is advisable to seek and develop commitment to ensure that various stakeholders will co-operate and implement the chosen strategy.

Reviewing the framework, the left-hand side of Figure 1 examines formal planning. The 'Planning Process' draw upon information from the 'Data Bank' (evidence on the current situation) and also upon the 'Forecasts' (evidence on what will happen in the future). The two-way arrow from 'Data Bank' to 'Planning Process' indicates that the planning process, to a large extent, dictates which information is required. The 'Planning Process' produces a set of 'Plans'. These plans describe objectives and alternative strategies. One strategy is selected as a basis for 'Action'. Actions will lead to 'Results', both intended and unintended. The results will go back to the 'Data Bank' and will be saved. The right-hand side examines forecasting. To make 'Forecasts' for an organisation, it is necessary to have information about the company's proposed strategies. This can be seen in the arrow from 'Plans' to 'Forecasting Methods'. Then an examination of the 'Forecasting Methods' will help determine which data is required. This can be considered as the two-way arrow from 'Data Bank' to 'Forecasting Methods'. Armstrong (2000, p. 13) defined forecasting methods as procedures for translating information about the environment and the company's proposed strategy into statements about the future results. These 'Forecasts' are then used as inputs to the 'Planning Process'.

3. METHODOLOGY

3.1 Research design: determining factors assessed against KPIs

To investigate the importance of forecast accuracy to supply chain performance, this research focuses on multiple internal and external determining factors, retrieved from the literature review. In order to understand the influences of these factors on forecast accuracy, the factors will be assessed against the KPIs of the case company. According to the financial department of Company X, there are substantial mismatches between the forecast and actual values on the following three KPIs: utilities, labour productivity and the usage of the biodigester. Therefore these three KPIs have been selected as sample to analyse the mismatches between the forecast and actual values. The determining factors, retrieved from literature review, are presented in Table 1 below.

Table 1. Determining factors against the KPIs

Factors	Biodigester	Utilities	Labour productivity
SCV			
Seasonality			
Globalisation			
Fast-moving data			
Data existence			
Data relevance			
Data reliability			
Human factor			
Technology & tools			

3.2 Data collection: quantitative as secondary and qualitative as primary source

For the production of ice cream, Company X tracks and monitors these KPIs. For the KPI analysis, business data will be retrieved from both primary and secondary sources. To understand and outline the current situation, secondary data such as the forecast files, current performances and financial reports are collected. In the following subsections, description and the current performance of these KPIs will be summarised. The green values can be seen as benefits, whereas the red values indicate losses. Additionally, as primary source, interviews will be conducted to understand the influence of the determining factors on the forecast accuracy. This can be seen as the empirical part of this research and by conducting interviews with the industrial financial manager (labour productivity) and the technical service engineers (utilities and the usage biodigester) the root causes of these mismatches will become clear. Although individual interviews are considered as a traditional approach, they offer the advantage of maximising the response rate and the quality of information as the opportunity to ask clarifications on aspects of concern (Hofisi, Hofisi & Mago, 2014, pp. 60-64). Besides, according to Alsaawi (2014, p. 150), the semi-structured approach allowed elaborating open-ended questions beforehand while giving space to further questions as dependent on the case. Also, it was expected to retrieve as much information as possible and to use them to interpret and understand the connections between the investigated factors in order to answer the research question. Finally, it was also anticipated that that respondents realise the extent of their problems which could provide input for

a problem-solving approach and inconsistencies between different expectations can be further detected.

The semi-structured interviews have been conducted as qualitative research approach. In total, three semi-structured interviews were organised, each lasting from 50 minutes to one hour. Each interview was held face-to-face at the company. Prior to the interview process, some questions were prepared acting as a guideline to follow during each interview session. The interview starts with a brief introduction of the research purpose. After introduction, questions related to the KPIs background where asked to fully understand the content of the KPI. Additionally, questions about information related factors, determining factors, interactions, forecasting and planning where asked, with the purpose to compare findings from literature against this case study. The used interview scheme is reported in Appendix A and the outcome of these interviews can be seen in the result section.

3.3 Research context: description of the KPIs, including the current situation

3.3.1 KPI: biodigester

The biodigester gives Company X the opportunity to take what had been seen as a waste product and turn it into a benefit for their business by producing their own energy. The biodigester is an anaerobic flotation reactor. Ice cream waste is fed into a tank, where 24 billion natural micro-organisms break down the particles, turning them into biogas. At the same time wastewater, used in keeping the factory clean, is also fed into the tank with the micro-organisms. What makes it original is that the wastewater streams, containing fat and oil, are treated in one reactor, together with the degradable particles. This is in contrast with conventional systems, whereby this is only possible by going through a number of processing stages. The biogas created by the biodigester is used in the factory's 'Sustainable' project which acts like a battery by insulating water at the correct temperatures for ice cream creation and dramatically reducing the need for natural gas to heat the plant. This initiative ties in with Company's X core values of being good to the community and planet.

3.3.2 Current situation

As already described above, the biodigester gives Company X the opportunity to turn waste into biogas. This results in a reduction of gas consumption, cleaner water output and more importantly, financial savings over long-term. The forecast for the savings of the biodigester, including the forecast and actual values, is shown in Table 2 below. This overview is based on the available data from the first quartile of 2019, started from 1 January 2019 until 31 March 2019.

Table 2. Forecast savings biodigester (in €)

Time	Actual	Forecast	Difference	VAR
Jan	30,259	32,274	-2,015	-6.24%
Feb	n/a*	29,151	n/a*	n/a*
March	27,603	32,274	-4,671	-16.92%
Total	57,862	93,699	-35,837	-38.25%

*Maintenance of the biodigester, one month out of control

3.3.3 KPI: utilities

For the production of ice creams is, besides raw materials, labour and packaging, energy needed. According to the internal terminology of Company X, utilities are the sum of the following elements: gas, electricity and water usage. In general, manufactures in the FMCG industry generates substantial energy consumption, with energy costs that account for a sizeable portion of the overall indirect costs.

3.3.4 Current situation

Utilities are essential services that play an important role in the production process and are directly related to the supply chain. The forecast for the utilities, including the forecast and actual values, are presented respectively in Tables 3 (electricity usage), 4 (water usage) and 5 (gas usage). These overviews are based on the available data from the first quartile of 2019, started from 1 January 2019 until 31 March 2019.

