

Kaunas University of Technology

School of Economics and Business

Increasing Supply Chain Efficiency Through Improving Sales Planning and Inventory Management: The Case of Specialized Retail Companies Group

Master's Final Degree Project

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Summary

Research topic is relevant because of several reasons: new technologies and production advancements initiate development in supply chains, global trade increases the competitiveness among supply chains, businesses start to prioritize cost-effective operations and growing customers demand for quality and speed from the supply chains. As perfect supply chain does not exist, companies keep inventories to efficiently deal with customers demand and be in position to gain maximum amount of profit. Unfortunately, managing huge inventories and placing accurate orders, become a problem for many supply chains.

This research is focused on supply chain efficiency and ways to increase it, through demand planning and inventory management. Firstly, key problematic aspects in the "Coffee Friend" groups supply chain will be identified. Secondly, purchase forecasting and inventory management models will be found and compared. Thirdly, with theoretical information, a model of increased efficiency will be proposed. Fourthly, expert interview and secondary data analysis will be done to understand the practices and experiences of "Coffee Friend" groups supply chain. In the end, several improvements will be suggested to increase the efficiency of the supply chain.

To complete the research, literature on supply chain will be studied, total of 67 different sources on supply chain topic. What is more, qualitative data analysis and secondary data analysis will be done to understand the specifics of "Coffee Friend" group.

The research results suggest that primary reasons of inefficiency are poor demand planning, lack of systematic approach on purchasing process, lack of methods for inventory management and campaign and seasoning effect.

Supply chain efficiency improvements were suggested and potential results evaluated through defined parameters. To solve the existing problems, an inventory management system installation was suggested. According to the system manufacturers, several improvements should be reached: improved forecasting accuracy to 99,9%, reduced lost sales to 2 million, reduced lead time to customers to 1,45 days and increased turnover ratio to 7,5.

Whole project length consists of 68 pages and it includes 22 figures and 24 tables. Project includes introduction, 5 main chapters, conclusions and literature references.

Maziliauskis Gediminas. Tiekimo grandinės efektyvumo didinimas tobulinant pardavimų planavimą ir atsargų valdymą: specializuotos mažmeninės prekybos įmonių grupės atvejis. Magistro baigiamasis projektas/ vadovas doc. dr. Egidijus Rybakovas; Kauno technologijos universitetas, Ekonomikos ir verslo fakultetas.

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Santrauka

Tyrimo temos aktualumas svarbus dėl kelių priežasčių: naujų technologijų ir gamybos pažangos, kuri inicijuoja tiekimo grandinių tobulinimus, tiekimo grandinių konkurencingumo augimas tarptautinėje prekyboje, atsirandantis verslų požiūris į taupesnę veiklą ir augantis klientų poreikis kokybiškai bei greitai tiekimo grandinei. Kadangi ideali tiekimo grandinė neegzistuoja, įmonės renkasi kaupti atsargas, taip pastatydamos save į poziciją efektyviam klientų poreikių patenkinimui ir pelno maksimizavimui. Deja, didelių atsargų valdymas ir tikslių užsakymų teikimas tampa problema daugumai tiekimo grandinių.

Šis tyrimas orientuotas į tiekimo grandinės efektyvumą ir jo didinimo būdus, per pardavimų planavimą ir atsargų valdymą. Visų pirma, pradedama nuo pagrindinių „Coffee Friend“ įmonių grupės problemų identifikavimo. Antra, bus ieškomi ir lyginami pirkimų prognozavimo ir atsargų valdymo modeliai. Trečia, bus pasiūlytas tiekimo grandinės efektyvumo didinimo modelis, paremtas teorine medžiaga. Ketvirta, kad suprasti „Coffee Friend“ įmonių grupės esamą tiekimo grandinės praktiką ir patirtį, bus atliktas eksperto interviu ir antrinių duomenų analizė. Pabaigoje, bus pasiūlyti sprendimai tiekimo grandinės efektyvumo tobulinimui.

Tyrimo įgyvendinimui bus studijuojama tiekimo grandinės tematikos literatūra, viso 67 skirtingi šaltiniai. Taip pat, kad geriau suprasti „Coffee Friend“ įmonių grupės tiekimo grandinės specifiką, bus taikomas kokybinis tyrimas bei antrinių duomenų analizė

Atlikto tyrimo rezultatai rodo, kad pagrindinės neefektyvumo priežastys yra prastas poreikio planavimas, sisteminio požiūrio į pirkimų procesą trūkumas, atsargų valdymo metodų trūkumas bei akcijinių kampanijų ir sezoniškumo efektas.

Pasiūlyti tiekimo grandinės efektyvumo tobulinimai ir įvertinti galimi rezultatai, pagal aprašytus parametrus. Esamų problemų sprendimui buvo pasiūlyta atsargų valdymo sistema. Pagal sistemos gamintojo nurodymus, pagrindinės tobulinimo vietos: pasiektinas 99,9% prognozavimo tikslumas, sumažinti prarasti pardavimiau pusiau – iki 2 milijonų eurų, sumažėjęs užsakymų įvykdymo laikas klientams iki 1,45 dienos bei padidėjęs sandėlio apyvartumas iki 7,5.

Visą projekto apimtį sudaro 68 puslapiai, randama 22 paveikslai ir 24 lentelės. Projektą sudaro įvadas, 5 pagrindiniai skyriai, išvados ir literatūros sąrašas.

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Introduction

In a perfect supply chain, a warehouse would not exist but there is no such thing as a perfect supply chain so inventory and its management plays a major role. Companies try to keep just enough stock to ensure the sales and on the other hand, to avoid the overstock. This constant search for a balance between the two brings out many questions and never the exact answer.

Inventory overstock is a huge problem, especially for a smaller enterprise that depends on daily cash flow. “Frozen” goods may indicate that such products are far from being in demand and could be stuck for a long time. Also, the case could be too high pricing, naturally too high purchase price as well. What is more, competitors might be stronger, so market knowledge is lacking too. Sometimes management remains only one who believes in a new product and that becomes a waste of money. All of this comes down to poor purchase forecasting.

Inventory shortage is another problem when the demand is high, but company runs out of products. This run-out may be quicker than planned. Also, it could mean the stored amount was far away from realistic situation in the market. Another case might be that logistics schedule was planned poorly and planned delivery should have been earlier, according to sales history. All of this comes down to poor purchase forecasting.

Research object: Supply chain efficiency.

Aim of research: To propose an improved supply chain management solution for the “Coffee Friend” group, based on effective forecasting and inventory management methods.

Main objectives:

- 1) To identify key problematic aspects in the “Coffee Friend” group that have profound effects on the supply chain.
- 2) To review and compare purchase forecasting and inventory management models and identify criteria for supply chain efficiency.
- 3) To propose the model of increased supply chain efficiency, based on efficient purchase forecasting and inventory management parameters.
- 4) To evaluate current purchase forecasting and inventory management practices and experience in “Coffee Friend” group.
- 5) Suggest improvements for a better supply chain management.in the “Coffee Friend” group.

Research methods:

- 1) Qualitative data analysis. Research was done using semi-structured expert interview with 24 planned questions. Such questions were formulated according to the insights from theoretical part.
- 2) Secondary data analysis. Research was done using commercial information from the “Coffee Friend” company group.

Results. From the theoretical analysis on supply chain efficiency and implemented qualitative data analysis and secondary data analysis, results indicate the need for a systematic improvement on purchase forecasting and inventory management processes.

1. Problematic aspects of supply chain management in “Coffee Friend” group

Supply chain is a mix of processes and agreements that create network from manufacturing to end-users. Activities, information and resources are applied to deliver the products or services through all stages of the chain.

In order to achieve great results, supply chain strategy must be planned and executed correctly. One of the key components for success is accurate purchase planning, which helps to control and prepare for what is coming ((Fildes, Goodwin, Lawrence, Nikolopoulos, 2009).

Talking about stock keeping, it plays a vital role in supply chain by creating inventory buffer between purchases and sales. Warehouses are applying different solutions to regulate the product flow and run operations effectively. Effective management of inventory could benefit the supply chain by eliminating cash flow troubles, lowering overstock or minimizing shortages (Palšaitis, Čižiūnienė, Vaičiūtė, 2017).

In order to better understand the components of efficient supply chain and the influence purchase forecasting and inventory management have, further research must be done on several questions:

- How the growth of the company impacts the supply chain.
- What are the main methods for effective purchase forecasting?
- What are the tools and practices for effective inventory management?
- What are the main parameters for measuring supply chain efficiency?
- How purchase forecasting and inventory management could increase the efficiency of supply chain.
- How seasoning and promotions affect the supply chain?

In this analysis, “Coffee Friend” group supply chain will be researched in a detailed way. To start with, it is an e-commerce and retail company group that works with an omni-channel approach. Company group uses franchising model to operate in multiple countries, such as:

- Lithuania – 5 physical stores, e-shop, HQ, central warehouse.
- Latvia – 3 physical stores and e-shop.
- Estonia – 3 physical stores and e-shop.
- Finland – 1 physical store e-shop, 3PL warehouse.
- Poland – 3 physical stores, e-shop, 3PL warehouse.
- Sweden, Germany, Austria, United Kingdom – e-shops.

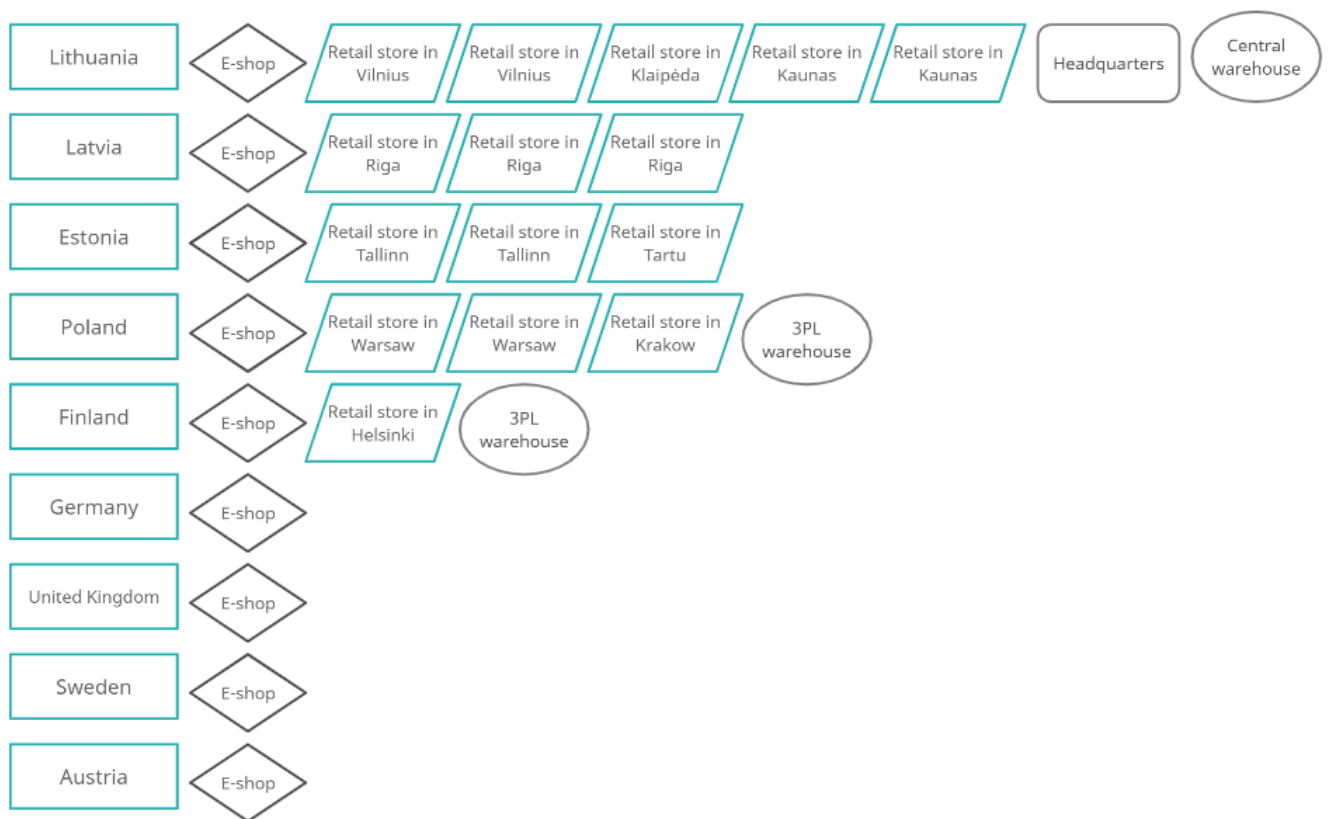


Fig. 1. “Coffee Friend“ group market spread

“The Coffee Friend“ group specializes in coffee, coffee machines and other related stuff such as chocolate, tea and coffee machines maintenance. The majority of the products are imported from different countries, mostly inside the Europe. There are total of 346 active suppliers from all three main categories.

Table 1. Product categories and suppliers

Appliances & Maintenance		
Ascaso	Bosch	Lelit
Stollar	Bialetti	Handpresso
Bravilor	De'Longhi	Jura
Siemens	Saeco	Nivona
Melitta	Nespresso	Philips
Krups	Miele	Wilfa
Electrolux	-	-
Groceries		
Café Liegeois	Mokito	Galler
Nestle	Bravissimo	Harney&Sons
Sweetbird	Chalo	Jacobs

Bontadi	David Rio	Mo-me
Nordic berry	Stick Tea	SUN365
Satro	Vero coffee	-
Accessories		
Asobu	Chemex	Hario
Loveramics	Fellow	-

The list of partners include some of the biggest brands in the world, such as Philips, Siemens, Miele, Electrolux, De'Longhi, Bosch, Nestle, Jacobs and others. The purchase of products is being done either directly from the manufacturer (Lelit, Wilfa) or from the local distributor (Krupps, Nivona, Melitta, Nestle, etc.). The supply chain is complex in a way that company group works with several distributors of the same brand, just in different countries (Jura, Miele, De'Longhi).

Table 2. Main import countries

Appliances & Maintenance	
Lithuania	Netherlands
Poland	France
Germany	Italy
Romania	Norway
Finland	-
Groceries	
Lithuania	Netherlands
Belgium	Romania
Italy	Czech rep.
Czech rep.	Poland
Spain	-
Accessories	
Netherlands	Poland
Germany	China
USA	-

The supply chain is not that simple as it seems, as some purchases are being made for company group, others – for a specific market, only Poland as an example. Therefore, majority of goods are still brought to Central warehouse in Kaunas.

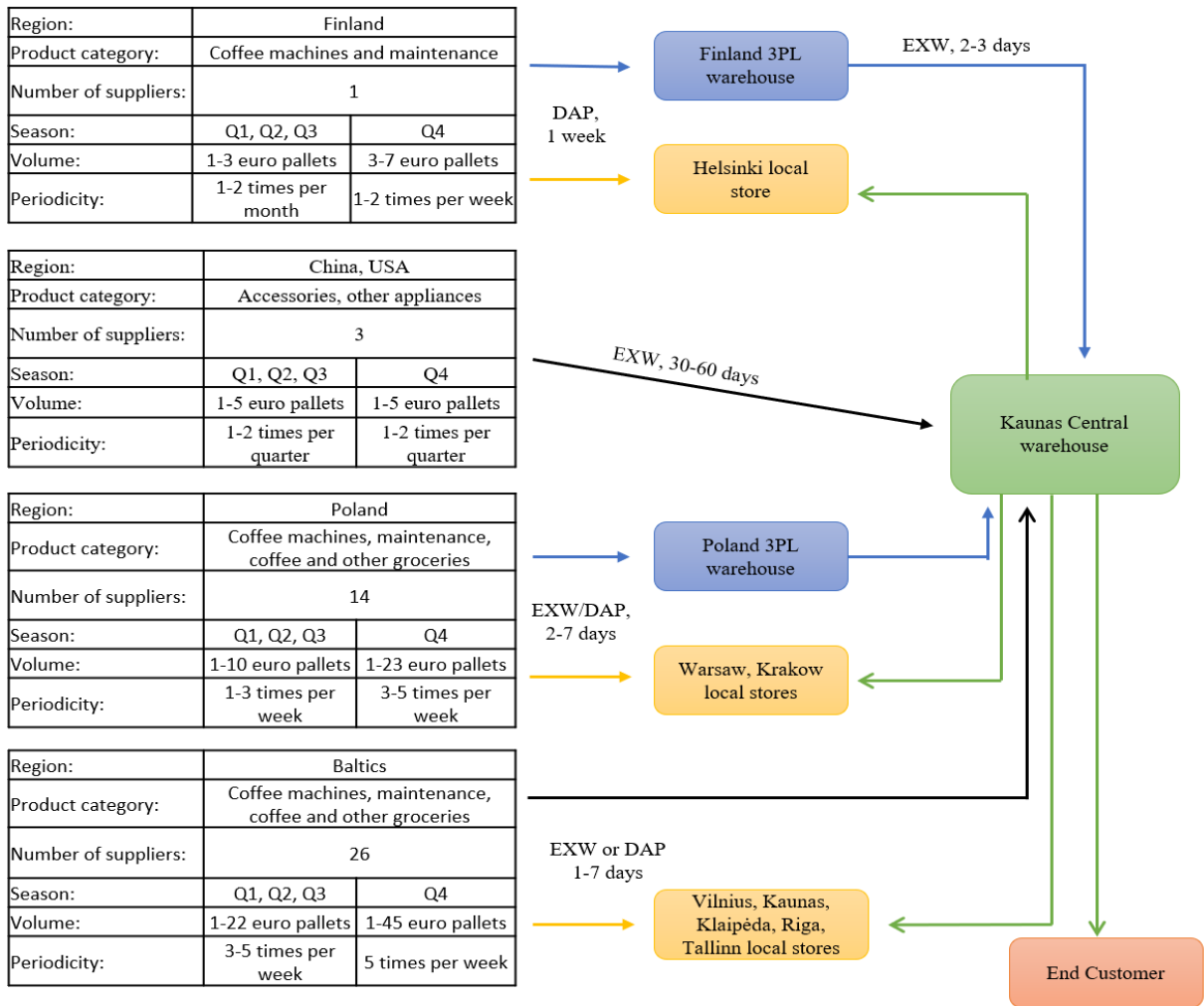


Fig. 2. “Coffee Friend“ group generalized supply chain 1/2

The supply of goods starts at a purchase order phase. Orders are delivered to several unloading places:

- Finland terminal – 3PL contract with logistics supplier who receives the shipment in Finland and delivers the goods to Central warehouse. The incoterm conditions are DAP Finland which makes the logistics more complex in terms of lead time.
- Central warehouse – the main 800 square meters warehouse located in Kaunas, Lithuania. Arrivals are either planned by organizations logistics department (EXW) or delivered by partners under the DAP conditions.
- Poland warehouse – 3PL contract warehouse whose main purpose is to receive incomings from Polish suppliers under DAP Poland agreements. This warehouse also works as stock keeping and order dispatchment unit for Poland, Germany and United Kingdom markets. Therefore, majority of the goods are still transferred to Central warehouse in Kaunas.

Local store warehouse – every small warehouse inside the store for a limited stock keeping purposes. Some products could be delivered in small quantities directly to sales point so in this way the Central warehouse procedures are skipped.

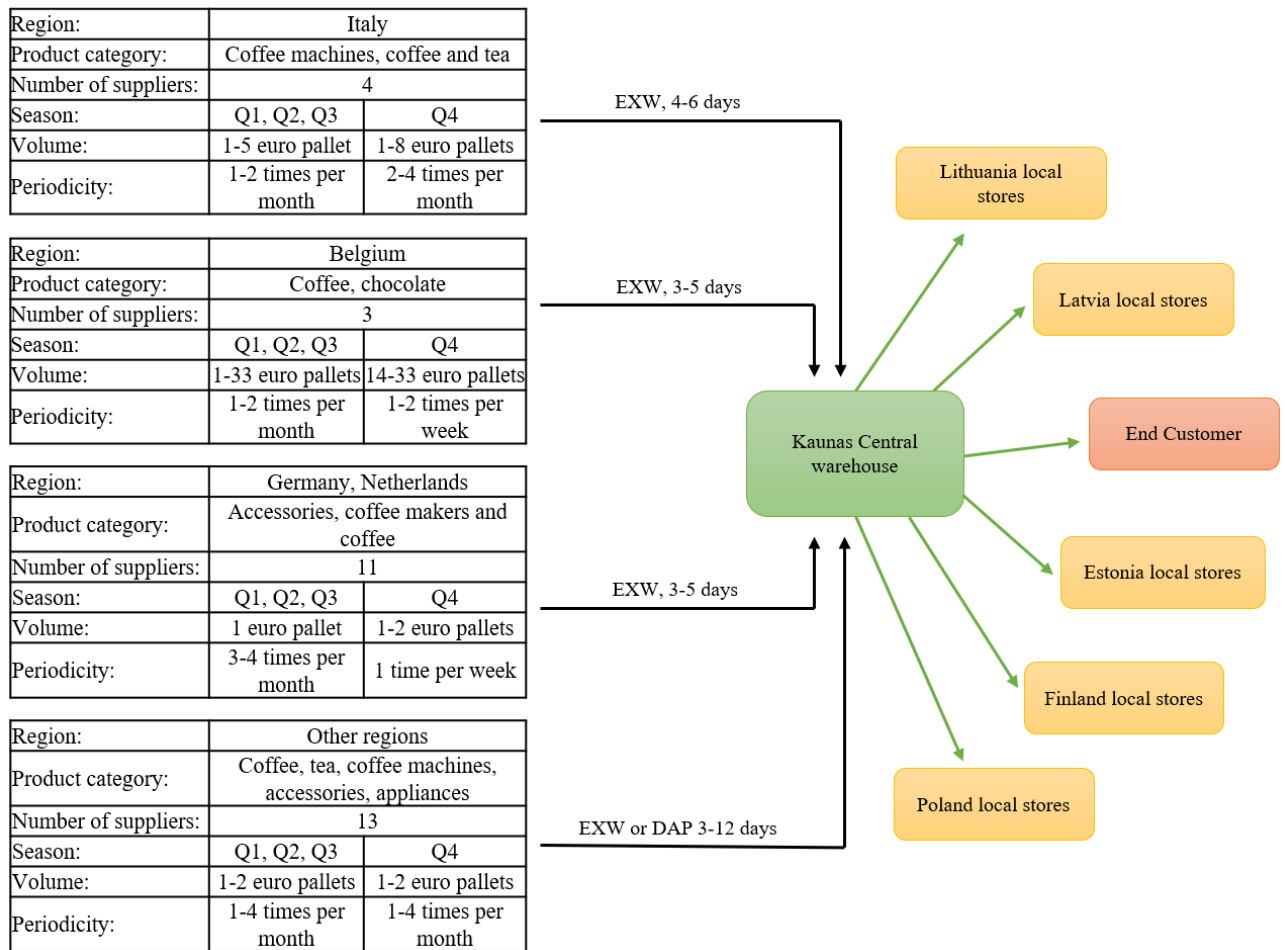


Fig. 3. “Coffee Friend“ group generalized supply chain 2/2

From the two supply chain tables, it could be seen that from total of 75 suppliers, Baltics, Poland and Belgium are the three main regions when it comes to supply. Baltics is the most dominant in terms of coffee machines because the biggest producers have their branches located within the area. Belgium is the biggest coffee manufacturer for the “Coffee Friend“ group so the volume comes up naturally. The next important aspect is seasoning. The import from some of the regions even doubles, either in volume or periodicity. The most usual incoterms are exworks (EXW) or Delivered At Place (DAP). It could be said that delivery time from the pickup to unloading takes from one day to two weeks.

It could be said that company group is emerging as a complex supply chain and needs smooth processes to successfully deal with current activities. With more and more supply channels and sales opportunities, company group has been facing some great numbers in growth over the past two years, after a disappointed 2018.

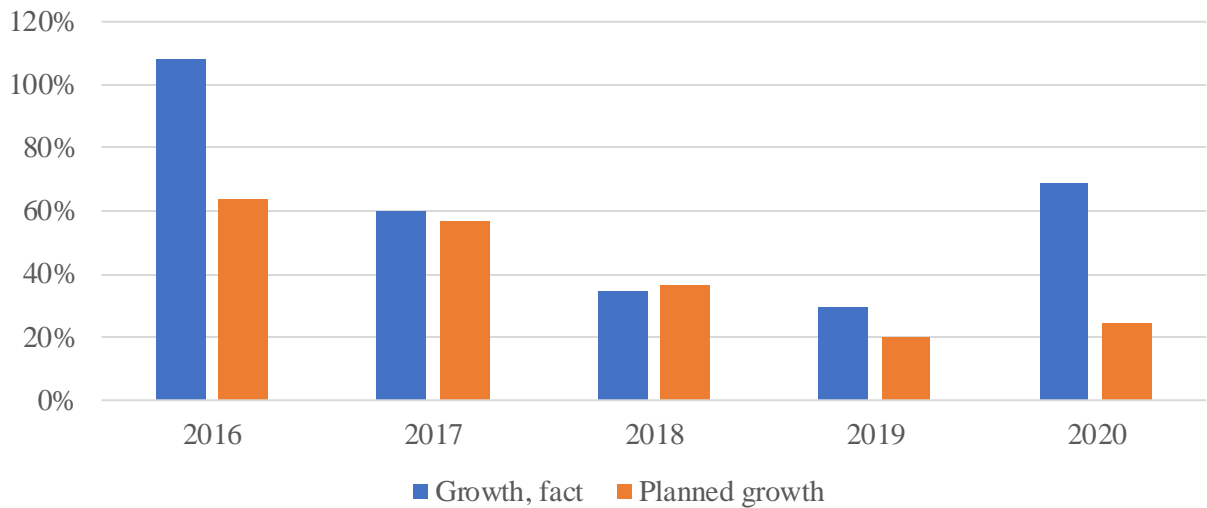


Fig. 4. “Coffee Friend“ group factual versus planned growth over the last 5 years

The actual sales over last two years really exceeded all the expectations. Usually bigger than expected sales seems like an aspiration for the profit seeking organizations, many challenges come right with it. Such statistics indicate the major problems in sales prognosis which leads to process change and lack of preparation in supply chain.

Talking about purchases, organization is facing a substantial difference between the forecasted amounts and factual purchased amounts. Such situation usually leads to insufficient stock, not satisfied customers, failed promotions, lost sales and profit.

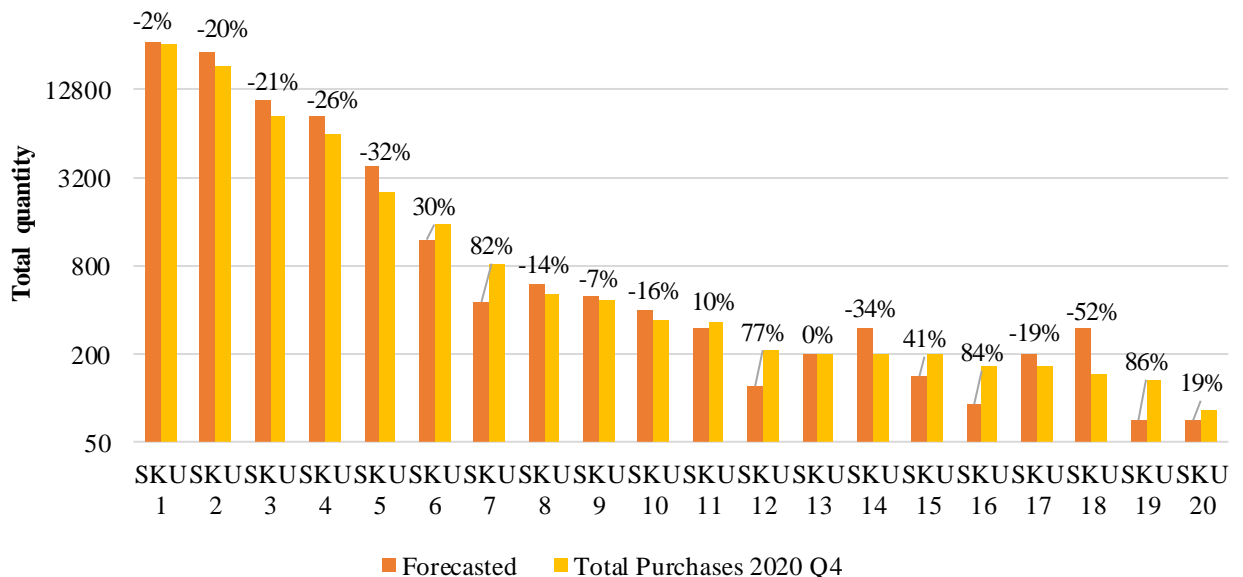


Fig. 5. Difference between 2020 Q4 forecast and actual purchases for top 20 SKU's

The 2020 Q4 forecast compared to actual purchases results indicate that the difference from planned purchases and actual purchases is really huge, varies even up to 82%. Such inaccuracies create overstock or lack of stock problem which results in profit loss.

Having inaccurate purchases, any supply chain could be challenged to reach efficiency and perform well. One of the key aspects how to rate the current situation would be a check of overstock percentage from total stock.

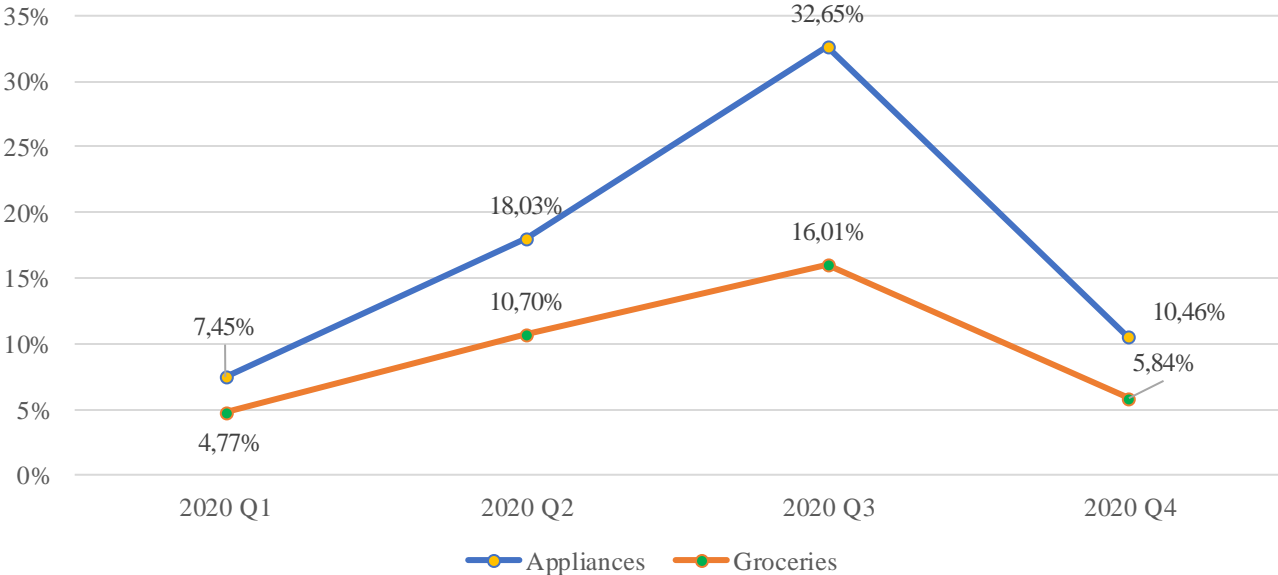


Fig. 6. Overstock percentage for appliances and groceries in 2020, by quarter

From the graph, it could be seen that company group is facing huge overstock levels, which vary even up to 32,65% in Q3 of 2020. Such data suggests the existing problem in wrongly forecasted quantities, which settles in central warehouse for a long time and decreases the inventory turnover ratio.

Keeping in mind the effect that inaccuracies in planning have on stock levels, it is important to evaluate the stock-outs, which could be one of the main reasons for decreased market share and lost sales.

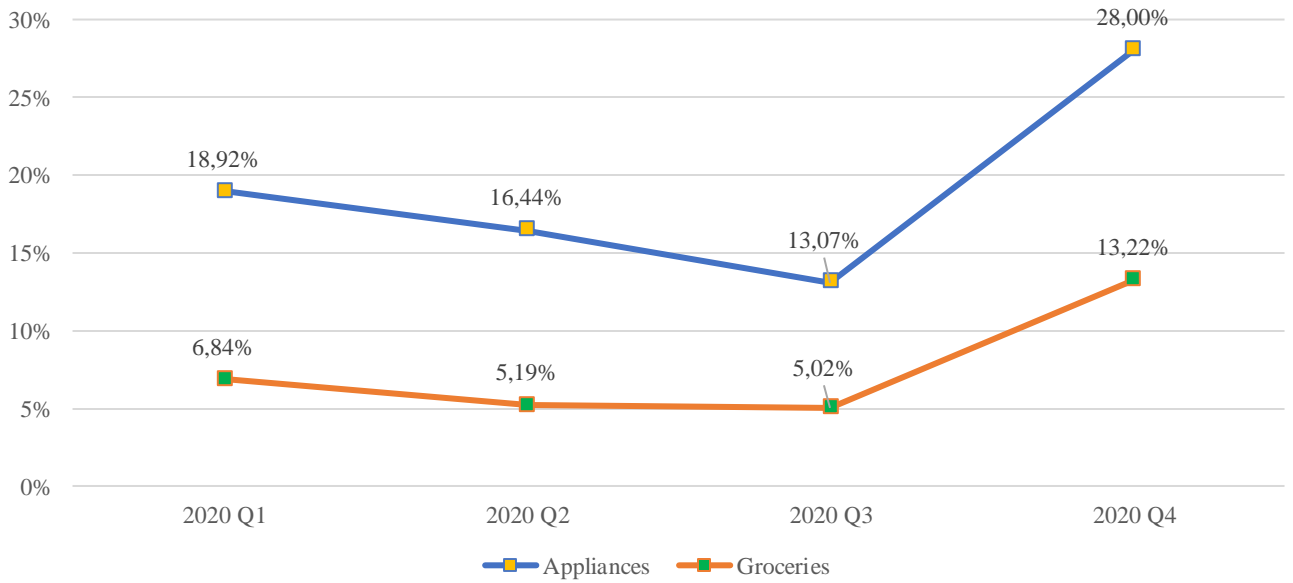


Fig. 7. Shortage percentage for appliances and groceries in 2020, by quarter

The graph shows that throughout the 2020, company has faced some major problems with stock-outs, especially in Q4, where shortages reached 28%. It could be viewed as a huge hit to sales and profit, as demand had not been satisfied during the most important period of the year.

Quickly changing stock levels should not be impacted only because of poor forecasting accuracy and inability to deliver the goods when needed. Companies tend to be influenced by seasoning if their products are consumed during some period specifically. As “Coffee Friend” group specializes in coffee and coffee machines, the assumption on winter season sales importance could be correct.

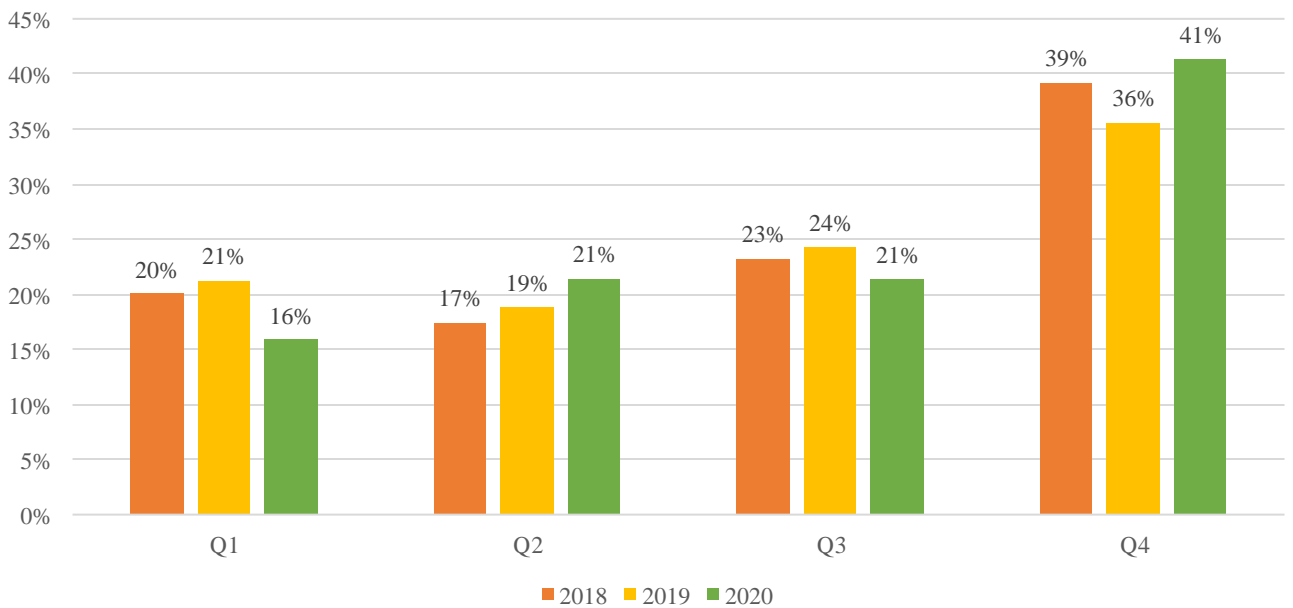


Fig. 8. “Coffee Friend” yearly sales share divided by quarters during past three years

Yearly sales share divided by quarters graph suggests the how important and full of challenges fourth quarter is to the company group. It could be said that company group is heavily touched by seasoning trends, as winter and summer seasons sales are different, covering around 20% and 40% from total sales respectively. It also could indicate how big of campaigns company runs on Christmas or Black Friday promotional seasons, but further research to confirm this idea must be made.

Apart from that, the warehouse is another part of supply chain that hurts from inaccuracies in supply chain management. Warehouse space usage could show how flexible the warehouse operations could be and how different seasons may impact the supply chain.