Table 3. Forecast electricity usage (in kWh)

Time	Actual	Forecast	Difference	VAR
Jan	1,287,458	1,235,284	52,174	4.22%
Feb	1,153,384	1,139,386	13,998	1.23%
March	1,427,816	1,289,914	137,902	10.69%
Total	3,868,658	3,664,584	204,074	5.57%

Table 4. Forecast water usage (in m^3)

Time	Actual	Forecast	Difference	VAR
Jan	13,289	10,991	2,298	20.91%
Feb	12,218	10,199	2,019	19.80%
March	14,127	13,401	726	5.42%
Total	39,634	34,591	5,043	14.58%

Table 5. Forecast gas usage (in m^3)

Time	Actual	Forecast	Difference	VAR
Jan	94,754	82,622	12,132	14.68%
Feb	76,430	80,631	-4,201	-5.21%
March	90,910	88,840	2,070	2.33%
Total	262,094	252,093	10,001	3.98%

3.3.5 KPI: labour productivity

In general, labour productivity is concerned with the amount (volume) of output that is obtained from each employee. Several factors, such as the proficiency of the workers, the degree of the used science and technology, the organisation and management of the production process and natural conditions influence the labour productivity. In this case, the KPI labour productivity consists of several variables and these are related with each other. All these variables have their own KPI. It is important to measure and monitor labour productivity, since labour costs are usually a significant part of the total costs (Andrade & Sadaoui, 2017, p. 1). Zhu et al. (2011, p. 284) mentioned already that business efficiency and profitability are closely linked to the productive use of labour. A reduction of the labour costs will provide the firm competitive advantage.

Company X formulated seven indicators of labour productivity: 1) number of shifts; 2) number of hours for Company X and Strategic Partner Z; 3) labour costs for Company X and Strategic Partner Z; 4) number of hours sickness; 5) total production volume; 6) Overall Equipment Effectiveness (OEE); 7) the volume/shift ratio. The metrics number of hours and labour costs for Company X, and OEE may need further clarification. During high season, the company operates 24/6 and the shift plan of the company consists of three shifts: day shift, swing shift and night shift. Two types of employees are working in the plant: permanent employees, which are on the payroll of Company X and temporary workers, which are paid via the employment agency, Strategic Partner Z. And lastly, the OEE measures the operational performance of the production line, taking into account the manufacturing performance losses and process driven losses.

3.3.6 Current situation

The current situation of the KPI labour productivity is presented in Table 6 below. The manufactory has in total five different production lines for the production of Brand A, Brand B and Brand C. Since labour productivity consists of many variables, overall analysis of this KPI will become too broad and complex for all different lines. To understand the current situation of this KPI, the performance will be analysed for one line on a weekly basis. In this report, the performance of line two in week 18 will be analysed. The forecast for labour productivity, including the forecast and actual values for each variable, are shown in Table 6. This overview is based on the available data from week 18, started from 28 April 2019 until 4 May 2018.

Table 6. Forecast labour productivity

Variables	Actual	Forecast	Difference	VAR
Number of shifts	17	18	1	-5.6%
Number of hours Company X	342.5	390	-47.5	-12.2%
Number of hours Strategic Partner Z	210	152	58	-38.2%
Number of hours sickness	0	23.4	-23.4	-100%
Labour costs Company X	13,882	15,806	-1.924	-12.2%
Labour costs Strategic Partner Z	6,720	4,864	-1.856	-38.2%
Production volume*	1,740	1,846	-106	-5.7%
OEE	71,2%	68,0%	3,2%	3.2%
Volume/shift	102.4	102.6	-0.2	-0.19%

*The volume is measured in litons, with 1 liton = 1,000 liters

4. RESULTS: PRESENTATION OF THE INTERVIEW FINDINGS

4.1 Summary of the findings: determining factors for the KPI biodigester

The expert for this interview is the electrical engineer of Company X, who is responsible for optimal functioning of the biodigester. The expert has 29 years of experience as (all-round) mechanic in several industries, including the FMCG industry. Currently, he works almost seven years for Company X and points out that the biodigester gives the firm the opportunity to turn waste into biogas, which results in a reduction of gas consumption and more important, reduction of wastewater discharge, including polluted water. Both advantages provide cost savings over long-term. The financial department calculated, for the biodigester, a yearly cost saving of €380,000. This correspond with, depends on the length of the month, monthly savings of €29,000-€33,000. From his point of view, in terms of savings, the financial department made a too prosperous forecast and an incorrect assumption. Benefits such as reduction in external biogas consumption, less water discharges and cost savings are only achievable if the machine is working at full capacity. This is often not the case, as long as the biodigester is dependent on two factors: 1) the amount natural micro-organisms, which break down the particles and turning them into biogas; 2) the amount of waste and wastewater, containing fat and oil.

According to the data of the current situation, which is described in subsection *3.3.1*, the interviewee made remarkable statements. The first statement is based on mismatches between the forecast values and the actual values for the months January and March. These mismatches can be explained by the production of the new types of ice creams, namely Product A and Product B. Product A characterised itself as delicious ice cream, with low calories and sugar. Product B is made with almond milk and are certified as 100% vegan. For the production of these types of ice creams, the company uses different ingredients which result in a high(er) level of fatty acids in wastewater. This causes ineffective input for the biodigester and hindered to work at full capacity. The expert emphasised an additional reason for the ineffective working of the biodigester. For the production of ice cream, water consumption is increased. This can be seen in subsection *3.4.1*. The consequence will be a decrease of the concentration fat and oil in wastewater, which also hinder the biodigester to work at full capacity. Both reasons cause less savings. The most notable finding is related to the month February. The financial department made a forecast of potential savings, but this did not match with the actual value. In February, maintenance was scheduled, and this means that the biodigester was out of control. The financial department was unaware of this and could not include this event in the forecast.