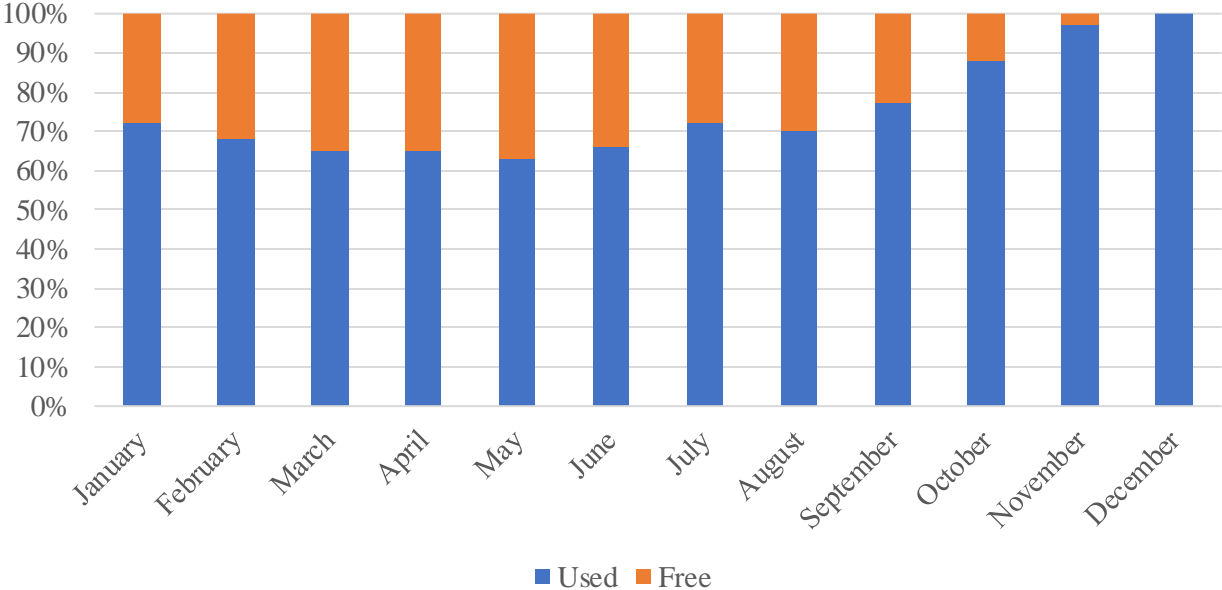


Fig. 9. Warehouse space usage throughout the year, 2020

The warehouse space usage throughout the year graph confirms that company group is affected by seasoning and heavy loads that come with it. In the last two months of the year, warehouse was full of stock which could cause warehouse process related issues. While from January to August, central warehouse keeps the stock levels around 70% or less from total capacity. As the sales season start to accelerate, company group uses more space to stock essential goods.

For this situation, the most problematic aspects seem to be the growth evaluation accuracy, which sets the tone for the upcoming year. It really affects the purchase forecasting and agreements with suppliers because at the end of the day, when quantities are agreed it may be hard or impossible to receive additional goods, especially during last months of the year. Wrongly shaped purchase forecasts have a huge effect on inventory as overstock brings additional costs, while on the other hand, the shortages may result in lost customers, decreased market share, lost sales and profit. What is more, analysis on quarterly sales share during the year suggested how important last quarter of the year is to the company group and how strongly it is affected by seasoning. On top of that, it seems like warehouse operations may be disturbed because of lack of space during last quarter of the year, as the stock keeping space usage reaches full potential.

With that said, the main problematic aspects could be characterized as:

- Inaccurate growth prediction (or wrongly planned sales).
- Inaccurate purchase forecasting.
- Overstock and shortages.
- Dealing with campaigns and seasoning.

Such problems cause inefficiency in “Coffee Friend” group supply chain. Further analysis must be done to understand the potential solutions for such problems. Firstly, it is needed to analyze the parameters of efficiency, so the performance of supply chain is evaluated and potential solutions could be applied and calculated. Secondly, it is needed to analyze methods of forecasting, so the better accuracy in planning is reached. Thirdly, inventory management tools or methods must be collected and analyzed, in order to suggest an improved way to deal with stock.

2. Main factors and measures of supply chain efficiency

Efficient supply chain is fundamentally based on planning and executing the plan correctly and accurately, while being flexible at the same time. The performance is determined by several aspects that are related to planning and management, such as: commercial negotiations and contracts with suppliers, logistics scheme, assortment management, information flow, inventory management and sales planning (Fildes, Goodwin, Lawrence, Nikolopoulos, 2009).

Problem analysis suggested the critical moment of inventory management and purchase forecasting, which is part of sales planning. As sales planning additionally includes parts of customer analysis, market analysis and contracts with suppliers, plus the planning itself, the whole research becomes too wide to deal with the scope of the paper, so the work is focused on purchase forecasting and inventory management aspects.

2.1. Measuring performance of the supply chain

Supply chain is a system that connects several pieces that are related and dependent on each another: suppliers, manufacturers, distribution channels and customers. Each of them has different and at the same time, necessary effect on the whole system (Lopez, Ydstie, Grossmann, 2003). Because of the technological development, global outsourcing, cost cutting approach, quickly changing customer demand, a supply chain system must be dynamic and flexible in a sense of responding and adapting (Srinivasan, Hamdani, Ma, 2021).

The new age business management is no more one entity versus another entity competition. It has shifted to include brands, suppliers, stores, internet and formed an internet network competition, which could be called a supply chain versus a supply chain environment (Lambert, Cooper, 2000). Organizations are creating partnership relations with suppliers and other companies alongside, to deal with competition effectively (Nyaga, Whipple, Lynch, 2010).

Planning in collaboration with supplier is heavily related to the better outcomes of inventory turnover, on-time delivery, decreased product pricing and more efficient and less costly supply chain in general (Petersen, Ragatz, Monczka, 2005).

The efficiency of supply chain heavily depends on managerial decisions, which in most cases are based on instincts and experience. As the supply chain develops and becomes more complex, such decisions happen to be far from optimal. As the result, supply chains start feeling "the bullwhip effect". The main causes for such phenomenon are inaccurate forecasting, order batching, pricing instability and shortages (Sarimveis, Patrinos, Tarantilis, Kiranoudis, 2008).

In the supply chain, two main elements define its efficiency: operational effectiveness and overall effectiveness. Operational effectiveness is linked to well managed resources, so all stakeholders of the supply chain are rewarded. It includes decreased costs, faster lead time and rational processes. What is more, overall effectiveness is defined as a mix of company goals that are measured by customer service level, assortment pricing, market share, growth in sales and profits (Kohli, Jensen, 2010). Financial

performance such as sales, profit and lost sales are the most important reflections of the supply chain performance (Chen, Paulraj, 2004).

Table 3. Measurements of supply chain efficiency

Supply chain efficiency measurements	Clarifications
Sales and profit	Growth in sales and profit.
Lost sales	Yearly Turnover*((Missing Stock Days)/365*100).
Inventory turnover ratio	Cost of goods sold, divided by average inventory.
Lead time	Time to fulfill the order from the beginning to destination.
Transportation costs	Actual logistics costs from supplier to holding unit and (or) from holding unit to customer.
Forecasting accuracy	Factual sales divided by forecasted sales.
Technology advancement	Softwares, systems and processes.

Frequently used indicator for supply chain efficiency is inventory turnover rate, which is calculated: cost of goods sold, divided by average inventory. The capability of lowering this number determines how productive a supply chain could be (Tliche, Taghipour, Depitre, 2020). What is more, investments in process development results in better inventory turnover ratio (Lee, Zhou, Hsu, 2015).

One of the main indicators to measure supply chain efficiency and evaluate unnecessary costs, is lost sales. It really shows the unutilized potential of the sales and apart from overall performance, impacts the satisfaction and loyalty of the customers (Altendorfer, 2017). Lost sales could be calculated by the formula: $\text{Yearly Turnover} * ((\text{Missing Stock Days}) / 365 * 100)$. If company holds the stock levels at zero for too long of a time, lost sales become even more expensive than a quick replenishment which is costly at all levels (Lodree, 2007).

Lead time defines the amount of time that takes to fulfill the order from the beginning to destination. Companies tend to divide lead time into two categories: from supplier to central warehouse and/or from central warehouse to the customer (Altendorfer, 2017).

Transportation costs could be one of the most noteworthy expenses, which influence product prices and take away funds from operational investments (Engblom, Solakivi, Toyli, Ojala, 2012). 40 years before, logistics costs contributed to almost 60% of total product costs. Over the years, with a substantial help from technology and such method implementation as just-in-time (JIT), lean production and order planning systems, supply chains have been developed to perform at the lowest possible costs (Gunasekarana, Patel, Ronald, McGaughey, 2004).

When measuring a supply chain performance, the top-tier metric for analysis is forecasting accuracy. It is calculated by dividing the factual sales from forecasted sales, and it helps to understand the accuracy of demand and the execution performance of supply chain (Chae, 2009). With the intention of planning

and managing the supply chain, companies tend to apply a process of forecasting that demand planners are executing. The most popular way to forecast a demand is, by using a system that runs on forecasting method such as exponential smoothing. The given forecasts are checked and adjusted according to order planner because of existing situation and external factors (Fildes, Goodwin, Lawrence, Nikolopoulos, 2009).

For bigger enterprises, inventory management is a crucial aspect for success, so companies tend to look for systems that run on theory of constraints (TOC) methodology. Such softwares are designed to improve demand forecasting, inventory stock, returns handling and warehouse management. (Mabin, Balderstone, 2003). TOC provides the solutions for a more efficient supply chain by managing inventory and its buffer, scheduling and offering measurements of performance (Simatupang, Wright, Sridharan, 2004).

In order to prevent stock-outs and keep the supply chain running efficiently, dynamic buffers are implemented. Buffers are target stock levels that are calculated in a complex manner by considering historical demand, past trends, previous stock-outs, campaigns, seasoning, lead time and could be adjusted manually by indicating current phenomenon (Reyes, Alvarez, Vasquez, 2016).

Table 4. Relevance of specific supply chain efficiency measurements

Supply chain efficiency measurements	Measurement relevance
Sales and profit	Sales and profit increase when purchases are done accurately and inventory managed efficiently, so the products are available for selling and supply chain costs are reduced.
Lost sales	Lost sales correlate with stock availability, meaning more effective purchase forecasting would result in less shortages.
Inventory turnover ratio	Better inventory turnover ratio could be reached by accurate purchases and managing inventory effectively.
Lead time	Lead time to customers could be reduced by having all goods available in stock, which is part of accurate purchase forecasting.
Transportation costs	Transportation costs could be reduced by ordering in bigger batches and minimizing urgent order probability. Solution for a more effective ordering is planning the purchases accurately and long in front.
Forecasting accuracy	Forecasting accuracy improves with systematic tools and available data that helps to plan correctly.
Technology advancement	Making an accurate purchase forecasting requires a substantial help from systems that are designed to analyze historical numbers and stock trends.

To sum up, the supply chain is system, made of many processes that starts even before production and finishes when reaches the final customer. Variety of processes are designed to help information flow and goods flow, while as a result maximizing sales and profits. As the supply chains became more and more complex, the competition is won by those who find a way to deal with it more efficiently than others. To evaluate the performance of supply chain, several measurements could be considered: sales and profit, lost sales, inventory turnover ratio, lead time, transportation costs, forecasting accuracy, technology advancement.

2.2. Theoretical methods to improve purchase forecasting

Traditionally forecasts have been a fundamental tool for planning and execution of supply chain management. Forecasts affect supply chain decisions and plays a focal point at serving customers demand, minimizing lead time and managing insufficient stock (Boone, Ganeshan, Jain, Sanders, 2019). Market need for a specific product or service is usually linked to different instabilities that can make them volatile and hard to predict. Demand uncertainty is a top concern that supply chain managers are facing, which may result in planning errors that create extra costs (Abolghasemia, Beh, Tarr, Gerlach, 2020).

Every product group has many different items and uneven sales to it, so detailed view at every item is essential in understanding the demand volume of target groups in selected time frame. With that said, goods need to be allocated for inventory stock in order to keep sufficient quantity and reach customers demand (Nivasanon, Ruekkasaem, Aungkulanon, 2019). Forecasting methods that include not only sales data history but also intentions have produced significant improvements in accuracy (Armstrong, Morwitzb, Kumarc, 2000).

In previous researches, it was found that very important aspect of forecasting is not the sales but the intentions of the purchase. However, the most accurate forecasts are being made when past sales data and intentions were combined (Armstrong, Morwitzb, Kumarc, 2000).

Also, there are models to be used in order to incorporate parameters and their uncertainty into forecasting. It includes the lead time and estimation errors to forecast the more exact quantities and never run out of stock (Prak, Teunter, 2019).

There is also another insight about how big data and associated technologies could play a major role in forecasting and its efficiency. It takes up customer behavior and experience inside the store and customer generated data from internet searches and social media. The benefits may be clear but the main concern there is customers data privacy, security and governance (Boone, Ganeshan, Jain, Sanders, 2019)

Talking about the methods, there was used a cross-temporal forecasting framework (CTFF) method to prove a need for it and advantage versus direct forecast where sales data is used for forecasting (Punia, Singh, Madaan, 2020).

Also, there are some thoughts about human factor in forecasting and why it is essential. Even though many advanced systems and complex methods do exist they are not that often used in practice. The study suggested that human factor must be part of forecasting when sales promotions comes in and system cannot be trusted for its learning for data and behavior (Perera, Hurley, Fahimnia, Reisi, 2019).

The theory suggests that reaching an accurate forecast in supply chain is almost impossible even with systems and methods. Nevertheless, it is clear there are many aspects to improve in order to make it more efficient.

Firstly, only historical sales data is not an answer for an effective forecast. Intentions of why it is being made and what is company gaining from it must be detailed and thought of. For example, annual target

reach with supplier may be one of the most popular intentions. What is more, there are several methods to include in order to reach a higher accuracy.

Secondly, new technologies and big data may be a helpful tool to come up with very accurate forecasts, but it also gives many questions. Other from that, systems are created for forecasting and may be very helpful until the promotions season starts. That may result in bad scenario. Meaning, systematic and human factor must be in the mix.

Thirdly, it is always important to evaluate such parameters as the lead time and error possibility. If company is dependent on several products, specific parameters must be applied when forecasting.

There are many aspects to include and to think of when making a forecast for retail business. To make it as accurate as possible several elements may be included:

- Time phase – daily, weekly, quarterly, yearly;
- Product level – SKU level, brand level, category level;
- Supply chain level – manufacturers, wholesalers, distributors, retailers;
- Sales data characteristics and demand – marketing promotions, weather, calendar events, seasonality, history of sales and stock-outs (Flides, Ma, Kolassa, 2019).

The addition of non-zero stock keeping policy brings a better performance than the simple zero stock ending policy. This can be adopted by adding a fixed number of remaining stock to act as a shortage indicator. When the inventory level drops to a specific amount, managers should be concerned about re-stocking (Sebatjane, Adetunji, 2020).

The most popular and general inventory management model is Economic Order Quantity (EOQ) model. It is known for minimizing the balance of inventory holding and re-order costs. In order to get the idea, several factors may be included:

- Noted regular inventory holding costs.
- Noted regular ordering costs.
- Noted regular demand.
- Noted regular unit price.
- Replenishment is done and delivered in one take.
- No shortages allowed (Ogbo, Ukpere, 2014).

It is essential to take into account forecasting during both, hot seasons and recessions because the ability to predict a boom period and calm sales season is very different. The best model for retail sales must help not only to make accurate forecasts over short to long time but most importantly to deal with extreme situations. Such a model has to be a combined one, based on a discounted MSFE (Aye, Balcilar, Gupta, Majumdar, 2015).

Forecasting methods are resigned to improve effectiveness and efficiency of inventory management in data transaction speed, information sharing, accuracy and minimizing mistakes (Pataropura, Sabatino, Riki, 2020). It is suggested (Aburto, Weber, 2007) that the problem to predict time series has been solved so far mainly by applying the ARIMA model, proposed by Box-Jenkins.

ANN is another forecasting model that has been used. Such a computing framework operates in a flexible way, can model many nonlinear problems. The main advantage for this ANN model over other nonlinear models is that ANN is a versatile approximator and can count wide range of functions with a terrific accuracy. It is so strong because it can process the parallel information from the chosen data. No presumption is needed of any form of the model in order to build process (Zhang, 2003).

Using a hybrid model is a way to solve forecasting issues and increase effectiveness of complex linear and nonlinear structural problems (Zhang, 2003).

The cross-temporal forecasting framework (CTFF) is used to generate the forecast for 3 elements – products, time and channels. This forecasting model suggests the short up to long time frame demand forecasts for strategic, tactical and operational organizing levels in a supply chain (Punia, Singh, Madaan, 2020).

It has been tested that the new Prophet forecasting library by Facebook may be one of the quickest forecasting tools but on the other hand it has many error concerns and cannot outperform more traditional combination of the hybrid ARIMA-LSTM model (Kulshreshtha, Vijayalakshmi, 2020). Long short-term memory (LSTM) is a different RNN. It is exceptionally structured and could be used for handling and predicting problems with long intervals and delays in time series. This model is used in other spheres such as autonomous speech recognition or natural language processing (Liang, Ge, Sun, He, Chen, 2019).

- Moving Average Method (MA): It is a technique to get an overall idea of the trends in a set of data from the last periods. It can be calculated for any period of future time and any subset of data.
- Weighted Moving Average Method (WMA): It is a forecasting technique which assign a heavier weighting to the most recent data than the oldest data. It is based on the principle that recent data are more relevant.
- Exponential smoothing model (ES): It is a technique appropriate for forecasting data with no trend and is also suitable when there is little data available (Pulido-Rojano, Pizarro-Rada, Padilla-Polanco, Sánchez-Jiménez, De-la-Rosa, 2019).

Support Vector Machine (SVM) first came onto existence in 1992, brought by way of Boser, Guyon, and Vapnik in Computational Learning Theory (COLT) convention with the paper. SVM is an algorithm of supervised learning methods used for regression and categorization. In this approach, every data object as a factor is plotted in an n-dimensional area (in which n is a variety of features) with the cost of every function being the value of a selected coordinate. SVM is a kind of technique, identified by the absence of local minima, usage of kernels, sparseness of the solution, and potential manage acquired through acting on the number of support vectors or on the margin, etc. (Jayant, Agarwal, Gupta, 2020).

The diversity of forecast methods brings the opportunity to increase planning effectiveness and on the other hand, it is also a challenge to understand and choose the most suitable for a specific situation. With that said, some research and comparison have to be done before re-organizing companies' way of dealing with demand.

Table 5. Forecasting method comparison

Method	Description	Strengths	Weaknesses	References
Economic Order Quantity	Calculates the suitable time of reordering and the optimal quantity to ensure the constant replenishment of goods without the shortages.	Ensures a smooth re-stocking process with balanced inventory costs.	Considers that purchase costs, stock keeping costs and the lead time are always constant and do not change over time or season.	Ogbo, Ukpere, 2014
ARIMA by Box-Jenkins	Autoregressive Integrated Moving Average (ARIMA) method is made of 3 main parts: Autoregression (AR), which shows a changing variable that regresses on its own lagged, or prior, values. Integrated (I) represents the differencing of raw observations to allow for the time series to become stationary. And Moving Average (MA).	Very accurate and pretty useful in a short run.	Very sensitive to data changes and does not automatically update. As a result, the whole modelling must be repeated.	Aburto, Weber, 2007
ANN	Artificial Neural Networks (ANN) is a powerful and general technique for machine learning. It is made on the human thinking and solves the problems that would be nearly impossible for humans.	Could get results even with some information missing. Non-linear attributes are considered, also could use amazingly high amounts of data.	ANN is a black box learning approach, cannot interpret relationship between input and output and cannot deal with uncertainties.	Zhang, 2003
Prophet forecasting by Facebook	A time series based tool which is dedicated to consider already known holidays and seasonality.	Very quick, does not require any knowledge in forecasting as itself finds seasoning trends.	External variables are not considered while also Prophet cannot be mixed with other model.	Kulshreshtha, Vijayalakshmi, 2020
Moving Average	A great analyzes method for a long projection of sales or purchases and relays on data consistency.	Very accurate when calculating constant increase or decrease in sales over different periods in time.	Cannot be applied to calculate seasoning, trends or campaigns.	(Pulido-Rojano, Pizarro-Rada, Padilla-Polanco, Sánchez-Jiménez, De-la-Rosa, 2019)
Exponential smoothing	Very similar to Moving Average method but provides more weight to the latest data and considers previous forecasts errors.	A more developed Moving Average method.	Cannot be applied to calculate seasoning, trends or campaigns.	(Pulido-Rojano, Pizarro-Rada, Padilla-Polanco, Sánchez-Jiménez, De-la-Rosa, 2019)

Method	Description	Strengths	Weaknesses	References
Visionary Forecast	It uses personal insight, judgment and when possible facts about future events. It is characterized by subjective guesswork and imagination.	Really great being an adjustment to other forecasts, could improve drastically.	Alone is pretty inaccurate and could only be used in a small companies.	(Broeke, Baets, Vereecke, Baecke, Vanderheyden, 2019)

From the comparison table, the main strengths and weaknesses could be seen between some of the most known or up-to-date forecasting methods. Talking about the Economic Order Quantity (EOQ), it is most suitable for non-complex businesses where re-stocking and lead time is based on consistency. ARIMA model seems to be very effective in a short period of time but struggles with any data change which results in time waste. Artificial Neural Networks (ANN) model is one of the recent inventions that is based on Artificial Intelligence which gets the job done even without some of the data. However, the biggest flaws are seen to be the need for lots of data and hard time understanding its decision making. Moving Average (MA) and Exponential Smoothing (ES) are very similar methods, while ES being more developed. They seem to be a great tool for a long projections but lack the ability to include seasonings and campaigns. Prophet method is the most recent tool, which was made by Facebook data predictors and shines as a very quick tool that considers seasonings but does not include external variables and cannot be combined with other methods. Visionary forecasting is the simplest method, where all the planning comes from data history and future insights. This method is still highly used in companies who does not have their forecasting automatized. This way of forecasting could be very inaccurate if used alone but really effective when mixed with others.

To sum up, there is no good or bad forecasting method, but it really depends on a situation it is used for. Some of the methods are suitable for a short accuracy while others focus on a long-term numbers. With that said, the complexity of today's supply chains may suggest mixing at least two methods for the best possible accuracy. Better accuracy would result in saved costs, as organization would minimize the overstock, avoid shortages and reduce urgent, not planned deliveries.

2.3. Theoretical tools to improve inventory management

The main reason to keep inventory stock is really simple. It is an insurance and protection from uncertainty in daily life. Customer demand has to be met, therefore stock keeping helps to avoid sales or services pause because of any unplanned situations (Davis, 1993). Stock keeping includes all the activities that takes from developing and managing the stock levels of raw materials, unfinished materials, growing items and ready to go goods, so that channels are accessible and costs are minimized. Inventories are crucial part of the supply chain by creating a buffer for production and distribution of the companies. They help by adding flexibility for purchase and production planners while also ensure quick releasement for shipping (Godana, Ngugi, 2014).

Inventory needs to be controlled properly as it is a major asset of a company. Inventory management should not be excessive nor inadequate. If stock is kept at a higher rate, more interest and storing costs would occur. Also, a low stock could result in underutilization of manufacturing items and lower sales.

The task of stock keeping is to determine and keep the optimum level of investment which results in achieving company objectives (Deveshwar, Modi, 2013).

Warehouses play a vital role in the overall chain of supply and begins with materials and finishes at the end customer. The efficiency results are determined by the processes of stock keeping and its help to the supply chain. Every warehouse must have specific solutions regarding product flows, infrastructure and individual limitations in order to effectively run the operations inside the warehouse. The efficiency of stock keeping is best evaluated by taking into account the causes resulting in shortages and not the competitive advantage (Palšaitis, Čižiūnienė, Vaičiūtė, 2017).

Effective management of inventory can optimize the supply chain, eliminate cash flow and lower the possibility of out-of-stock situations. It is extremely important to optimize inventory management to reach organizations strategical goals (Meng, 2006).

The evidence on benefits for inventory management in regards of profitability, sales, firms performance, warehouse optimization are clear and undeniable (Pataropura, Sabatino, Riki 2020).

Stock keeping itself has a function, namely the inventory function for the company sake is to:

1. Eliminate the risk of delays in logistics of raw materials or products.
2. Eliminate the risk for such situations when product or material is not usable/sellable.
3. Eliminate the risk of increasing prices or inflation.
4. Stock seasonal materials or products that may be missing for some specific time in the market.
5. Stock high amount of goods that are purchased for better pricing.
6. Quickly provide services or necessary products to satisfy the customers (Pataropura, Sabatino, Riki 2020).

Many organizations have faced over-stocking, which led to expired products. Also, understocking or lack of stock or either product theft by employees and delayed deliveries that caused cost consumption. That is why the inventory control is a very important tool for preventing an organization from unnecessary losses. The key there is to set up strict rules to purchase team which must be followed during the process of purchasing and storing (Simon, Chukwuemeziem, 2018).

Stock keeping has many levels to it and some of the issues that usually are related to inefficient management of the inventory includes:

1. No/lack of supply chain criterions or standards such as performance measures, observation of tracked measures, fragmented criterions, separated individual sites.
2. Invalid definition of customers and their trends such as wrong measures of item fill rates, no criterions for responding timetable, no criterions for backorders fulfillment, inaccurate information on estimated delivery, delays in estimated delivery information, inaccurate estimated day of arrival.
3. Weak informing systems, such as unprocessed linkages between the databases, too many operational sites for the same function, incorrect and delays in transferring the data, unpredictability not taken into account, no system for history of uncertainties, incomplete information on unpredictability sources.

4. Too generic inventory management policies, that are not affected by the degree of uncertainties, lack of flexibility in stocking, simple and reliable on the thought of one manager policies.
5. Poor organizing between departments in regards of order fulfillments, lack of communication/ information flow between departments and individualistic approach on delivery process.
6. No analysis on delivery methods, like stock and responding time effects not weighted.
7. Wrong stock keeping costs consideration.
8. No tracking of product expiry dates.
9. Not considered price of rework.
10. No system for inventory management evaluation.
11. Supply chain holes, that come from several factors: managerial decisions without questioning inventory capacity and its work effectiveness, manufacturing, distribution and incomplete situation with other networks, lack of strong strategy between localizing and customizing, shortsighted vision on external factors, lack of competency on operational decisions, inadequate approach on long-term and biggest customers (Lee, Billington, 1992).

With inventory management being an integral part of supply chain, several methods could be applied.

Table 6. Stock keeping management method comparison

Method	Description	Strengths	Weaknesses	Suitable for/if	References
ABC analysis	ABC analysis classifies the goods on SKU level by giving A, B or C category, in order to identify which products bring the most profit.	Helps for better use of resources and pricing strategy.	Does not cover potentially trending products and seasoning.	Company has limited resources and has to choose purchasing and stock keeping priorities.	(Zowid, Babai, Douissa, Ducq, 2019)
Last-in, first-out (LIFO)	LIFO means that the new products from your warehouse will leave firstly.	Warehouse does not need to rotate batches.	Results in obsolete stock if goods have expiry dates.	All the products are non-perishable.	(Gul, 2001)
First-in, first-out (FIFO)	FIFO means that the oldest products from your warehouse will leave firstly.	Helps to avoid obsolete stock.	Requires well organized warehouse and constant product movement from the back to the front.	Storing perishable products.	(Gul, 2001)
Just-In-Time (JIT)	JIT is made for arrival and dispatchment of goods with little to no time in stock.	Very low inventory holding costs, no overstock and improved cash flows.	High risk of shortages and order unfulfillment if any errors in supply chain happen.	Very consistent supply chain or (and) limited products in the assortment.	(Green, Inman, Birou, Whitten, 2014)

Method	Description	Strengths	Weaknesses	Suitable for/if	References
Drop shipping	Drop shipping does not require any inventory management process at all, as the goods from the supplier goes straight to the customer.	No need for any of stock keeping processes. Avoidance of overstock and improved cash flows.	No control of supply chain and shortages, poor level of customer support.	Testing new products (especially in the new market), startups and small enterprises without a warehouse.	(Yu, Cheong, Sun, 2017)
Stock-taking	Manual check and record of physical inventory stock. Usually done to analyze the findings with systematic stock.	Helps to prevent inaccuracies in stock.	Takes quite a lot of time and closes all of the operations.	FMCG segment, companies with many SKU's. Is essential for every company to do at least from one to several times per year.	(Wijffels, Giannikas, Woodall, McFarlane, Lu, 2016)
Third-Party Logistics (3PL)	3PL refers to outsourcing goods and warehouse processes to 3PL provider. It usually covers all processes, from arrivals to single order dispatchment or in some cases - only storing.	Could be applied for business expansion in other markets. Also helps for those without warehouse.	High costs for long-term keeping. Hard to deal with exceptions as everything goes without priorities.	Warehouse cannot handle stock increase due to seasoning or enterprise does not have a warehouse itself.	(Tezuka, 2011)
Fast, slow, non-moving	Classification of stock into three categories: fast-moving, slow-moving, and non-moving inventory.	Helps to clean unpleasant stock and better understand the market needs.	Takes quite some time and data to categorize every SKU.	Finding out overstock, potential shortages, go-to products and products that should be taken out of assortment.	(Devarajan, Jayamohan, 2016)

Even though every company is different, the main inventory management methods remain the same for all. It is only a matter of choice, which way to manage the inventory. ABC classification could be very useful for such enterprises with limited resources, to really prioritize the more valuable products in terms of purchases, inventory keeping and profit seek. LIFO method is good for warehouses that keep the goods deep on shelves. This way could help by lowering the rotation when placing arrivals. Talking about FIFO method, this one is truly essential for warehouses with perishable goods. Even though it means that every batch will need a rotation, the most important goal still remains the dispatchment of products with earlier expiry date. JIT method is more a specific one because traditional businesses would risk too much on implementation of it. However, if the supply chain is very consistent and the amount of assortment is very low, it could function greatly and save some costs. For startups or small businesses without warehouse, a perfect solution could be a drop-shipping method. This way, overstock problems and stock administrative processes are avoided but not being in control of your supply chain does not sound like a long-term solution. It is known that when dealing with day-to-day warehouse operations, physical stock may differ from systematic due to warehousing mistakes. For this reason, the fundamental

solution for error clearance is stock-taking from time to time. If company depends heavily on seasoning, an excellent solution could be 3PL option. Either to outsource some of the load from main warehouse or even outsource the whole process from arrivals to dispatchment. It probably will not save the costs but definitely will help when spacing becomes an issue on Christmas occasion, for example. Talking about the stock issues, a rational way of solving could be the FSN method implementation. In such way, some old, non-moving stock could be exposed and cleared out from assortment. Also, the fast-movers typically should be reorganized and brought to the nearest possible pick up place.

All in all, better managed inventory would highly benefit the supply chain as the higher availability of goods would result in minimized lost sales and higher profit. Also, the well-managed inventory is the key part to lowering the holding costs as less overstock would mean better inventory turnover ratio. With that said, it is necessary to apply some well-known methods to deal with inventory management problems and improve the supply chain efficiency in general.

2.4. Relationship between sales planning, purchase forecasting and inventory management

Aggressive global competition and marketing innovations have increased the complexity of sales forecasting. For those reasons, sales demand planning is the primary option to reduce inventory investment, increase customer satisfaction and in general, improve supply chain (Trapero, Kourentzes, Fildes, 2014). Companies depend heavily on accurate sales prognosis at SKU level when making marketing, inventory management, financial and purchasing decisions. Historical sales and upcoming promotions are the key factors to consider when making a sales demand forecast (Ma, Fildes, Huang, 2015).

In many cases, when the products are on promotion for some time, during which demand is significantly higher than usual, the shortages happen due to inaccurate sales predictions. It is obvious that the accuracy of sales prognosis directly contributes to higher profits by lowering shortage situations and decreasing safety inventory (Ali, Sayin, Woensel, Franso, 2009).

In order to decide what, how much and when to purchase, reliable prediction of future sales is required (Aburto, Weber, 2007). When having a well-arranged sales prognosis, the purchase forecasting should take place accordingly. Inventory management projects are often linked to many business processes like sales, planning and purchasing (Vries, 2020).

In practice, it is necessary for inventory management to be related to purchase forecasting in some way. The decisions that are made for stock keeping are still based on an estimated purchase procedure. Those two elements traditionally are explained differently in general, but really depends on each other. So it is important to understand the relation between inventory management and forecasting as those two are combined for a better performance of organization. (Ali, Boylan, Syntetos, 2012).

Stock keeping efficiency is heavily relied on accurate forecasts and even though at first level, when goods arrive some costs may not be increased because of a quick addition of goods, in the second level, when overstock happens, total supply chain costs improve dramatically (Hosoda, Disney, 2009).

Furthermore, one of the most challenging aspects of inventory management is to make decisions regarding replenishment costs and storage costs. If orders are small, the quantity and frequency of such orders will increase. On the other hand, the small quantity of orders taken in big batches help to reduce the replenishment costs but may result in overstock. Thus, an excellent balance between storage and ordering expenses should be a priority (Obimpeh-Quayson, Qu, 2020).

The amount needed to have as a safety stock for a product or a service really depends on the degree of demand uncertainty and primarily forecasting errors. The unpredictable demand obviously affects the management and execution of supply chain, but the costs would be reduced if there are little to no forecasting errors (Beutel, Minner, 2012).

It is already explained that the sales prognosis highly influences purchasing process. When making a purchase it is necessary to consider several aspects that are a big part of sales plan:

- Target agreements with suppliers – commercial aspects that set the tone for yearly growth and are included into sales plan as a goal to reach.
- Seasoning – some businesses depend heavily on Christmas or other seasons, where the sales could be even doubled, compared to other seasons.
- Projects – could be a significant sale of high volume or a contract with a constant supply.
- Campaigns – marketing influenced activities that could drastically increase the sales.
- Customer demand – the backbone of sales prognosis, to exceed the demand means to know it.

With a known sales plan and indicators to it, purchasing takes place. There are number of ways to proceed with purchasing process which is done accordingly to:

- Forecasting – using one or several methods to set up the product flow in the supply chain. Could be done for any length of time and especially needed during the change of the seasons.
- Agreed quantities with suppliers – automatically inserted amounts in the sales and in the purchase plan as such products are under the agreement.
- Order per inquiry – mostly a way to deal with projects or higher amounts of unplanned sales.
- Sales analysis, regular ordering – short period sales history influence of the daily supply.

Deliveries also depend on the suppliers lead time, ways of carry, transit times and so on. But in a well-organized supply chain, logistics are arranged in a way to support the sales. That is why the schedules are done, in order to perform as best as possible during campaigns and never lose a customer with a shortage of some product.

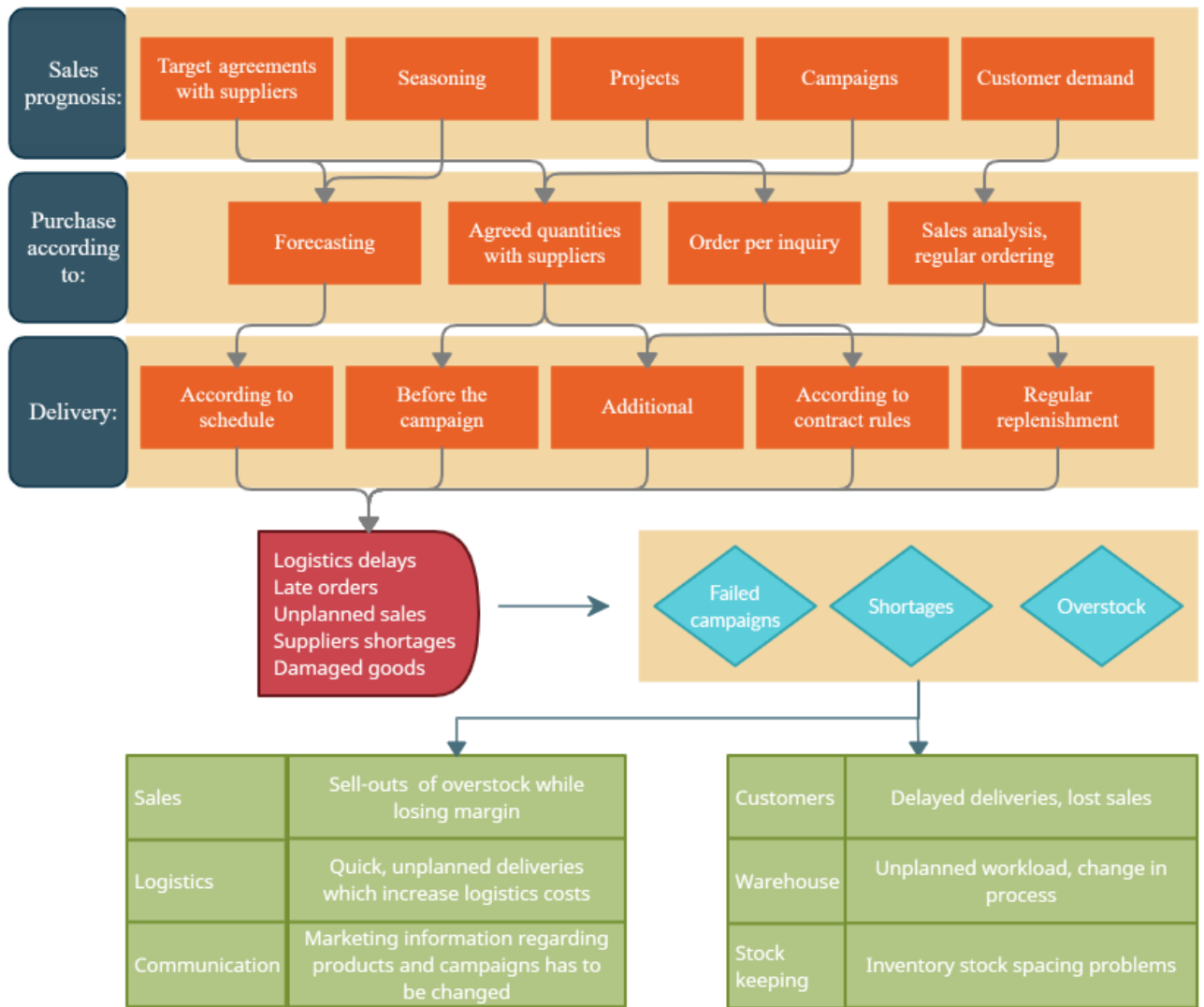


Fig. 10. Supply chain problem analysis

Talking about supply chain problematic aspects, it all starts with sales prognosis which is made up of several elements and follows up with the purchases. In order to reach agreed targets, a forecast is a must, which includes yearly campaigns products and quantities. In this way, the goods would be delivered according to schedule, which as well made according to starting and ending dates of campaigns.

Seasoning is a big deal for any company to cope with, so the forecast there plays a vital role. The more accurate the forecast, the more on time deliveries. Which, by the way, should be planned in front.