The main goal of this interview is to gain insights in forecasting and planning. For the topics information storage and systems, the interviewee made the following statements. He uses only one Excel file, which included the amount and type of chemicals, the chemical oxygen demand (COD) values and the cost savings values. Data is retrieved from the stand-alone computer of the biodigester and the file is only shared with his supervisor. The supervisor is responsible for sharing it with the management team, including the financial department. Questions related to the quality and accuracy of the data where answered as follows: the expert emphasises that the retrieved data is reliable, since he takes daily several monsters, and if in doubt, he takes extra monsters to trace potential mistakes. This ensures the reliability. Looking at the frequency and way data sharing with the financial department, he points out that he has no idea how the collaboration is organised. From his point of view, he felt not

responsible since he shared the file with his supervisor. Unfortunately, the supervisor (and manager of the supervisor) did not share this with the financial department (on time). Indeed, the supervisor knows the existence of the file, but he is more interested in the fact that the biodigester works than the daily savings. The interactions are done via small conversations and are done at random times. This implies that the supervisor does not receive the file on a fixed time perioded, indeed, he received the file hardly ever. Examining the quality of the planning, the expert emphasises that the activities planning and forecasting are both related with each other and that the planning between the supervisor and the management team, should be improved, with the aim of having an accurate financial forecast. In order to investigate the influence of determining factors, which influence the forecast accuracy, the expert points out that SCV, seasonality, globalisation and fast-moving data has no influence on the operation efficiency of the biodigester, and also no influence on the planning and forecasting activities. On the one hand, the composition of the wastewater and the level of fatty acids influence the operation efficiency of the biodigester, one the order hand, (the lack of) existence knowledge and inefficient data sharing influence the planning and more important, the forecast activities.

When taking a closer look to the current situation, he mentioned that the calculated yearly saving of €380,000 is based on savings of 2017, which can be considered as a peak year. If we cannot manage the high level of fatty acids in the wastewater, the maximum savings will be €200,000. By changing the production and cleaning process, it is possible to gain the missing benefit of €180,000. Finally, the last statement is related to the stagnation of the biodigester. One day stagnation will cost the firm +/- €1,000. The expert is the only person who can manage the machine. At the moments when he is on leave, the machine is out of control, and this will hurt the financial forecast. He assumed that the financial department is unaware of his absence. After all, he mentioned that he is aware of the negative results and that cost savings should be the key motivation, however, instead of focusing solely on savings, he highlights that this initiative ties in with the firm's core values of being good to the community and planet.

4.2 Summary of the findings: determining factors for the KPI utilities

The person participating in the second interview for this research is the utility engineer of Company X, who is responsible for the operational conditions of the utilities. Besides, the expert is the environmental pillar leader of the World Class Manufacturing (WCM) program. The WCM-program is based on a continuous improvement approach, including the integration of Six Sigma, Lean Manufacturing and Total Productive Maintenance (TPM). The goal of the WCM-program is to use the best available work practices in order to achieve the best efficiency on the operation level, with more focus and opportunities for cross-departmental improvement. The interviewee has 24 years of work experience, including six years for Company X, in the optimisation of supply chain processes. As mentioned previously, utilities are the sum of the following three elements: gas, electricity and water usage. These elements correspond with expenses of €1,6 million.

The financial department assumed that the energy usage of this year should be equal to previous year, 2018. This assumption is based on the production volume data and the number of times of changeovers. In the first quartile of 2019, the company had one extra shift, compared with the previous year. The extra shift ensures a small increase in volume, which is hardly changed compared with 2018. Furthermore, the company enjoys a wide range of product portfolio, which will lead to more changeovers. The changeover is needed when there is a change in product variants. Because of uncertain supply of raw materials, the firm had in 2018 more changeovers than planned. This means that the utilities, especially the water usage, increased. A simple analogy would be: two opposing actions, the increase in production volume (which causes an increase in utilities) and the reduction of changeovers (which causes a decrease in utilities), will cancel each other out. Based on this interpretation, the forecast for utilities was made. The data of the current situation, which is described in subsection *3.4.1*, proves the opposite. Compared to one year previously, there is an increase of 3.98%, 5.57% and 14.15% respectively for the gas, electricity and water usage. The financial department is concerned about this situation, especially the increase in water consumption. The interviewee indicates that he is aware of this fact. In his eyes, utilities belong to the environmental pillar of WCM. The purpose is to develop an energy management culture, with energy and cost reduction as aim. Additionally, to better understand the whole picture of forecasting and planning, related questions have been asked.

For the topics information storage and systems, the expert indicated that he uses the programs Excel, Vispro and Strata. With Excel, the expert makes clear spreadsheets, including the values of utilities. Vispro gives visual insights into the values of utilities. The final program, Strata, is an energy management software with the focus on energy and process optimisation. The software is connected to the measuring devices of the plant. An advantage of this system is that it collects high frequency process data or increment utility data for real time exception analysis or management reporting. He points out that he is aware of the existence and advantage of Strata, however, he emphasises that time constraint affects the focus to fully understand Strata. Another noticeable point he made is that he was obligated by Company Y to use it. Indeed, some plants of Company Y have even built an entire business model for tracking, monitoring and analysing utilities. Company Q, ice cream factory in south of Europe, is a nice example. This plant fully integrated Strata in their business process and receives notifications and exception reports if targets are not matched with established benchmarks. The files created by the expert are saved in the network drive and only accessible for technical service managers. By examining the information accuracy and reliability, he points out that the utility values retrieved from Strata and Vispro corresponds with the invoices of the energy companies. By reviewing the frequency of interactions and the way of data sharing with the financial department, the interviewee emphasised that he has a small number of face-to-face meetings with the financial department. The meetings deal with topics related to energy consumption and forecasting. By examining the quality of planning, also he emphasises that planning and forecasting are both related with each other. Additionally, he mentioned that transparency of data is key factor that influence the forecast accuracy. With the objective to investigate the influence of determining factors, he points out that SCV, seasonality and globalisation have direct influence on the sales, production and indirectly on the utilities forecast. Generally, these three factors are dealing with uncertain environmental conditions and forced Company X to expand the business network, moving from a local to more complex and vulnerable supply chain.

Exploring in detail the current situation, the expert mentioned that the 'same utilities' assumption is unjustifiable. The forecast of the financial department did not fully include the following projects and issues: 1) expansion of equipment; 2) production speed up line four; 3) expected volume growth. According to the

interviewee, these trends affect the utilities significantly. The increase in water usage can be explained by the introduction of Product B. To avoid cross-contamination, different and extensive cleaning methods must be applied. Also, the new product range of Brand C influence the utilities. In the new product development process (NPD), the firm performed several test trials for these products. In practice, the results did not match with the expectations and leads to an increase in utilities. This impact was not included in the agenda and forecast. In general, he indicates that he is aware of the increase in utilities and the importance of an accurate financial forecast, therefore he made some recommendations. To exploit the full potential of an accurate utilities forecast, he advised to strive for excellence in tracking, monitoring and analysing utilities. The ultimate aim is to have the same business model as Company Q. Therefore, it is necessary to focus more on automation and to measure the performances per line, which results in enlargement of the current line performance indicators (LPIs). Since this plan is long-term oriented, he advised the financial department, with the intention of performance tracking, to gain access into Strata. After all, he mentioned that for meeting the forecast, which is described in subsection *3.4.1*, not only the forecast should be corrected into a more reliable forecast, no, actions are needed which will reduce the energy consumption and give the company the opportunity to build an energy-efficient supply chain.