Apart from regular orders or campaigns, companies use to work on different projects that may require unusual products or challenging volume. Such orders are being made according to inquiry because prognosis does not cover huge irregularities. Projects normally have contracts and delivery agreements, so such supply goes through different path.

The stable demand is the most important part for regular supply chain. Sales history and forecasted growth initiate the regular replenishment for majority of the goods, without any major inaccuracies.

As well-planned supply chain as it gets even faces some unexpected problems from time to time. Most cases are about logistics delays or damaged goods during the transportation but couple of situations not necessarily include logistics:

- Late ordering – without a reliable data or pretty accurate forecasting method, the companies tend to be too late when making an order.
- Unplanned sales – with an inaccurate sales prognosis or unpredicted growth, sales increasement may cause shortages.
- Suppliers shortages – sometimes suppliers also have inaccurate plans, big growth of other customers or are affected by lowered production and therefore, cannot supply the needed volume.

Those problematic aspects inside the supply chain bring the worst in stock keeping. Even though warehouse's main role is to hold the stock, but eventually parts of this stock become harmful. The overstock increases holding costs, capture more space in the warehouse and in the end, most probably results in a discounted sell-out, which lowers the profit. Talking about shortages, this consequence of a poor planning could bring even more damage as company loses customers.

To summarize, supply chain is like a live organism where any mistake affects other processes. The importance of a correct planning is as high as it gets. Sales prognosis influences purchase forecasting in a major way and wrongly managed data (or wrong data) may result in costly stock. Inventory management is strongly touched by stock-outs and overstock that seem to change the inside processes and warehouse workflow priorities. Finally, because of the mistakes in some parts of the supply chain, all stakeholders are included in an unpleasant form.

From the theoretical analysis, several takes could be made for a more efficient supply chain planning and execution. Firstly, the complex supply chain requires complex solutions, which start at forecasting phase. From the review and analysis of theory, the main argument for forecasting improvement is method mixing. Majority of forecasting methods are pretty decent but cannot handle the planning alone. The exponential smoothing seems like a strong primary method because of its accuracy in a long-term prognosis. Also, this way of forecasting includes the constant increase or decrease over different periods, which is essential. But the inability to include seasoning and campaigns, initiates the need for second method. With that said, in a fast-growing company it is really hard to take a new system and fully rely on it. So the logical decision would be the combination of exponential smoothing and visionary forecast, as the following method could oversee the quickly changing external factors, the value of seasons or campaigns, new market entrance aspect, inventory management strategical goals or even cash flow situation. Improved way to forecast should eventually help to deal with inventory management problems. But this improvement cannot work out without strong intake from stock keeping itself, which must have a methodology as well. For the Fast-Moving Consumer Goods (FMCG) keeping, the First-In-First-Out method should be applied in order to move perishable products on time. What is more, the fast, slow and non-moving categorizing really helps the supply chain to clear overstock and improve cash flows. If organization heavily relies on seasons and campaigns, the much-needed solution in terms of warehouse spacing is Third-party logistics (3PL). Using this method, some of the stock could be outsourced to deal with seasoning, when big batches of goods arrive. Finally, the stock-taking should be included as

necessity to control inventory inaccuracies, as this problem may affect the whole supply chain and sales process.

2.5. Theoretical supply chain improvements through forecasting and inventory management

The theory is provided with many insights on forecasting and inventory management aspects and ways to go. The root of all problems seems to be the inaccuracy in demand planning. As wrongly forecasted sales not only set the foundation for unreached yearly expectations, but more importantly, cause a bunch of problems in purchasing and inventory management regard. The demand forecasting is very sensitive to seasoning trends and relies heavily on different campaigns, whether by the company itself or the aggressive actions made by competitors.

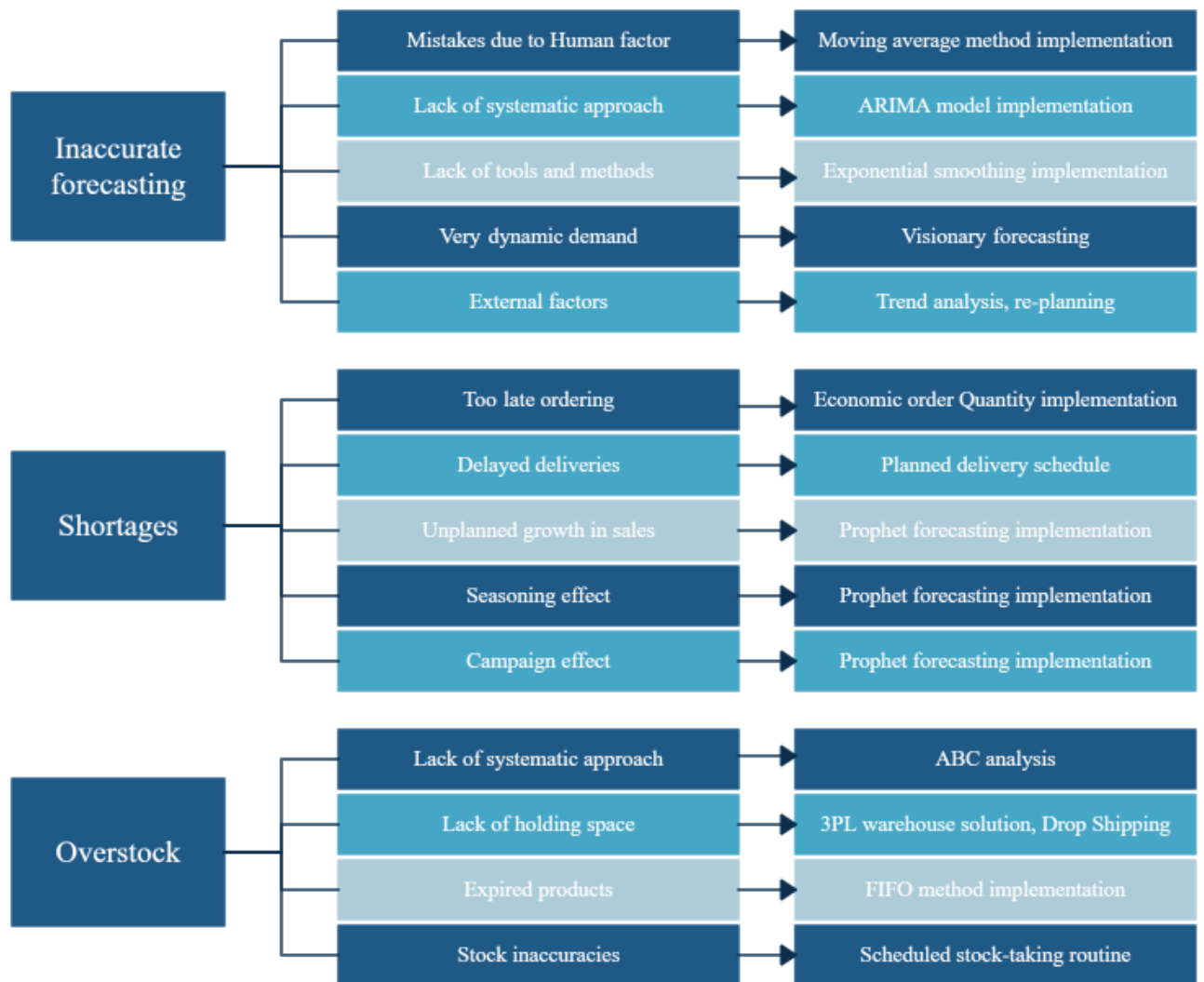


Fig. 11. Problem components and ways to solve, according to theory

The theory suggests that solutions for such a case would include a more complete planning. Seasoning and campaign influence has to be taken into account, by analyzing the previous sales trends throughout the year. A pretty suitable way to solve inaccurate demand would be a Prophet forecasting tool by

Facebook implementation. It offers the high-quality planning solution that includes seasoning and holiday trends.

Another problem that really comes after the sales prognosis is inaccurate purchases. As theory states, the purchase forecasting is heavily depending on sales prognosis and the accuracy of it. The process of purchase could be harmful to the supply chain if done too early or too late. There are regular manufacturing delays and logistics delays that postpones arrival of goods in a bad way. Also, when the seasoning and campaign effects are not considered, the replenishment is too low for the specific time of the year. So all of the problems bring the worst of the supply chain that results in too low or too high stock level which either increase the supply chain costs or results in unreached sales potential.

From the theory, the main solutions aimed to solve purchasing problems, include implementation of one of the forecasting methods. The history shows that ARIMA model is at the top of popularity because of showed results throughout the years of usage. Also, it is by far the most accurate tool for short-term planning. What is more, the theory suggests that one model or method by itself cannot solve the wide range of problems because of its specification and wide range of problems complexity. So in a such situation, the Economic Order Quantity (EOQ) must be implemented next to it for the best possible results. By mixing ARIMA model, which is known for its accuracy in a short-term and Economic Order Quantity which is capable of dealing with regular replenishment in almost perfect way, would be the most beneficial to the purchasing process.

The third problematic aspect that is highly influenced by wrongly adjusted purchases is inventory management. If the purchases are done poorly, the warehouse gets a heavy load of goods that should not be here, or the warehouse is lacking the products to provide. With keeping over the needed inventory, the warehouse faces a problem of spacing. It disturbs majority of the processes in the warehouse, as lack of space blocks the natural flow of order picking and placing. What is more, without the functioning system, the track of product expiry dates is near impossible. When products become expired, it is an automatic write-off and results in unnecessary costs. On top of that, another problem that is seen to happen is inaccurate stock. It is a result of a poor systematic approach on inventory management.

Theoretical analysis suggests methodical and modeling solutions to improve the inventory management in many ways. Firstly, the ABC analysis must be implemented in order to analyze the preferences of stock as it helps to adjust resources effectively. Secondly, FIFO method has to be implemented so the oldest products leave the warehouse firstly. That helps to avoid expired goods in stock. What is more, the most idealistic scenario that the theory suggests, is Just-In-Time technique. In this case, the arrivals become dispatched orders without the stocking process. On top of that, the purchase meets the sale and there is no chance of overstock or shortage.

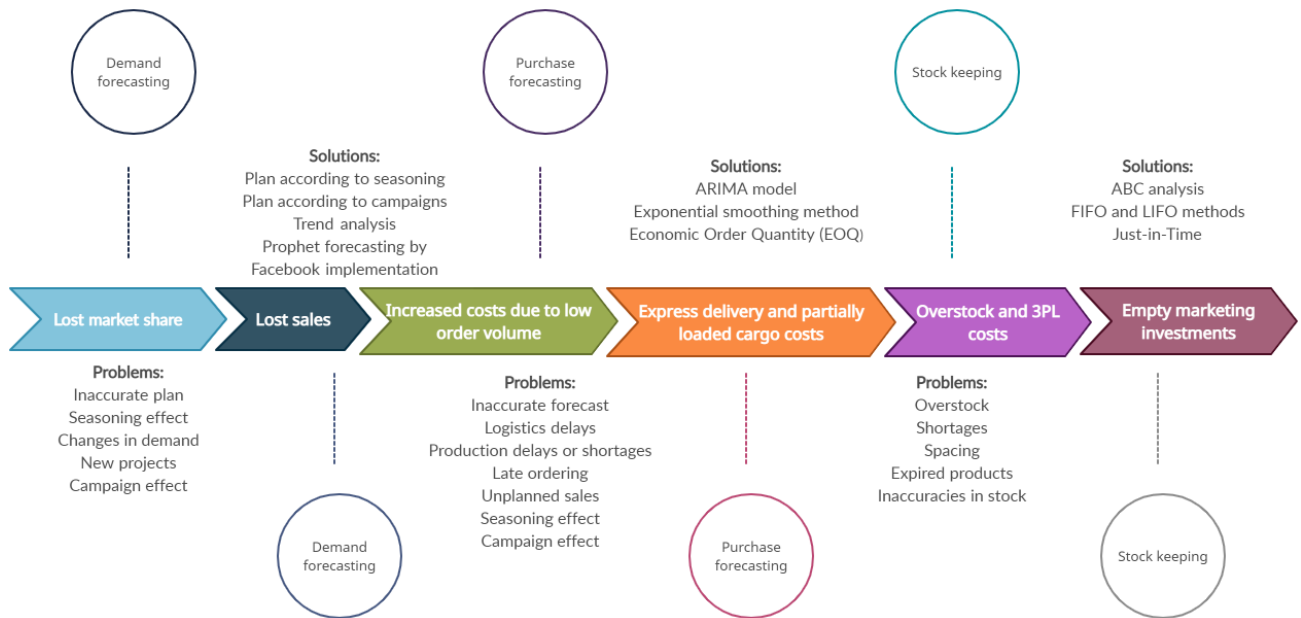


Fig. 12. Theoretical solutions for demand, purchase forecasting and inventory management

To sum up, the theory suggests planning the demand by using Prophet forecasting system and always include seasoning and campaign effect. Also, trends have to be considered. By doing that, the accuracy in sales prognosis would be reached and the next step – purchasing becomes much easier of a task. Purchasing process must be done by mixing ARIMA model and Economic Order Quantity methods. Such hybrid ensures the smooth replenishment and gives high chances of rational stock level. What is more, with a well-planned purchases, inventory management becomes lighter task to solve. And adding such methods as ABC analysis, FIFO or Just-in-Time, the inventory management becomes more efficient, cost-friendly and less time consuming.

3. Purchase forecasting and inventory management efficiency research methods

The aim of this study is to propose supply chain management solutions, based on effective forecasting and inventory management methods. So, to recommend potential supply chain improvements through purchase forecasting and inventory management, several questions must be raised, and some data must be gathered. Firstly, the choice on qualitative research will be described. Secondly, explanation on specific data gathering will be provided.

Social science has been relying on both qualitative and quantitative methods for a long time. As a matter of fact, there is no good or bad method, as it only depends on the scope and situation. Thus, a discussion on both methods will be provided briefly.

Quantitative methods are mainly standardized procedures, which focus is on the social phenomena. The measurements come through numbers and hypotheses are tested through fixed variables. As the measures are standardized, such methods suitability applies to fairly large samples. As a result, it finds the generalizable data. If to criticize this method, such research tends to have very little or even no contact with people. A phenomenon or some social actions are just not measurable by numbers or statistics. So, in this kind of situation, the quantitative methods are more likely to limit the finding of specific phenomena aspects (Silverman, 2006).

Qualitative research is concerned about the profound understanding of words, opinions and experiences. Qualitative research is based on thoughts of individual, rather than widespread. Mostly, qualitative research are inductive, but with a legit theoretical vision, the data would be more study-centric, rather than theory-centric (Mayring, 2003).

The biggest concern with qualitative methods is whether they are valid and reliable. As the researcher is involved, the qualitative research could be described as too subjective. The qualitative research is based on individual cases so the general concept could be restricted. Nevertheless, the qualitative research tries to understand and examine a specific case rather than reach a generalization (Bryman, 2008).

So, both methods have their strong points and concerns but at the end, it really depends on type of research. The focal point of this research is understanding a specific case through the thoughts and comments from the experts. Such comments are not overseen by the researcher, so it makes the qualitative research necessary.

Qualitative research provides different methods, including focus groups, interview and structured observations. Observations are more focused on analyzing the natural behavior on specific context. The focus groups really offer a great data source for analyzing a cultural or categorical norms or differences. Interviews are based on collecting data on individual's opinion, experience, perspective regarding particular topic. For this research, the interview method suits pretty well as it allows to find out individual experience and perspective by using open questions, related to the specific case. A structured interview is needed to get all the in-depth answers and gain as much as possible data.

3.1. Expert interview

Before the interview, a framework for this procedure was put in order. Theoretical part was well studied and insights were gathered. Research questions were inspired by the theory and developed with a perspective to collect full in-depth data on organizations supply chain practice and experience.

In order to execute the interview smoothly, the questions were structured in different categories and had specific research questions:

- The more general supply chain overview: What are the main challenges that organizations supply chain is facing?
- The take on purchasing: What are the tools and routines for purchasing process?
- The take on inventory management: What are the tools and routines for inventory management?
- Seasoning effect: What are the main aspects of supply chain that needs to be adjusted because of the seasoning?
- Campaign effect: What impact campaigns have on the supply chain and do they need to be considered when forecasting?

Table 7. Expert interview questions

Expert interview questions	Theoretical validation
How company plans and executes the supply chain?	The supply chain starts at knowing the demand and having supply channels to fulfill it. The assortment has to be selected and conditions with suppliers have to be agreed. Then follows the order, the payment, the logistics chain to the customer or reached the warehouse in the middle.
How important to the company is the quality of process flow in the supply chain?	The supply chain is a collection of different process that depend on each other. If any part of the supply chain is low in quality, the whole company suffers in a long run.
How long in front, strategic planning on the supply chain is being made? What are the strategies that impacts the execution of supply chain?	Strategic plans are made around 5 years in front but for the supply chain could be adjusted for one year as the yearly agreements with suppliers are made.
How often company faces a change in demand and how to deal with it?	To cope with demand, a company could be needed to hire more staff, act quickly by adjusting the purchases and planning a campaign if the stock is too high. Also, if the demand starts to increase, the warehouse must be expanded and cash flows improved.
Could you say that demand remains the same throughout the year? If no, how often and how big the changes are?	Normally, companies tend to have different demand levels throughout the year if they depend on seasons. Most companies excel at winter or summer due to season uniqueness.
How company adjusts its supply chain when demand becomes much higher than forecasted?	When the supply chain has to act differently than planned, it normally increases the costs. The adjustments should be made by reaching a supplier for a higher amount of goods and (or) looking for additional supplier to provide same products or alternatives to it. Also, it has to expand the stock keeping space and invest more in purchases.