4.3 Summary of the findings: determining factors for the KPI labour productivity

With the objective to understand the KPI labour productivity and to further investigate the importance of forecast accuracy to supply chain performance, interview was held with the industrial finance manager. This person works one year for Company X and previously she worked for other (financial) departments of Company Y. Aforementioned, labour productivity is a crucial KPI for the firm. As stated in subsection *3.5.1*, the KPI labour productivity consist of several variables and these are related with each other. Corresponding to the data of the current situation, the interviewee made some statements. The first statement is based on mismatches between the forecast and actual values for the number of shifts and production volume. Small change in demand, unexpected maintenance and uncertain supply of raw materials caused these mismatches. In week 18, technical issues caused production problems resulting that the production line cannot operate at full capacity. Uncertain supply of raw materials caused more changeovers as wel as clean-in-places (CIPs). CIP refers to the use of a mix of chemicals, heat and water to clean machinery, vessels or pipework without dismantling the plant. The mismatches for the work hours for Strategic Partner Z and Company X can be explained by unexpected leave of the firm's personnel. This caused a smaller actual value than the forecast value. On the other side, the lack of manpower was compensated by temporary workers of Strategic Partner Z. This effect is also observable in labour costs for both type of workers; cost increase at Strategic Partner Z and a cost reduction for Company X. For gaining insights into the topics planning and forecasting, the interviewee made the following statements. She points out that she uses several data sources to create the overview, which is described in subsection *3.5.1*. Strategic Partner Z utilise Planbition, a planning software with integrated tools for smart planning. The number of Strategic Partner Z hours and the corresponding costs are retrieved via mail. The supply chain department is responsible for data related to the production volume and OEE. For presenting the data, they use Power Pivots. A Power Pivot is an Excel add-in which is useful for performing powerful data analysis and to create sophisticated data models. The files are saved in the network drive and are accessible for the financial department. Personnel costs of Company X are calculated by the fincial department, relying on documents of the HRBR department. Questions related to the quality and accuracy of the data where answered as follows: she emphasises that the retrieved data from the several departments are reliable, since production (volume) and labour are measured accurately by the responsible departments. The created overview is made weekly and will be presented to the management team, consisting of the planning & logistics department, supply chain department, quality assurance department, technology & innovation department, HRBR department, financial department and the factory director. The goal of this meeting is to continually improve the internal and external supply chain. By tracking labour productivity, the firm monitors (potential) mismatches and this encourage to take action. Looking at the frequency of interactions, she emphasises that a weekly management team meeting is hold and, if possible, necessary documents will be shared adequately via the mail or network drive. Also, it became clear that these information systems do not collaborate together plus with the financial department. Consequently, making an overview such as described in subsection *3.5.1*. becomes a time-consuming and labour-intensive activity. Only one production line for one year is analysed in this research, in real-life there are five different production lines and 52 weeks.

Examining the quality of the planning, the expert emphasises that the activities planning and forecasting are both related with each other. With the objective to create an accurate financial forecast, it is important that several departments deliver important files and share relevant information (with an eye on the future) with the financial department. Internal and external factors influence the production and cost structure of the firm, and it is important to know these factors and their corresponding impacts. She mentioned that financial forecasting identifies trends in external and internal historical data, and projects these trends in order to provide the decision-makers (in this case the management team) with information about what the financial status of the company is likely to be at some point in the future. Therefore commitment is an important factor among internal supply chain members. So, planning is related to forecasting and both are responsible for the future results. With the objective to investigate the influence of determining factors, she points out that SCV, seasonality, globalisation and fast-moving data have direct influence on the production (volume) as well as on the labour productivity, so these factors influence the accuracy of the forecast. If suppliers underperform, Company X uses quality claims to compensate the (potential) losses. In general, it can be stated that unexpected events such as changes in demand forced the manufactory to implement a responsive supply chain.

When taking a closer look to the current situation, the forecast for working hours can be explained by leave of the firm's personnel, which was in this case unexpected holiday leave and no sick leave. The solution was to make use of Strategic Partner Z personnel in order to have a balanced labour force and to continue with the production. According to the interviewee, the increase in OEE is not only beneficial for production processes, it stimulates also the operational eco-efficiency which is in ties in with the firm's core values of being good to the planet. In week 18, there was no introduction of new flavours, however NPD influence the KPI labour productivity on various levels. Increasing the product portfolio deals with test trials including new technology, which negatively influence the OEE. Apart from the fact that operation cannot operate at full capacity, more manpower is needed to eventually detect and adjust failures.

5. DISCUSSION AND IMPLICATIONS

5.1 Comparing case study findings against the literature review

As previously reported, the analysed KPIs are direct and indirect related to the supply chain. Relying on the literature review, some expectations were met, whereas others were not. All determining factors, retrieved from literature and empirical research are presented in Table 7 below.

Table 7. Summary of the determining factors, retrieved from literature review and empirical research

Factors retrieved from literature*	Biodigester	Utilities	Labour productivity
SCV		X	X
Seasonality		X	X
Globalisation		X	X
Fast-moving data			X
Data existence	X	X	X
Data relevance	X	X	X
Data reliability			X
Human factor		X	X
Technology & tools		X	X
Factors retrieved from research*			
Culture	X	X	X
NPD process	X	X	X
SDP**		X	X

*The x indicates that the factor has influence on the forecast accuracy
**SDP stands for supplier delivery performance

Forecast accuracy is mainly influenced by production related factors, like SCV (Christopher & Holweg, 2017, p. 3), globalisation (Lee, 2002, p. 105), seasonality (Gupta & Maranas, 2003, p. 1219) and fast-moving data (Petropoulos et al., 2014, p. 152). Furthermore, information related factors, especially data existence (Yan & Wang, 2000, p. 1171; Ali & Boylan, 2010, p. 5; Zhu et al., 2011, p. 284), data relevance (Ramanathan, 2012, p. 78) and data reliability (Chen & Wolfe, 2011, p. 70) have influence on the accuracy of the forecast. Additionally, factors such as the human factor (Singh, 2014, p. 5) and technology and tools (Fildes & Hastings, 1994, p. 16), play also a critical role on forecast accuracy. Considering factors that (all) KPIs share, production related factors mainly influence the forecast accuracy for utilities and labour productivity. The inaccuracy of the values, presented in Tables 3–6, can be explained by internal and external influences.

Demand volatility is related to SCM and focuses mainly on the bullwhip effect. Referring to the bullwhip effect and conducted research by Lee et al. (1997), Company X deals with the fact that amongst production related factors, change in demand influence production volume as well as SCV, which is closely linked to the KPIs utilities and labour productivity. According to Gupta & Maranas (2003, p. 1219), seasonality is a significant driver to demand volatility. Seasonal effects are periodic fluctuations that occur on a certain base or certain seasons. This research proves this. During high season, demand increase, more manpower works on the workforce, more shifts are planned, production volume increase as well as utilities. During low season, it works the other way around. Reviewing globalisation, Lee (2002, p. 105) pointed out that increasing globalisation and market competition have forced companies to expand their business networks, moving from local to more complex and vulnerable supply chain. When reviewing research, the plant is responsible for the supply of ice cream for the whole European market. Next, in order to succeed, the firm is dependent of worldwide supply of resources. Additionally, the strategy of being an innovative leader in the premium ice cream industry, dealing with a commitment towards social activism and environmental responsibility, influences the local supplier selection process and ensures to go global. Consequently, the created inefficiency influences directly the labour productivity (in terms of volume, labour hours and OEE) and indirectly the utilities (in terms of changeovers and CIPs). Finally, it was found that fast-moving data influence the forecast accuracy of labour productivity. Fast-moving data affects the ability to act acute and adequately to internal and external influences. This aligns with Petropoulos et al. (2014, p. 152), where it has been stated that forecast accuracy is negatively influenced by fast-moving data.

Reviewing information related factors, all interviewees stated that data existence, relevance and reliability are factors with high impact or importance for forecast accuracy. Considering the KPI biodigester, inefficient and lack of data sharing negatively influence the financial forecast. Thomassey (2010, pp. 481-483) already stated that gathering the latest information and sharing with the relevant parties will minimise the impact of uncertainties and increase the chances of adjusting the forecast close to a real-time manner, which can be used to reflect on the current situation. For the KPI utilities, difference in assumptions influence the accuracy. By sharing these assumptions, the forecast accuracy increases and both parties benefit from such improvement (Yan & Wang, 2012, p. 1171). For the KPI labour productivity, data sharing between relevant departments, described in section *4.3*, exist and this stimulates the profitability (Zhu et al., 2011, p. 284) and reduces the bullwhip effect (Ali & Boylan, 2010, p. 5). Considering the relevance, i.e. ‘what to share’ is the second factor contributing to forecast accuracy (Ramanathan, 2012, pp. 77-78). The type of information includes a good range of both internal (generated within business) and external (generated from environment) data, as well as direct (primary) and indirect (secondary) data. Based from interviews, the biodigester deals with internal and primary data. Labour productivity deals with internal and exteranl data, as well as with direct and indirect data. Utilities deals mainly with internal data, plus direct and indirect data. Ramathan (2012, p. 78) suggest that a combination of both internal and external data will result in a better forecast than either alone. Finally, according to literature review and results, data reliability influences mainly the KPI labour productivity. Multiple parties are involved in data quality. Chen & Wolfe (2011, p. 70) already stated that information quality is affected by the number of relays and handlings from its origin to its destination. Directly exchange between two parties ensures higher quality, while multiple handlings along several parties, the quality tends to decrease due to manipulation along the way such as formant change, data conversion and inappropriate interpretation and communication which make the information less visible or more difficult to understand.

Finally, literature indicates that forecast accuracy is influenced by the human factor (Singh, 2014, p. 5), and technology and tools (Fildes & Hastings, 1994, p. 16). This research support both factors. Singh (2014, p. 6) already pointed out that the forecaster is the leader in the forecasting process for making the right adjustment and the right decisions and that forecasting capability is depending on the forecaster's competence, such as experience, skills and even their personalities. Given the KPIs and corresponding representatives, forecasting capabilities differs with industrial finance manager being at the highest level, followed by utility engineer, and the electrical engineer being at the lowest level. The industrial finance manager sees forecasting as a high priority task, and by combining different qualitative and quantitative forecasting methods and/or approaches, she reduces the variability and uncertainty, and this will result in a more accurate and reliable forecast (Chase, 2009, p. 7). Reviewing capabilities of the utility engineer, the expert made his forecast based on historical data of previous year and includes upcoming projects and issues. This can be seen as a combination of causal/explanatory models and time series analysis (Kilger & Wagner, 2015, pp. 125-127), however, in this case the effects of issues and projects are not worked out well and caused mismatches. Studying the capabilities of the electrical engineer, it was found that no forecast was applied, since the biodigester is dependent on factors where he has no control over. Finally, research showed that technology & tools influence the forecast accuracy of all KPIs. According to Fildes & Hastings (1994, p. 16), information technology becomes an essential part of today's business, ensuring that forecasting capability is integrated in various systems and tools. Labour productivity utilise several data sources and tools, where Power Pivots being at the highest level of sophistication, and Excel being at the lowest level. Looking at utilities, the full potential of the tools is not reached, e.g. Strata with its associated advantages. The biodigester utilise no tools and systems for forecasting. Overall, Plischke (2012, p. 188) mentioned already the importance of monitoring KPIs and that KPI management should be enhanced. This is in line with Parr et al. (1999, p. 1), who stated that having a system to manage business data is a fundamental part of competitiveness.

5.2 New determining factors identified which influence the forecast accuracy

The conducted interviews give rise to the assumption that further factors, not previously identified factors, influence the forecast accuracy. According to the results and data analysis three new determining factors can be added: 1) culture; 2) NPD process; 3) supplier delivery performance (SDP). Cultural barriers such as lack of cost awareness, differences in priorities and mutual cooperation affect the forecast as well as the effectiveness of the supply chain. The factor culture affects the KPI biodigester (in terms of lack of cost awareness, difference in priorities and mutual cooperation), utilities (in terms of lack of cost awareness and mutual cooperation) and labour productivity (in terms of lack of cost awareness and mutual cooperation). Such perceptions are indicative of a culture that fails to recognize the importance of accurate forecasts. Another determining factor, which influence all KPIs, is the NPD process. The introduction of new flavours, especially Product A, Product B and Brand C are responsible for the inaccuracy of the forecasts. The new flavours ensure that the biodigester deals with ineffective input and hindered to work at full capacity. Besides, in order to avoid cross-contamination, different and extensive cleaning methods must be applied. This causes more changeovers and CIPs. Furthermore, new flavours influence the labour productivity negatively. According to Ball et al. (2011, p. 961), the NPD process influence the OEE at all the three stages: 1) OEE is zero during the pilot production; 2) OEE is low during the start-up period; 3) OEE becomes expected during the ramp-up period. Same holds for production volume, which is associated with OEE. This process is depicted in Figure 3.