Expert interview questions	Theoretical validation
How the new projects effect the planned sales and purchases?	The new projects could be a great addition to increase the sales, especially if the targets are not reached and company deals with overstock. On the other hand, new projects may harm the current supply chain as demand becomes much higher than expected and company deals with shortages.
How company approaches the possibility to start new projects, which may affect already established supply chain?	The new projects could be a great addition to increase the sales, especially if the targets are not reached and company deals with overstock. On the other hand, new projects may harm the current supply chain as demand becomes much higher than expected and company deals with shortages.
How the processes of supply chain must be adjusted when starting a new project? And do you see any potential risks to the supply chain by doing that?	Before starting a new project, the estimation must be calculated on additional purchases, needed warehouse space, needed investments and new process implementation with existing or new staff workload.
How is the process of purchasing executed?	A process of purchasing starts with strategy formulation that includes the sales prognosis, target agreements with suppliers, cash flows situation, warehouse space and follows up with past sales data, planned growth and lead time analysis.
How a responsible person knows when to proceed with an order?	Order manager must gather a sales data, current stock data, upcoming campaign situation, lead time possibility and could even have purchase schedule to be guided by.
Are there any concerns about production shortages on suppliers side? If so, how do you deal with it and how it effects companies supply chain?	Some contracts with suppliers could include the commitment to supply right amount of goods. If that is not the case, the supply chains tend to look for other purchase opportunities or alternative product adding.
How purchase forecasting is being made?	Purchase forecasting must include all the factors that could effect purchases. It starts with sales prognosis analysis, either last year sales or current forecasted sales. Also, the warehouse space aspect and financial opportunities must be included. The purchase forecast could be done either by SKU level or supplier level, depending on complexity of supply chain and agreements with suppliers.
What kind of data is used to make a purchase forecasting?	Usually, the data needed for purchase forecasting includes: historical sales, latest sales, stock situation and target agreements with suppliers.
How do you choose a criteria when forming a purchase forecast?	A criteria is based on supply chain strategy, strategical partnerships, potential expansion or upcoming projects, as well as campaigns and seasoning.
How company plans arrivals and are there any late arrivals due to some reasons?	One way to plan the arrivals is to prepare a delivery schedule according to purchase plan. Late arrivals may happen due to logistics delays, product shortages on suppliers' side or too late order placement.
How is the information on arrivals passed to different departments?	The information on arrivals should be done by communicating the delivery schedule to the departments that are depending on it (sales, warehouse i.e.).
How company manages and analyzes its inventory stock? What are the indicators?	Inventory stock should be managed by following the stock levels, stock value, product turnover rate and space usage in the warehouse.
How company finds out if there are any overstock or shortage problems?	Stock analysis by value, or every SKU sales per specific period, versus current stock and lead time analysis

Expert interview questions	Theoretical validation
How company tracks space usage in the warehouse?	Using a Warehouse Management System or at least gathering information on total pallet space versus total pallet factual quantity ratio.
How different every quarter throughout the year is, in terms of purchasing?	Companies with a high demand increase in any of the quarter, tend to purchase more one quarter before and purchase less after the peak quarter.
How different every quarter throughout the year is, in terms of inventory management?	Companies with a high demand increase in any of the quarters, tend to stock up more goods one quarter before and during the sales quarter. The inventory stock may vary even up to 50% during the year, depending on changing demand.
How frequently company runs campaigns and how it effects purchase planning and inventory management? What kind of adjustments are made?	Campaigns could be run very often but it depends on the segment and stock situation. Purchases must be planned before the start of the campaign and warehouse must be ready to stock up higher amounts of goods for that reason.
How big of a role campaigns play in companies' success and how frequently company runs them?	Campaigns could be a huge factor to increase the sales, gain more of a market share and raise a awareness of the company.

Analyzed theory and problematic aspects were part of interview questions formation, which had the theoretical substation suggested (table 5). When choosing a suitable respondent, several criteria was considered:

- Academic degree in field of business management or similar.
- Substantial experience in supply chain.
- At least 3 years of successful managerial experience.

The chosen expert was Ieva Mišeikienė, Chief Commercial Officer at „Coffee Friend“ group. Her experience in supply chain consists of almost 10 years of managing small, medium and large enterprises. She has a Bachelor's and Master's degree in a field of economics and business management.

The interview was made remotely, because of today's pandemic situation due to COVID-19. When the call started, the expert was notified that this interview is recorded for keeping the data as precise as possible. The positive answer was received and discussions began. Before asking planned questions, the interview was started by getting to know individuals background and experience, which seems like a substantial principle for answer solidity. Even though, the plan was to keep the interview as structured as possible, still a couple of questions were asked on the spot, due to unpredictability of interview process. Planned interview length was 30 minutes and for this concern, it went well, as it took 27 minutes to cover all planned and on the spot occurred questions.

3.2. Secondary data analysis

Secondary data analysis is a research method, that focuses on using datasets for additional information on specific subject. Such method benefits the research by providing extra considerations, which during the primary research may be limited.

Secondary data analysis is concentrated on exploring and collecting already existing data. Such data could be gathered from the internet, government sources, public libraries, educational institutions and commercial information sources (Trinh, 2018).

Researchers collect primary data to get the necessary information for hypothesis analysis and use secondary data for alternative, more wide information spectrum. Secondary data could include any type of data that supports or adds to primary data. In a such way, answering to a research question becomes richer in data (Vartanian, 2010).

For this research, it is a must to understand all of the commercial aspects, from the current demand to historical purchases, so the commercial information source method will be chosen.

Collecting a Commercial information benefits the research by providing an in-depth data, highly related to a specific case. In this situation, the data will be gathered from “Coffee Friend” group, as the research is based on improving its most important aspects of the supply chain.

The data should cover the problems that organization is facing and provide a necessary numerical suggestion. To begin with, the status on forecasting accuracy is required so the total annual sales and purchases from 2016 to 2020 will be analyzed. Secondly, it is needed to understand the overall change in sales throughout the year and how seasoning could impact the supply chain. Thirdly, the comprehension of how big of a difference campaigns make is essential. To get familiar with stock situation, product shortages and product overstock will be analyzed quarterly, including the results of the last two years.

Table 8. Secondary data analysis questions

Research questions	Problem	Theoretical validation
Seasoning effect: What are the main aspects of supply chain that needs to be adjusted because of the seasoning?	Seasoning effect	Seasoning is the phenomenon in business, as demand, processes, workload, planning, finances, inventory face a significant change due to some events, weather or other external stimulus.
Campaign effect: What impact campaigns have on the supply chain and do they need to be considered when forecasting?	Campaign effect	Campaigns are planned sales strategy in order to boost sales, attract more customers, improve awareness and take over competition in one or more sales channels. Usually, campaigns are run for a specific time and could have a limited amount of goods as well.
The take on inventory management: What are the tools and routines for inventory management?	Product overstock	Product overstock is referred to inventory that is over the specific limit. Such stock is toxic in a way that increases the holding costs and uses space without the quick potential sell out.
The take on stock keeping: What are the tools and routines for stock management?	Product shortages	Product shortages or stock-outs is a situation when inventory runs out of a product even though the demand is existing. Such situation is usually referred to lost sales and profit.
The take on purchasing: What are the tools and routines for purchasing process?	Inaccurate sales prognosis	Sales prognosis is an estimation of the business sales per specific period of time. It heavily affects other parts of the company and determines potential purchases, investments and developments.

Research questions	Problem	Theoretical validation
The take on purchasing: What are the tools and routines for purchasing process?	Inaccurate purchase prognosis	Purchase prognosis depends on projected demand and agreements with suppliers. It tries to oversee the campaign, seasoning and other aspects while optimizing a supply of goods.

Table 9. Commercial information for data analysis

Problem	Data
Seasoning effect	Sales by quarter, 2018-2020
Campaign effect	20 SKU's stock value and sales during regular period and campaign period
Product overstock	Overstock percentage by category (appliances, groceries) per quarter, 2018-2020
Product shortages	Shortage percentage by category (appliances, groceries) per quarter, 2018-2020
Inaccurate sales prognosis	Forecasted versus factual yearly sales, 2016-2020
Inaccurate purchase prognosis	Forecasted versus factual yearly purchases, 2016-2020

Sales by quarter, 2018-2020. Such data could indicate many things but for this specific research, it will be looked at the change in demand through different seasons. It is very important to note such phenomenon, as purchase forecasting and inventory management are heavily dependent on it. A serious disbalance on quarterly sales would indicate one of the problems and therefore, recommendations may follow.

20 SKU's stock value and sales during regular period and campaign period. For understanding the difference that campaigns have on the sales, it is needed to compare how products are being sold regularly versus promoted. One or two products may not provide a surely answer, so for that reason, 20 different products are chosen. It must be an optimal amount of sufficient data, so the results are reliable. An obvious change in sales per SKU would indicate the need for improvement.

Overstock percentage by category (appliances, groceries) per quarter, 2018-2020. To become aware of how accurate the purchases are and how well inventory is managed, the overstock percentage for two main categories will be collected. As to be precise on data, such percentages will be gathered through quarter, from the last two years statistics. It is expected to get a closer look on how big of a problem overstock is and whether it requires further recommendations for improvement.

Shortage percentage by category (appliances, groceries) per quarter, 2018-2020. To become aware of how accurate the purchases are and how well inventory is managed, shortage percentage for two main categories will be collected. As to be precise on data, such percentages will be gathered through quarter, from the last two years statistics. It is expected to get a closer look on how big of a problem stock-outs is and whether it requires further recommendations for improvement.

Forecasted versus factual yearly sales/purchases, 2016-2020. In order to understand the accuracy of historical sales and purchase forecasts, the data analysis on planned versus factual numbers will be made. Total sales and purchases will be included from the last 4 years, as the results from a smaller time frame could be not enough for a decent outlook.

3.3 Research process

The research is divided into two parts – quantitative and qualitative. Both will cover the needed aspects of the supply chain, as quantitative research takes on commercial information that is expressed in numbers and qualitative research that gathers data from expert interview.

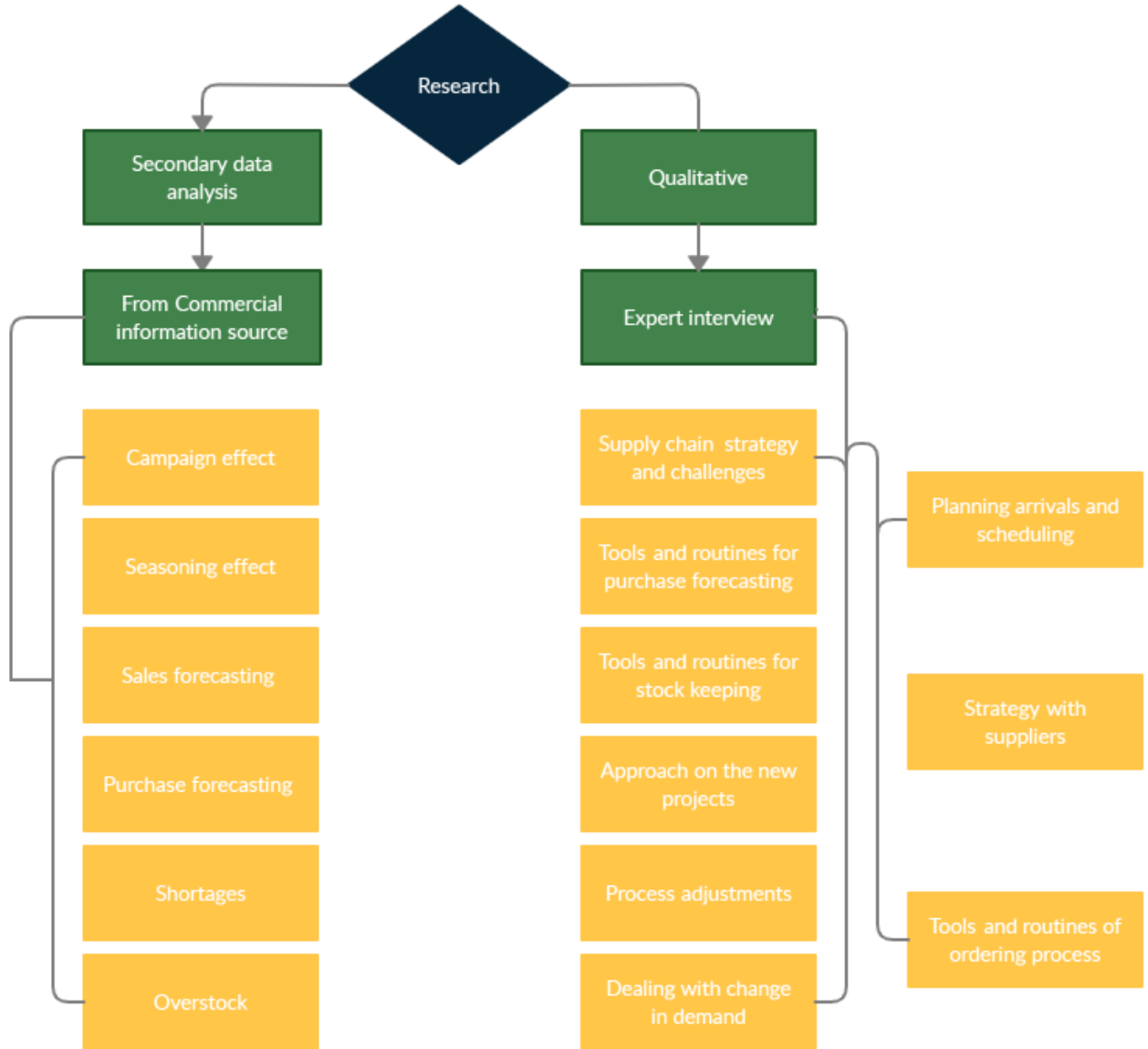


Fig. 13. The process flow for research methodology

The main idea is to understand the processes, strategy and drawbacks of the supply chain so further recommendations could be made. It is expected to collect as much data as possible from the expert and complement the findings with statistical data that comes from commercial information source. So the mix of implemented quantitative and qualitative researches should offer a substantial data for further discussions.

4. Research findings

To gather data for the research, qualitative and secondary commercial (company internal data) research methods were implemented. For the qualitative research, expert interview method was chosen, where the interviewer was Chief Commercial Officer of the „Coffee Friend“ group. Due to pandemic and limited access to contact, only one person was part of expert interview.

In this section, the findings from expert interview will be presented. Interview answers are divided into such categories: supply planning factors, supply chain participants, increased demand factor, forecasting factors, forecasting process, purchasing challenges, stock management, seasoning and campaigns. For the deeper analysis, each category follows up with subcategories that have justification from expert interview.

Also, secondary data analysis will be done, in order to complement primary findings. Collected data will be shown and analyzed in diagrams, so the numerical findings are easily understood.

4.1 General supply chain overview

Firstly, the fundamental aspects of the supply chain needed to be clarified. It is important to know how the company plans and executes its supply chain so the further discussions could be made.

Table 10. Categorized supply chain aspects

Category	Subcategory	Quotes from the interview
Supply planning factors	Previous sales	<i>According to previous sales and estimations [...].</i>
	Market demand	<i>According to [...] market demand and tendencies</i>
	Annual and half-annual planning frequency	<i>Normally, we plan annually with strategy re-check after half a year</i>
	Planning challenges	<i>COVID-19 situation had us dealing with strategic questions every quarter.</i>
Supply chain participants	3PL warehouse	<i>Products are delivered with forwarder to central, 3PL warehouse or retail store and then shipped to sales channel</i>
	Central warehouse	
	Local stores	

Summarizing the first categorized table, it could be said that company plans its supply chain yearly with a re-check in the middle of the period, so adjustments could be made. Also, the main aspects for planning remain historical sales and market demand analysis. Such data indicates the potential quantities and market may dictate the current demand and competitive environment. It is also needed to note the tendencies who may indicate the phenomenon in consumer preferences. On top of that, many challenges occur because of the COVID-19 situation so the strategic planning is adjusted quarterly. The findings suggest many similarities to theory as company is collecting appropriate data for strategic planning and deals with current challenges by adjusting its strategy more often than previously.

What is more, it is known that most of the products are not going directly to the customers as their first destination of reach is one of the warehouses or retail stores. The theory indicates that having a 3PL warehouse could help by shortening the supply chain and providing additional space for holding the goods. Also, a direct supply to local stores means shortened route to potential customers as central warehouse is skipped. This way to supply is cost and time-effective but makes an argument why planning of arrivals and stock planning is important.

The general overview of the supply chain seems on point as company correctly analyzes and frequently adjusts its strategy according to the market. Likewise, there are solutions for incomings as 3PL warehouse and local stores are used as additional destinations, next to the central warehouse.

4.2 Forecasting

Forecasting is a big part of the supply chain because it helps to execute the supply chain strategy on time. By doing that, costs are kept at optimal level, warehouse is ready for incomings, cash flows are divided rationally and stock levels are complete.

Table 11. Categorized forecasting aspects

Category	Subcategory	Quotes from interview
Forecasting factors	Seasonal changes	<i>Demand curve was drastically falling down during the Q1 and Q2 and was coming back up in Q3 and Q4</i>
	New projects	<i>implemented very intensively and spontaneously [...] without really considering the potential risks to the supply chain</i>
	Campaigns	<i>Campaigns play a vital role in company success as they cover around 50% of total sales</i>

The main factors that influence the forecasting for this company are seasonal changes, new projects and campaigns. It is understood that company is heavily affected by different seasons as highest demand is to be seen during the second part of the year.

What is more, company tends to implement new projects without a structured plan and considerations of potential harm on the current supply chain. Such decisions are not only risky but needs a structured plan or preparation for managing potential threats.

Also, the expert provided some information on campaign importance as sales during such periods cover a half of total sales. The planning on campaigns seems like one of the biggest factors and challenges as well.

Table 12. Categorized forecasting process aspects

Category	Subcategory	Quotes from interview
Forecasting process	Market research-based data collection	<i>Assortment selection, [...] market research.</i>
	Decision on quantity	<i>Sales analysis, price analysis, product analysis, target agreements with suppliers</i>

	Forecasting framework	<i>Closely looking at suppliers strategy in general and their strategy with us. [...] depends on planned (sales) forecast and seasoning demand</i>
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From the expert interview, it is known that forecasting process starts with needed data collection such as potential assortment analysis, whether the products are suitable for the market. Also, alternative products and their sales are analyzed, plus if the price of the product fits the market needs. What is more, company sets up forecast volumes according to agreements with suppliers as it could make a huge difference on overall purchases. Talking about the suppliers, expert noted that one of the main factors on criteria choice is how the suppliers looking at the company from partners perspective. On top of that, suppliers approach in general: on marketing, on growth and development potential, on support, is a huge indication on how to deal with forecasting. Also, the criteria for forecasting relies on planned sales, which is one of the main factors according to theory. It starts with demand prognosis and purchase forecasting comes right after.

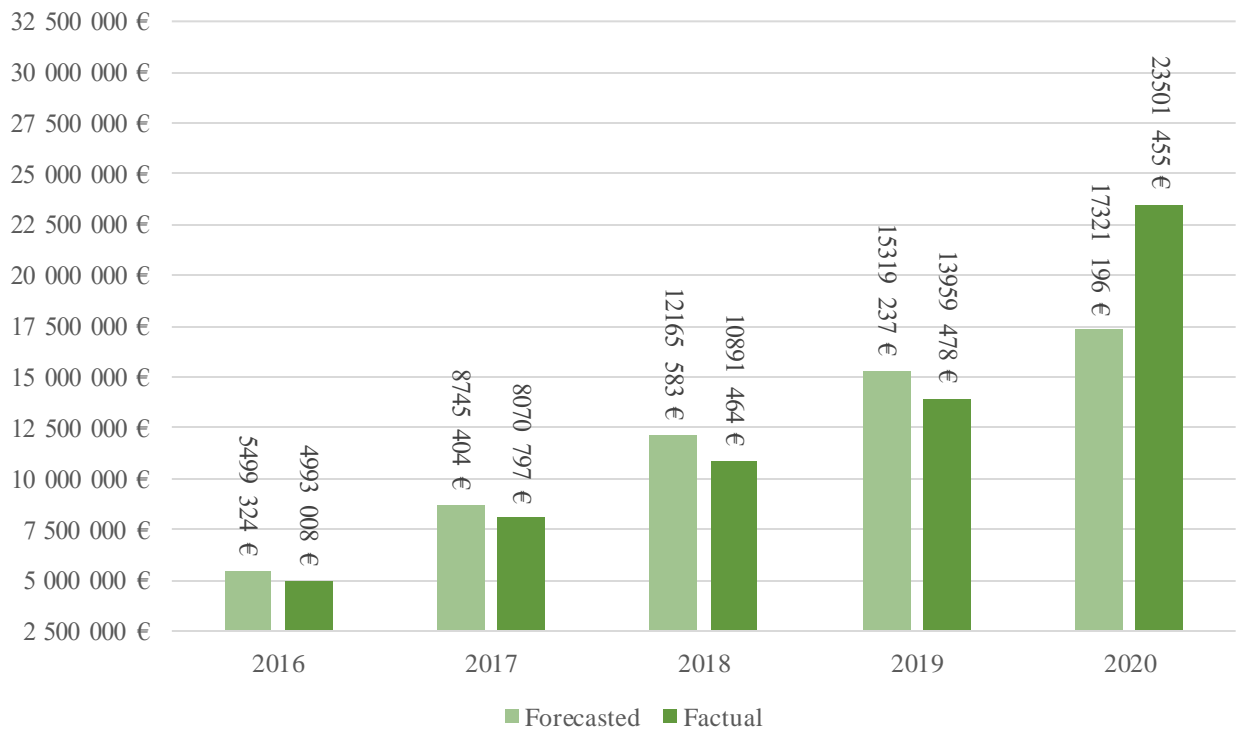


Fig. 14. Forecasted versus factual yearly sales, 2016-2020

From the data that suggests forecasted versus factual sales, it could be seen that from 2016 to 2020 company had been planning their sales with considerable inaccuracies. Every year, from 2016 to 2019, the factual sales were from 7,7% to 10,5% lower than expected, which indicates the weakness in prognosing, as this tendency remained the same. In 2020, the factual sales were almost 36% higher than planned, which challenges the supply chain at many levels. Such a high and unplanned increase could hurt the warehouse spacing and processes in general.