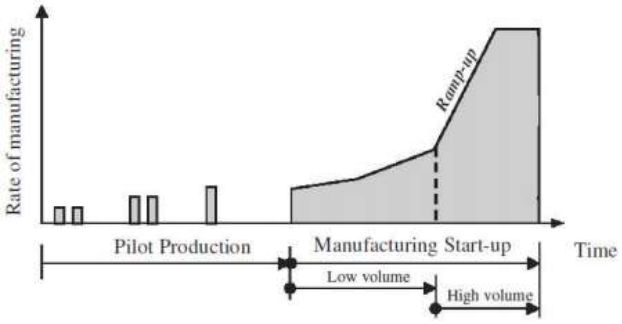

Figure 3. Start-up and ramp-up phases in NPD (Ball et al., 2011, p. 961)

Apart from the fact that the firm cannot operate at full capacity, more manpower is not needed immediately. The technology & innovation department is responsible for the implementation of new flavours, aiming to have no extra manpower. However, if things are not proceeding according to the plan, more manpower is needed to eventually detect and adjust failures. This influence also the forecast for labour productivity. The final factor, SDP, has influence on the forecast accuracy. In this case, utilities and labour productivity are the most affected KPIs. Because of uncertain supply of raw materials, the production line(s) cannot operate at full capacity. This unexpected event caused more changeovers and CIPs, and directly influence the utilities (more energy, especially water, is needed) and labour productivity (not the desired production volume, lower/higher OEE and inefficient balance of permanent and temporary employees). According to Forslund & Jonsson (2010, pp. 77-79), SDP, including on-time delivery, delivery reliability, lead time length, inventory service levels etc. is expected to be critical factor, especially in today's lean supply chains, where deficient service performance can have (negative) consequences that can propagate to the end-customer.

5.3 The direct influence of planning on forecasting and indirect influence on the decision-making process

Research from Krapp et al. (2013, p. 977), Holden et al. (1991, p. 14) and Reiner & Fichtinger (2009, pp. 55-56) emphasise already the importance of forecasting in the decision-making process, and Polat (2008, pp. 419-424) concluded that forecasting has a major role and the potential capability to use in many of its functional and strategic decision-making areas. In order to make justifiable decisions and to draw a unified focus from all supply chain participants into one single forecast, where participants work collaboratively on this single forecast with the aim to achieve the best for the whole supply chain, planning is needed (Viswanathan et al. 2007, p. 5059; Gupta & Maranas, 2003, p. 1219). Approaches such as CPFR (Vlčková, 2008, p. 337) and S&OP (Thomé et al., 2012, p. 360; Oliva & Watson, 2009, p. 140; Stahl & Wallace 2012, pp. 29-33) demonstrate the importance of integration internal and external supply chain parties in order to ensure efficient coordination among different functions for aligning strategy with the supply chain planning. This is in line with Ahumada et al. (2009, p. 1), who stated that the increasing complexity of food supply chains and their attempt to match seasonal food production to a global demand has encouraged the adoption of more systemic planning. Optimisation of the supply chain is accomplished in the form of

efficient planning decisions. Compared to the case, the company's strategy can be described as being an innovative leader in the premium ice cream industry, dealing with a commitment towards social activism and environmental responsibility. This is done by applying the WCM approach, with the purpose of using the best available work practices in order to achieve the best efficiency on the operation level, with more focus and opportunities for cross-departmental improvement. Although the strategy and approaches are well defined, (full) integration of CPFR and S&OP is missing, which leads to forecast mismatches. Without high-quality forecasts, chance to making unjustifiable decisions will be increased and this will influence the overall supply chain performance.

5.4 Application of Armstrong's framework to the case study

Research by Armstrong (2000, p. 1) shows the relation between planning and forecasting. Based on Armstrong's framework, an application of his framework is developed for this case study and outlines the findings of the analysed KPIs. The application of his framework can be seen in Figure 4.

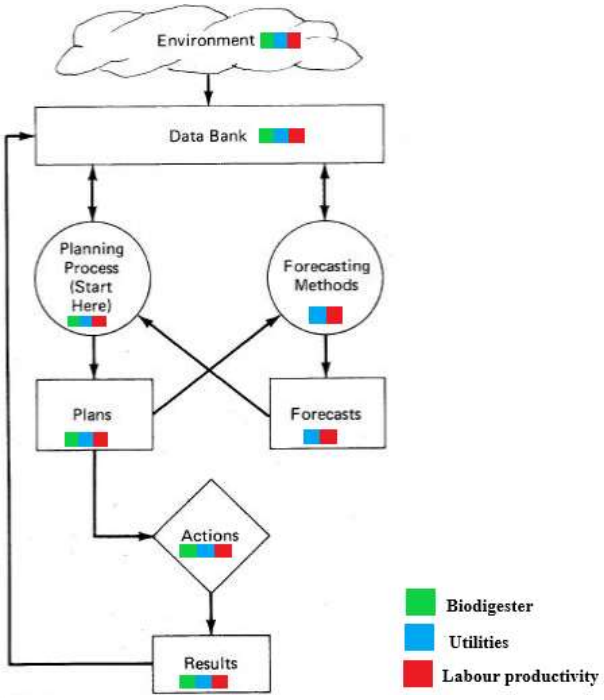

Figure 4. Application of Armstrong's framework to the case study (Armstrong, 2000, p. 3)