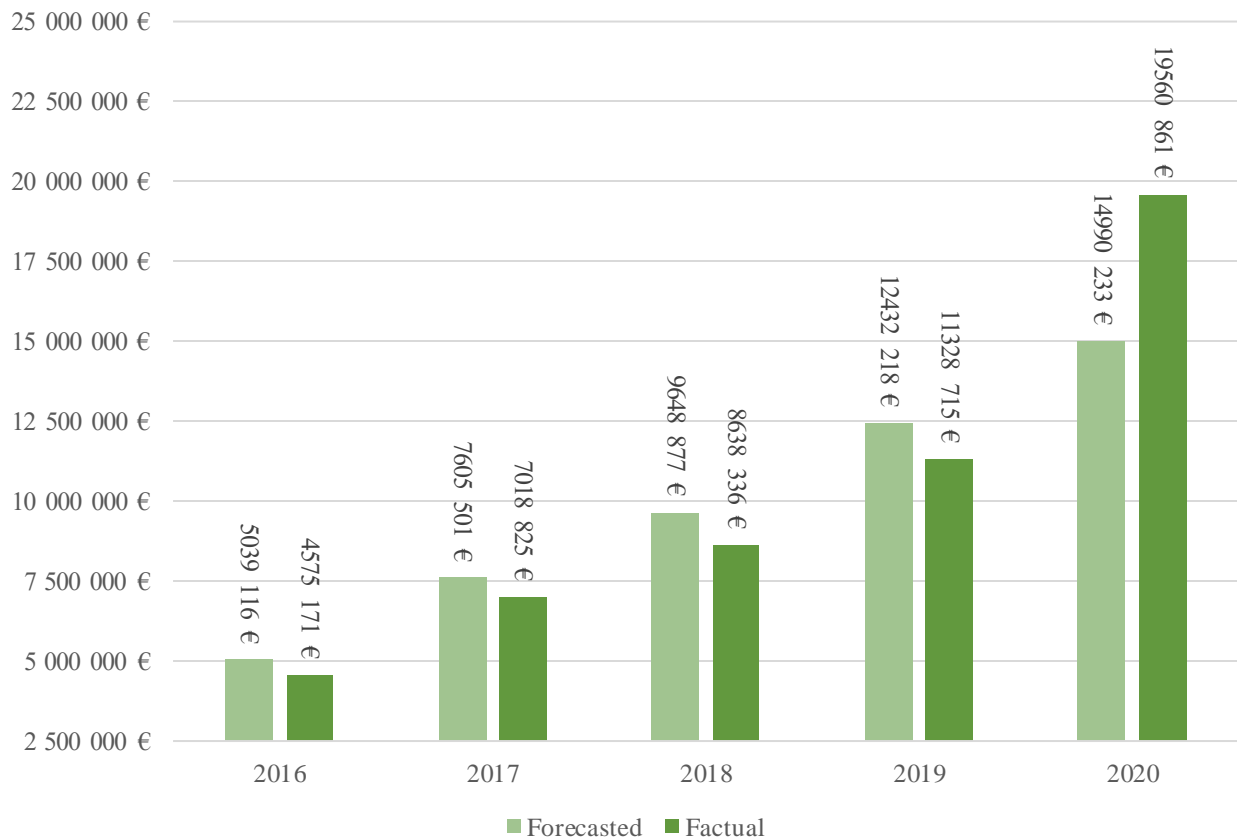


Fig. 15. Forecasted versus factual yearly purchases, 2016-2020

Data that shows forecasted versus factual purchases indicates the same problem as previously mentioned sales prognosis. To add, it really reflects how the wrongly planned sales affect purchase planning, as exactly theory suggested their dependency. It could be said that purchase forecasting needs improvements as well, but the bottom line is, without a well-planned sales prognosis, the purchase planning is not efficient at any given case.

To sum up all the data from qualitative and internal data methods, company is in the right direction of choosing forecasting criteria and understanding the importance of seasoning and campaigns but has to do a better job with new project implementation and improve its sales prognosis. It could be told that inaccurate purchase forecasts must be drastically improved as well, but as previously mentioned and argued with quantitative data, such inaccuracies happen due to poor demand planning.

4.3 Purchasing

Even though planning is essential, forecast is only a one step in the supply chain. In order to execute what was planned, the process of purchasing becomes necessary.

Table 13. Categorized purchasing aspects

Category	Subcategory	Quotes from interview
Purchasing process	Supply managers duty	<i>Responsible person checks the situation and evaluates if the order is needed.</i>
	Inbound logistics	<i>Communicate to warehouse about the deliveries when the order is picked up from the supplier.</i>
Purchasing challenges	Product availability	<i>There are huge shortages in this COVID-19 environment because the demand is much higher than supply</i>
	Late arrivals	<i>We do face late arrivals due to logistics delays and customs procedures.</i>
	Process adjustments	<i>Planning and ordering ahead, stocking up much higher quantities and searching for alternatives.</i>

From the interview, it is noticeable that ordering process lacks a systematic approach, as orders are being made on purchase managers understanding. This usually happens in startups and small organizations but as the company becomes a medium-sized, it could be hard enough to effectively deal with all the suppliers. According to the theory, system-based approach on purchasing is the key component for effective process management.

Expert indicated two problematic aspects – product availability during the pandemic and late arrivals due to logistics delays and customs procedures. Product availability is solved by planning and ordering ahead and stocking higher amounts of goods, which is also applicable to late arrivals. But for the most part, such solutions help not to lose sales but adds extra holding costs, worsens cash flows situation and most importantly, increases the warehouse space usage by a huge amount.

Table 14. Categorized factors of increased demand

Category	Subcategory	Quotes from interview
Increased demand factor	Warehouse improvements	<i>By expanding Central warehouse, expanding the external warehouses.</i>
	Relying on partnerships	<i>Cooperating with suppliers for higher availability of goods, looking for alternative supply channels.</i>
	Rare process change	<i>Our processes in such situations are adjusted too rarely.</i>

As the process of purchasing takes place, one of the many challenges that could happen is increased demand. Expert mentioned that they are dealing with such phenomenon by expanding warehouse space and contracting 3PL warehouses. It perfectly solves the space usage concern and adds flexibility to settle with bigger volumes. What is more, over the plan demand is only a positive sign when the product availability is at optimal level. Expert mentioned that cooperating with suppliers is the first thing done when there is a need for bigger supply. Also, alternative supply channels are explored and taken into consideration.

With a couple of good decisions, increased demand could be managed properly but the drawback that seems to be a key factor is lack of process adjustment. With quickly increasing demand, much higher purchases than expected and additional warehouses prepared, processes must change due to supply

chain becoming more complex and requiring more tactical decision. When facing an increased demand, forecasts being the key components, must be adapted according to current situation.

To sum up, company makes decisions on purchasing when it is needed and reacts to pandemic situation by stocking up more goods and expanding the premises, but definitely lacks the systematic approach on ordering process and leaves out process updates on the side. Such way of dealing with challenges could work in a short run but is not sustainable enough for a longer period of time.

4.4 Inventory management

Many things, such as turnover money, investments, purchases, warehouse space and keeping costs, as a few to be mentioned, depend on effective inventory management. Also, companies have their preferred indicators and ways of managing the stock to operate cost-efficiently.

Table 15. Categorized inventory management aspects

Category	Subcategory	Quotes from interview
Inventory management	Stock data	<i>Analyzing stock levels, sales, product turnover rate.</i>
	Overstock	<i>Promotional activities, a sell-out or distributed to another sales channel.</i>
	Shortages	<i>Additional order follows up.</i>
	Warehouse availability	<i>Company does not track warehouse space usage.</i>

It could be said that inventory is managed correctly, as product turnover rate plays a vital role in any company and it repeats the theory. Also, company tend to deal with overstock by making additional campaigns to increase the sales of specific products or distributing to other sales channel, which could be a local store warehouse in different market that company group operates. What is more, it is understood that shortages happen and only solution is placement of instant order. Talking about the warehouse space usage, company does not track such indication.

So, from the expert interview it is important to note that organization is keen on solving overstock and stock-out problems but are not concerned on finding the root of the problem as there were no specific comments made on such aspects, apart from not tracking warehouse space usage. Also, it could be said that company is very short in inventory management methods, which are designed to increase effectiveness of inventory management.

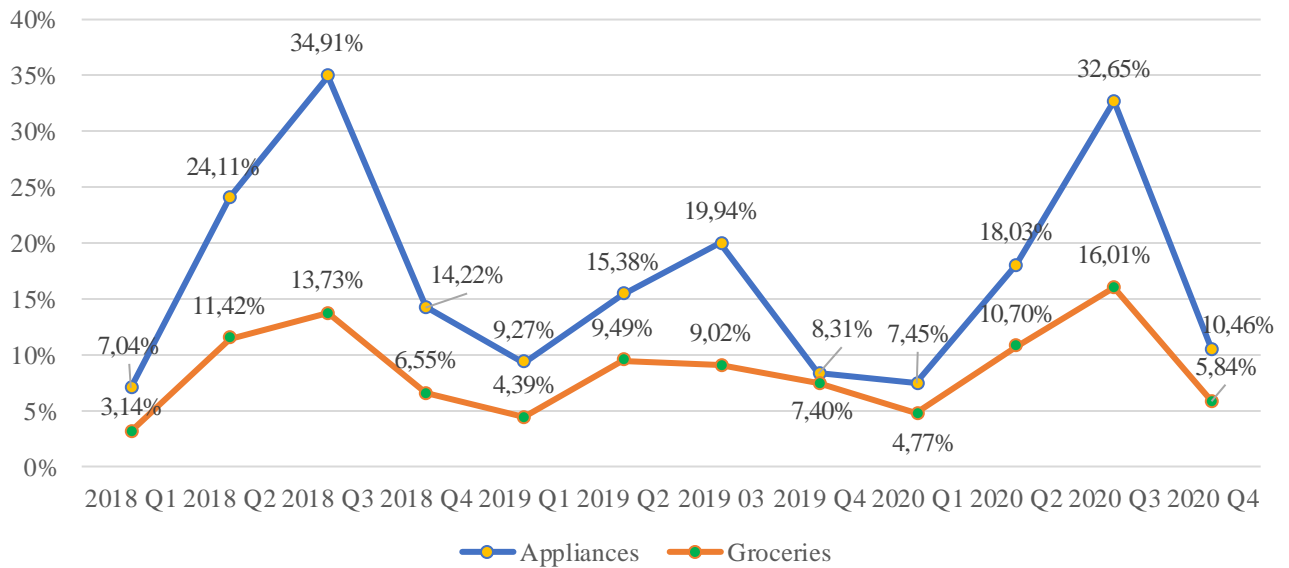


Fig. 16. Overstock percentage by category (appliances, groceries) per quarter, 2018-2020

A graph that shows the quarterly overstock percentage by category, suggests the substantial problematic aspects of inventory management and inaccurate purchasing. The biggest overstock tends to happen during the Q3, as according to expert, this quarter is the most active purchase-wise. It could be said that third quarter is preparation for Q4, which is the biggest sales season, but even in Q4 or Q1 the stock levels never reach a proper number as appliances are never under 7%. One of the biggest concern is heavy overstock during the Q2 in every year, keeping in mind, that this quarter was mentioned as the lowest in sales, but somehow purchases are made and increased stock results in overstock.

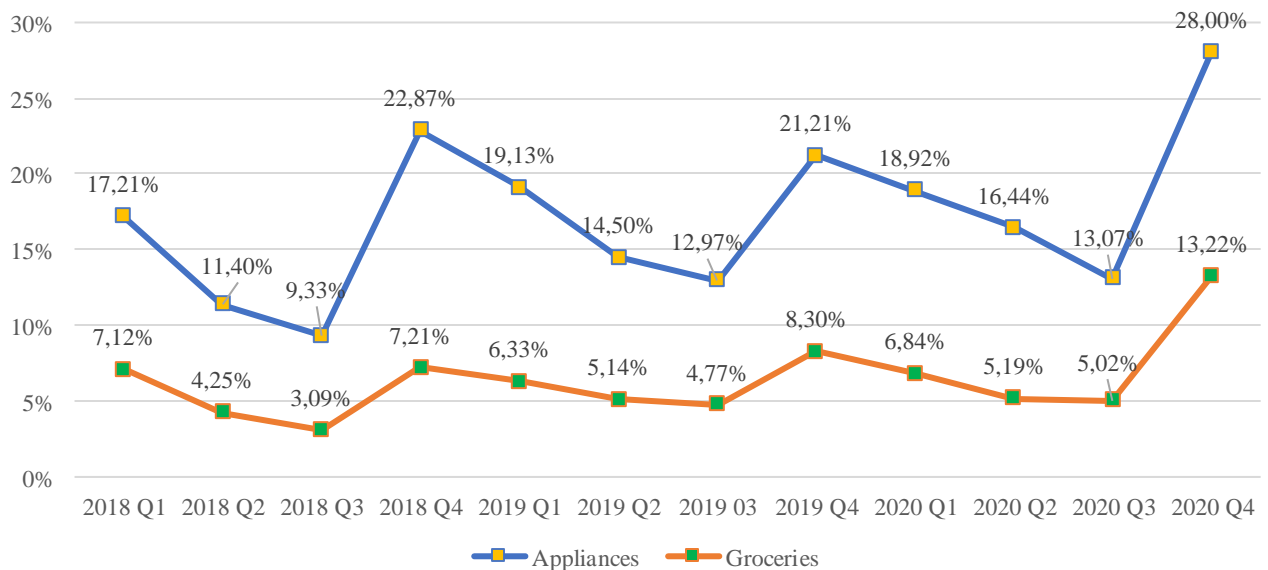


Fig. 17. Shortages percentage by category (appliances, groceries) per quarter, 2018-2020

This graph indicates the quarterly stock-outs percentage for two main categories. It could be seen that even the high amounts of purchases and overstock in Q3 does not help at the end of the year, as there were no single fourth quarter, where shortage percentage in appliance category would be lower than 21%. Also, the trend is obvious as the highest shortages tend to happen in Q1 and Q4, while the biggest overstock happens in Q2 and Q3.

To sum up, even with decent practices of dealing with existing overstock and shortages, company tends to come back to the same position year after year. There is no doubt about making promotions to sell-out overstock or make a quick order to fill the stock-outs, but the main problem here remains coming back to this situation time and time again. It was not mentioned any specific ways to manage the inventory so further recommendations from theory will be provided.

4.5 Seasoning effect

Some companies are heavily affected by seasoning due to demand increase and as a result, purchases and stock levels are drastically changing. To deal effectively with seasoning, it is needed to plan ahead, spend finances wisely and prepare stock for sales season.

Table 16. Categorized seasoning aspects

Category	Subcategory	Quotes from interview
Seasoning	Effect on purchasing	<i>[...] winter season, which is the most important sales-wise so the purchases increase by around 50% (in Q3) and by 30% in Q4.</i>
	Effect on inventory management	<i>During the second part of Q3 and first month of Q4, the warehouse keeps highest amount of goods.</i>

Expert indicated that for both, purchasing and inventory management, seasoning effect is felt. As the winter sales are the most important, purchases increase even by 50% in Q3, meaning the preparation is there. Naturally, the stock levels are increased in Q3 and Q4, before the biggest sales occur.

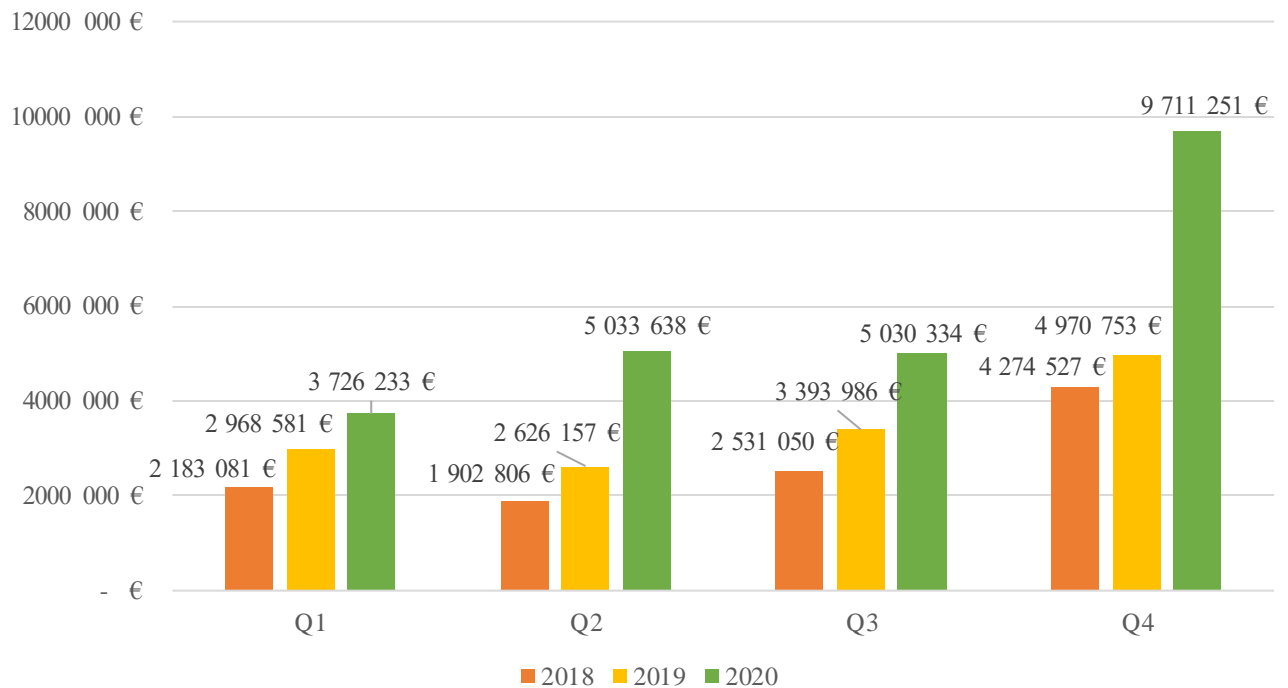


Fig. 18. Sales by quarter, 2018-2020

The graph shows sales by quarter for the last 3 years and it indicates how seasoning influences the sales. Comparing the sales from 2018 Q2 and Q4, there is a huge growth of 125%. In 2019, the growth is slightly lower but still accounts for almost 90% increase. If to analyze 2020, the trend is a little bit different in terms of least selling quarter, which became the first one. To clarify such phenomenon, most difference made the pandemic situation that were part of sales increase in Q2, making this quarter exceptionally successful. In fact, even with such a good quarter, the difference from Q2 and Q4 was still 93%. Such indications are more than enough to understand how important Q4 to the company success is, and how seasoning plays a vital role in planning and inventory management.