Besides the factors retrieved from the literature review, culture, NPD and SDP can be seen as environmental factors which influence the forecasts of all KPIs. The relation between the 'Data Bank' and 'Planning Process' is mainly influenced by the data existence, relevance and reliability. Looking at 'Forecasting Methods', this process is mainly influenced by the human factor and technology & tools, especially for utilities and labour productivity, where forecasting capabilities of the forecaster and influence the 'Forecasts'. Considering, the 'Planning Process' (see also Figure 2), it becomes clear that commitment is the missing link. In order to provide well defined 'Plans', commitment from all supply chain players is needed. The 'Planning Process set produces a set of 'Plans', which give rise to 'Actions'. These 'Actions' will lead to 'Results', both intended and unintended. These 'Results' are displayed in the current situation sections of all KPIs.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion: theoretical factors confirmed, new determining factors have been found and forecast accuracy directly influence the supply chain performance and decision-making process in SCM

"*A study to examine the importance of forecast accuracy to supply chain performance*" is the determined main scope of this BSc thesis. Through literature review and case study with Company X, qualitative and quantitative data were collected to identify causes that lead to inaccurate forecasts. Furthermore, by analysing KPIs with significant mismatches between the forecast and actual values, this report could be considered as an advisory on the process of forecast improvements, and will provide recommendations for solving these mismatches, in order to optimise the supply chain performance. In the following KPIs, there were significant mismatches between the forecast and actual values: utilities, labour productivity and usage of the biodigester. Different determining factors are confirmed or disproved, regarding the existing literature. Existing literature suggests that production related factors (SCV, globalisation, seasonality and fast-moving data), information related factors (data existence, relevance, and reliability), the human factor and technology & tools influence the accuracy of the forecasts. Next to the determining factors mentioned in literature, the case study found out that culture, NPD process and SDP should also be considered as determining factors. Table 7, introduced earlier in this report, summarised which factor influence which KPI. Based on conducted research, the influence of the determining factors depends on the KPI's complexity and position in the supply chain, internal or external. It was found out that complex KPIs, like labour productivity and utilities, are more vulnerable for internal and external influences. Additionally, it can be concluded that double positioned KPIs, active in the internal and external supply chain, are more vulnerable for internal and external influences than single positioned KPIs.

Further, literature and case study have shown that planning and forecasting are both related with each other, plus the importance of forecasting in the decision-making process. Forecasting has a major role and the potential capability to use in many of its functional and strategic decision-making areas. Evidence from literature suggest that accurate/high-quality forecasts will assist the management team in the decision-making process. For Company X, the advantages of accurate forecasts are in threefold: 1) the ability to create sustainable (competitive) advantage; 2) supporting the company's strategy, which is in line with innovative leadership, matching with the WCM philosophy; 3) staying on the financial budget. In order to make justifiable decisions and to draw a unified focus from all supply chain participants into one single forecast, where participants work collaboratively on this single forecast with the aim to achieve the best for the whole supply chain, planning is needed. When considering the results of the case study, inefficient use of CPFR and S&OP leads to non-ideal integration of internal and external supply chain parties. Consequently, this discouraged to exploit the full potential of accurate forecasts.

Concluding, it is acknowledged that being the starting point of all supply chain activities, the forecast and its degree of accuracy play a critical role in SCM. In fact, high forecast accuracy is the backbone of supply chain responsiveness, reliability and success.

It is valuable for a company to have accurate forecasts, since this encourages healthy collaboration between supply chain partners, positively influence the decision-making process, brings mutual benefits to all supply chain participants and eventually creates a win-win result for the company.

6.2 Recommendations: improving the information quality management, applying CPFR and S&OP, and considering the side effects of culture, NDP and SDP on forecast accuracy

Based on the findings, it is for the financial department highly recommendable to build a stable performance metric which will contribute to a more accurate decision-making process, and at the same time present decision makers (management team) the impact of forecasting errors. By implementing advanced and collaborative KPI dashboards, the organisation can access their success indicators in real time manner in order to make decisions toward achieving long-term goals (Clark et al., 2006, p. 19). LaPointe (2005, p. 99) confirms this and mentioned two factors driving the need for dashboards: 1) poor organisation of the many pieces of potentially decision-relevant data; 2) the managerial biases in information processing and decision-making. These two causes are relevant and applicable for the case study. Next, this case study explored that culture, NDP and SDP can be seen as determining factors It would be advisable to analyse the current organisational culture. In addition to that, it is recommended to fully implement CPFR and S&OP into the organisation and to put forecasting high on the agenda of all relevant departments. Considering the information related factors, it is advisable to build transparency into the many pieces of (un)used data and tools (Thomassey, 2010, pp. 481-483). Given all information related factors, it would be advisable to revise and optimise the current information quality management, especially in the field of technology and tools.

It is also heavily recommended to review the supply chain, since NDP and SDP influence all three KPIs. Based on this study, the complexity of supply chain and the organisational structure makes the firm more vulnerable for internal and external influences. Research suggest that coordinated responsive supply chain reduces internal and external influences (Wong & Hvolby, 2007, pp. 407-408). Research by Ambe (2010, p. 5) suggest that in order to survive, companies need to respond increasingly to unexpected shocks and discontinuities, where more focus for achieving greater agility is needed. This means shifting from SCM to agile supply chain management (ASCM). Furthermore, since NDP and SDP are determining factors it is advisable to go into the detail of these factors. Research by Schiele (2010, p. 138) suggest the importance of earlier supplier integration into the NPD process, effecting the NPD contribution positively, while also managing the overall costs.

7. IMPLICATIONS, LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

7.1 Implications: proving practical evidence on determining factors while contributing to literature with new drivers

This study has sought to contribute to the knowledge on the importance of forecast accuracy to supply chain performance. Even through SCM is a hotly debated and familiar researched topic, there is a considerable amount of research available on volatility and determining factors on forecast accuracy, but there has been little actual research into the causes and effects of forecast (in)accuracy, especially in the FMCG sector. From a theoretical perspective, this study has therefore positively contributed to theory development by combining insights from forecasting and planning. This research not only highlights the importance of forecast accuracy, but also the determining factors which play a critical role in this process. Besides, based on Armstrong's (2000, p. 3) framework, application for this case is made with the purpose of understanding the relation between planning and forecasting. From a practical perspective, the results of the study can be useful for organisation(s) (especially in the FMCG sector) to extend their perspective on the importance of forecast accuracy. The greatest value of this study lies in the empirical findings and provided recommendations for Company X, in which they can optimise their forecast accuracy and SCM.

7.2 Limitations: due small sample of KPIs and firms' complexity, findings cannot be generalised

This study, however, is subject to a few major limitations to what this study has suggested so far; these limitations give rise to suggestion for future research. It has been restricted in its time and scope, leading to an analysis on only three KPIs. It would be interesting to study other KPIs, where significant mismatches between the forecast and actual values occur, with the same depth in order to fully understand the impact of forecast accuracy on supply chain performance. The same time and scope restrictions have also limited the range of the analysed KPIs. For the KPI labour productivity, only the performance of line two in week 18 is analysed. This means that my study is just a snap-shot of the current situation. Another production line and/or time period will give a different result. Further, given that primary data for the KPIs came from interviews with the responsible representatives, the data may have been slightly biased. Besides, Company X is a wholly owned subsidiary of Company Y. This study is based on the complexity of the investigated company and it can be not verified if the same findings and conclusions apply to small and medium sized businesses. Additionally, this study did not take the supply chain impacts and opportunities caused by the Brexit into account.

7.3 Further research: extension of the case study with novel KPIs and gain insights into the effects of culture, NPD and SDP on forecasting

As mentioned in the whole report, forecast accuracy has been considered one of the sensitive topics of SCM, especially in the eyes of practitioners. From a theoretical perspective, in order to fully understand the relation between forecasting and planning, further research is suggested. Additionally, this report concludes that determining factors, *described in chapter 5*, are the key factors in forecast accuracy. More extensive research is needed to support this. Same holds for new determining factors (organisational culture, NPD process and SDP), which are retrieved from empirical research. In order to validate the findings of this thesis, it is recommended to replicate the analysis with other KPIs, where significant mismatches between the forecast and actual values occur. The specialised interview scheme, which can be found in Appendix A, can be used.

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9. GLOSSARY

3PL: Third-Party Logistics
ARIMA: Autoregressive Integrated Moving Average
ASCM: Agile Supply Chain Management
CIP: Clean in Place
COD: Chemical Oxygen Demand
CPFR: Collaborative Planning, Forecasting and Replenishment
FMCG: Fast-Moving Consumer Goods
HRBP: Human Resource Business Partners
KPI: Key Performance Indicator
LPI: Line Performance Indicator
MARINA: Multivariate Autoregressive Integration Moving Average
NPD: New Product Development
OEE: Overall Equipment Effectiveness
P&G: Procter and Gamble
S&OP: Sales and Operations Planning
SCM: Supply Chain Management
SCV: Supply Chain Volatility
SDP: Supplier Delivery Performance
SKU: Stock Keeping Unit
SMA: Simple Moving Average
TPM: Total Productive Maintenance
WCM: World Class Manufacturing

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11. APPENDIX

Appendix A - Interview scheme with the industrial finance manager, utility engineer and electrical engineer

INTRODUCTION

Research aim: analyse forecast accuracy and determine its major causes. In the end, this report will be an advisory on the process of forecast improvements and will provide recommendations for solving mismatches, in order to optimise the production process of the company.

Interview objectives: the focus is to understand the way of interactions, the frequency of interactions, the accuracy/quality of the exchanged information, collaboration on planning and forecasting between you and the financial department.

Remarks: express the thankfulness for the participation, address any confidentiality issue, refer to the approved ethical review of the University of Twente, and address that it is our common interest to find a common solution(s) for the current problem(s).

BACKGROUND INFORMATION

- What is your job title and what are your responsibilities?
- How many years of experience do you have in your job? And at Company X?
- What is your educational background?
- Can you explain your KPI in detail?

DATA & INFORMATION SYSTEMS

- Which information systems (hardware, software, database etc.) are you currently using? And if known, which systems for the future?
- Where and how do you store the data?
- What are the (company) reports that you consult most while performing your own activity? Or how do you collect the data to perform your activity?
- Do you perceive the reports helpful or how would you eventually improve them? In case you notice unfamiliar figures/values in the reports, what do you usually do?
- How satisfied are you with your current information systems as the main information sharing method? Any plan of changing or improving?

INFORMATION QUALITY & ACCURACY

- Generally, which information do you use most while doing your task (e.g. report, discuss in person/email)? Do you create your own report/database to store important data for your job activities?
- What are the key factors which influence the existence, relevance and reliability of your KPI? (e.g. machine deviations, lack of trace ability etc.)
- Is there any chance of mistakes in the created/retrieved data?

FREQUENCY OF INTERACTION & DATA SHARING

- How does your information systems collaborate with the information systems of the financial department?
- On which basis (e.g. weekly, monthly, randomly) do you usually interact with the financial department?
- Based on your own experience at the company, have you ever been any special situations that change the frequency of interaction? And if so, how did you perceive the change?
- What specifications/information do you exchange during a usual "alignment" meeting with the financial department?
- Where do you usually set up the meeting(s) with the financial department? (e.g. physical place, via phone, emails, Skype calls)
- Generally, how long does it take the process of communication with the financial department? (meant as from the first attempt of contact till getting (if get) a reply)
- In your opinion, is it useful for your work output(s) to interact and collaborate with the financial department?

PLANNING QUALITY

- For your KPI, to what extent are forecasting and planning related with each other?
- What are the benefits of CPFR brought to the improvement of forecast accuracy? (explain CPFR if necessary)
- What are the benefits of S&OP brought to the improvement of forecast accuracy? (explain S&OP if necessary)
- Based on your own experience, would you perceive an enhancement in the collaboration with financial department as beneficial for your work? If so, what would you like to improve or eventually change? (e.g. create a page for direct interaction, a dedicated report, platform etc.)

DETERMINING FACTORS

- To what extent has SCV, globalisation, seasonality and fast-moving data influence on the forecast accuracy?
- If we talk about data collection and sharing, are you behaving in a proactive or in a reactive attitude?
- For making the right adjustments and decisions, do you think you have the capabilities and competences to perform a reliable forecast? (skills, experiences, personalities)
- Based on your opinion, what are the main internal or external influencing factors (economic outlook, market etc.) that may influence the forecasting activities? (only your own KPI)

CURRENT STATUS & MISMATCH KPI

- The financial department forecast your KPI on the value of *xxx* (refer to values of section 3). To what extent is the forecast achievable? And why is it (not) achievable?
- Are you aware of the negative effects of your KPI mismatch? And how are you aware of this mismatch?
- Do you realise that your KPI influence the overall supply chain performance? (investments, cash, budget, CSR etc.)
- Is your performance in line with the company's strategy? (explain that the brand is an innovative leader in the premium ice cream industry and is committed to providing all natural, high quality ice cream with respect to environmental and social responsibility

CONCLUSION

- Do you have any question/ clarifications/ additional information to add?