To sum up, company is heavily affected by seasoning as the purchases in Q3 are increased by 50% and sales could be higher by even 125% in Q4. Such numbers indicate the need for planning and purchasing ahead plus the strong warehouse preparation before the Q3 as the goods start to arrive. Forecasts must be influenced by seasoning trends, keeping in mind the potential demand growth of over the 100%.

4.6 Campaigns influence

Campaigns are one of the most effective ways to increase the sales. Some companies or even some markets are strongly relied on promotions. In fact, supply chains are the mechanisms that keep such activities alive and be able to flourish.

Table 17. Categorized campaign aspects

Category	Subcategory	Quotes from interview
Campaigns	Effect on inventory management and purchasing	<i>Stock before a campaign sometimes grows up around 30% more. The sales, the stock and the purchases, all of them increase.</i>
	Frequency of running a campaign	<i>Campaigns are made every month and even for a week length.</i>

From the expert interview, it could be said that company is heavily relying on campaigns and run them monthly. Such an answer indicates how quickly the demand for a specific product could grow. Also, the expert mentioned that before some of the campaigns, the total stock level increases up to around 30% or even more. This situation heavily influences the purchases as well, so the planning must be on point and, once again, warehouse must be ready to take care of the load.

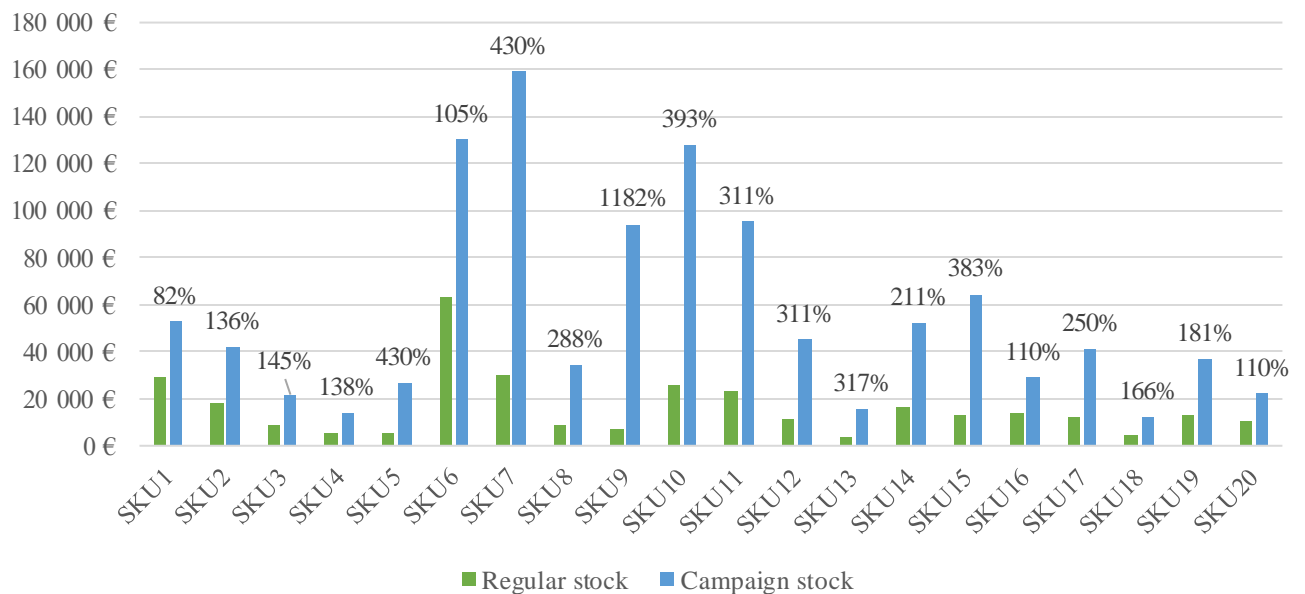


Fig. 19. 20 SKU's stock value during regular period and campaign period

From this graph, that represents the difference of stock value during regular sales and promotional sales, could be made an argument that campaigns initiate an incredible stock rise in value. Even the lowest increase in stock value was 82%, while the highest was a shocking 1182%. Such statistics could suggest organizations dependency on campaigns and how big of a stock is needed to run them successfully. Also, if campaigns are made every month and stock value rises by hundred percentages, it could be one of the answers to high overstock levels, which were indicated previously.

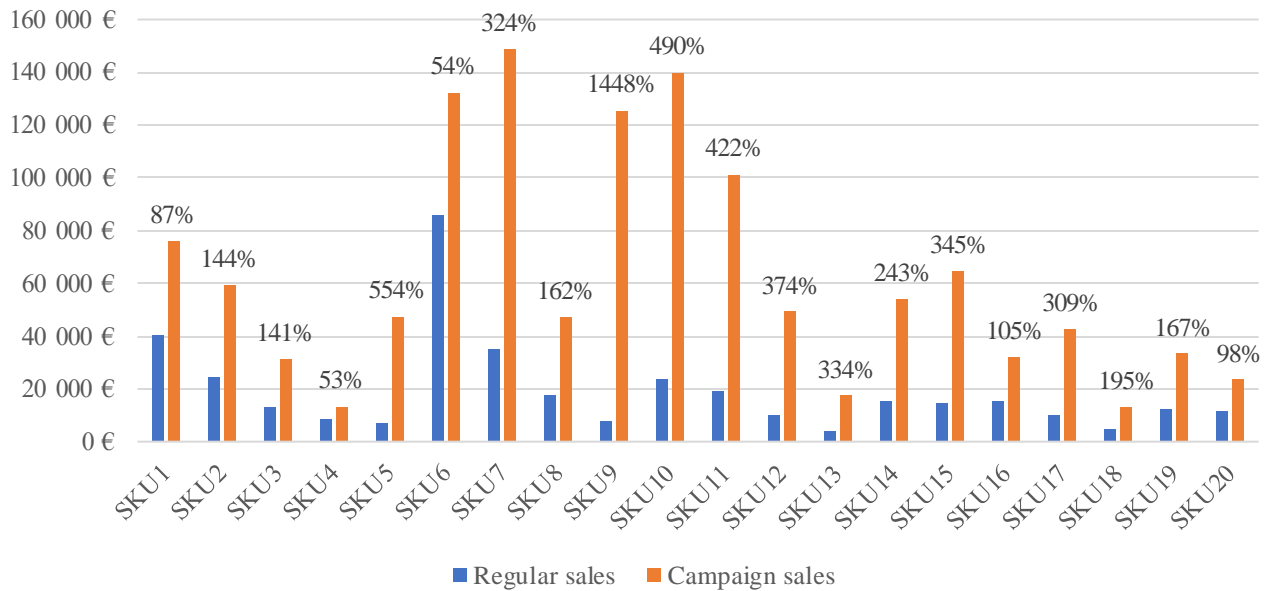


Fig. 20. 20 SKU's sales value during regular period and campaign period

This graph illustrates the sales difference per SKU during the regular period and campaign period. It truly reflects the previous comment made by an expert that campaigns cover around 50% of the total yearly sales. It also suggests the fundamental aspect of criteria for planning the demand and forming the purchase forecast.

In summary, company runs campaigns monthly, which take a huge part in sales success, increasing the SKU sales value by hundreds of percentages. On top of that, stock levels correlate with rise of sales, so it challenges many processes. According to previous findings on overstock and shortages, it could be told that such a high campaign effect could eventually be the main problematic aspect to such a high overstock and stock-out levels.

5. Discussion on suggested decisions to improve supply chain efficiency through purchase forecasting and inventory management

Table 18. Categorized results from the empirical research

Category	Subcategory	Results
Supply planning factors	Previous sales	The general overview of the supply chain seems on point as company correctly analyzes and frequently adjusts its strategy according to the market. Likewise, there are solutions for incomings as 3PL warehouse and local stores are used as additional destinations, next to the central warehouse.
	Market demand	
	Annual and half-annual planning frequency	
	Planning challenges	
Supply chain participants	3 PL warehouse	
	Central warehouse	
	Local stores	
Forecasting factors	Seasonal changes	Company is in the right direction of choosing forecasting criteria and understanding the importance of seasoning and campaigns but has to do a better job with new project implementation and improve its sales prognosis. It could be told that inaccurate purchase forecasts must be drastically improved as well, but as previously mentioned and argued with quantitative data, such inaccuracies happen due to poor demand planning.
	New projects	
	Campaigns	
Forecasting process	Market research-based data collection	
	Decision on quantity	
	Forecasting framework	
Purchasing process	Supply managers duty	
	Inbound logistics	
Purchasing challenges	Product availability	
	Late arrivals	
	Process adjustments	
Increased demand factor	Supply chain adjustments	
	Suppliers	
	Rare process change	
Inventory management	Stock data	Even with decent practices of dealing with existing overstock and shortages, company tends to come back to the same position year after year. There is no doubt about making promotions to sell-out overstock or make a quick order to fill the stock-outs, but the main problem here remains coming back to this situation time and time again. It was not mentioned any specific ways to manage the inventory so further recommendations from theory will be provided.
	Overstock	
	Shortages	
	Warehouse availability	
Seasoning	Effect on purchasing	Company is heavily affected by seasoning as the purchases in Q3 are increased by 50% and sales could be higher by even 125% in

Category	Subcategory	Results
	Effect on inventory management	Q4. Such numbers indicate the need for planning and purchasing ahead plus the strong warehouse preparation before the Q3 as the goods start to arrive. Forecasts must be influenced by seasoning trends, keeping in mind the potential demand growth of over the 100%.
Campaigns	Effect on inventory management and purchasing	Company runs campaigns monthly, which take a huge part in sales success, increasing the SKU sales value by hundreds of percentages. On top of that, stock levels correlate with rise of sales, so it challenges many processes. According to previous findings on overstock and shortages, it could be told that such a high campaign effect could eventually be the main problematic aspect to such a high overstock and stock-out levels.
	Frequency of running a campaign	

From the empirical research results, it could be said that “Coffee friend” group does the needed analysis and adjusts its supply chain strategy according to situation. Also, the understanding of seasoning and campaign effect is solid, but the constant growth in sales make the supply chain unstable. Purchase forecasts lack the accuracy and process of purchasing is at the basic level, which increases unnecessary stock levels over the desired limits. What is more, company lacks methods for effective stock management, so the inventory turnover ratio is not controlled according to the needs of cost-effective practice. On top of that, campaigns have a big influence on purchases and stock levels but are highly overlooked when making yearly forecasts.

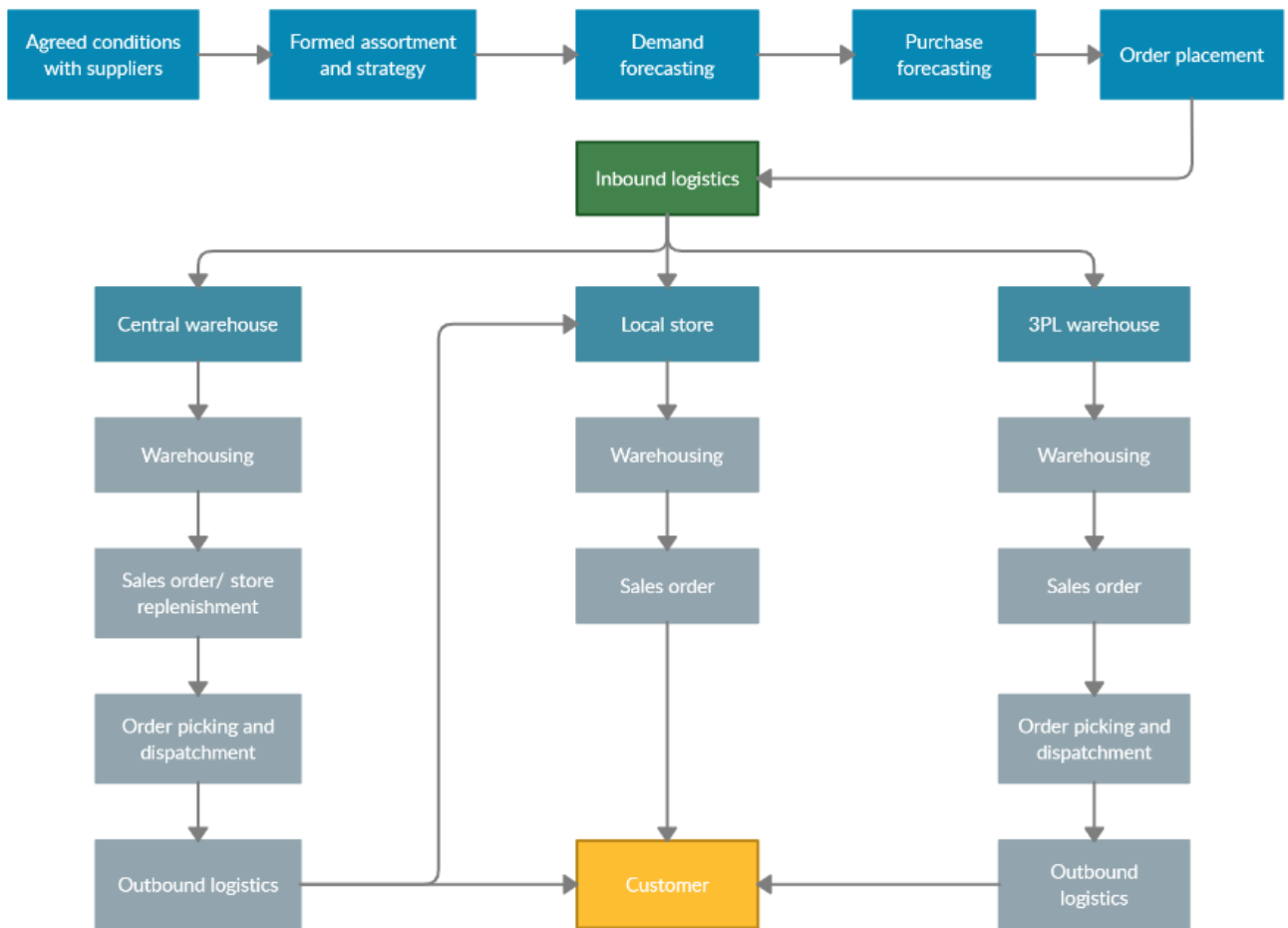


Fig. 21. Current supply chain of the “Coffee friend” group

Agreed conditions with suppliers. Company group starts the whole supply chain by finding suppliers, agreeing or re-negotiating conditions, which include:

- Pricing. Product regular pricing and campaign pricing for the specific or undefined period.
- Terms of payment. Whether the payment for the goods will be done before the loading or delayed for a specific time, 30 days for example.
- Delivery. It is a very important aspect when talking about high amounts of supply. Transportation covers lots of additional costs and liabilities, so preference is always to get the goods at place.
- Product warranty. Same as transportation costs, warranty cases are either covered by supplier or retailer. Most of the times, there is a warranty agreement for the specific time, 2 years for example.
- Ordering process flow. It depends on suppliers system and practices, how the different processes in the supply chain will be made.

Formed assortment and strategy. Company plans its assortment and its strategy by analyzing alternative products sales, demand, pricing and market research.

Demand forecasting. Company plans its demand by checking historical sales and applying predicted growth.

Purchase forecasting. Purchase forecasting is mostly dependent on demand forecasting, so the sales potential is fully reached. Also, as the purchases increase in Q3 and Q4, the planned quantities increase in parallel.

Order placement. A responsible person checks the stock levels and sales updates and decides whether the order is needed or not. Orders are made on suppliers level, meaning all of the products from the specific supplier, are considered.

Inbound logistics. Orders are either delivered or picked up by the company itself. Three main destinations include Central warehouse, local store or 3PL warehouse. Information to warehouse is passed by using “Google Sheet” when the goods are picked up from the supplier.

Warehousing. After the goods are received, they are distributed through the warehouse to specific places for keeping. Inventory stock situation is checked quarterly and product manager decides if their product is classified as an overstock, shortage or the stock levels are correct. Warehouse space usage is not tracked by the supply department.

Sales order/ store replenishment. After an order made by the customer or manually formed by the salesperson, information is passed to warehouse that initiates the process of picking.

Order picking and dispatchment. Orders are being picked by the order pickers who make the packages ready for dispatchment.

Outbound logistics. Prepared orders are picked up by courier and delivered to the customer or local store for stock replenishment.

Table 19. Theoretical solutions for supply chain inefficiency

Method category	Reasons of inefficiency	Theoretical solutions
Purchase forecasting	Poor demand planning	Exponential smoothing implementation.
Purchase forecasting	Lack of systematic approach on purchasing process	ARIMA model, Economic order quantity implementation, delivery scheduling.
Inventory management	Lack of methods for inventory management	ABC analysis, FIFO method implementation.
Purchase forecasting	Seasoning and campaign effect	Prophet forecasting implementation.

Even with a constant growth in sales and expansion of markets, company group faces struggles with its supply chain that results in ineffectiveness. One of the main reasons for such phenomenon is poor demand forecasting. Theory suggests that exponential smoothing should be the best choice going forward with a task to increase the accuracy of forecasting.

Apart from that, lack of systematic approach on process of purchasing, seems like an ineffective and time consuming way of making orders. To solve this problem, theory suggests ARIMA model,

Economic Order Quantity (EOQ) method implementation and delivery scheduling which would benefit the warehouse processes and general information flow as well. Such solution is based on technological improvements – systems that are using ARIMA and similar algorithms to suggest the ordering volumes and frequency.

One more reason to inefficient supply chain is lack of methods for inventory management. Inventory is being managed simply and rarely, without any substantial way or tool to analyze and improve. Theory suggests ABC analysis technique, which helps to categorize most important SKU's according to their importance. FIFO method is designed to lower the costs as the oldest stock is sold out first.

Finally, company group is heavily touched by seasoning, in terms of sales, purchases and stock levels, that are inconsistent throughout the year. It is known that organization earns half of the sales by running campaigns, so the stock has to be ready to perform at the highest volumes monthly. To improve efficiency in a such part of the supply chain, the theory suggests Prophet forecasting tool implementation.

A well-balanced inventory management system, that is designed to work on algorithms, could solve each and every problematic aspect and improve efficiency. The traditional systems help to forecast more accurately, suggest ordering according to historical sales and trends, while also keeping the stock levels at the lowest possible points. If taken **Slim4** inventory management system for example, the manufacturer suggests such improvements after installation:

- 50% less shortages.
- 2-5% increased sales.
- 10-30% less inventory value.
- 50% increased forecasting accuracy.
- Up to 50% increased efficiency of the supply chain.

Table 20. supply chain Efficiency indicators in “Coffee Friend” group

Efficiency parameter	Efficiency result
Inventory turnover ratio	6,25
Lost sales, 2020	4 052 144,90 €
Average lead time to customer, days	2,89
Average inbound logistics costs, per shipment	229,85
Demand forecasting accuracy, 2016-2020 average	86%

From the theoretical analysis on the supply chain, most common parameters to evaluate the efficiency are considered. Inventory turnover ratio currently is at 6.25, which means that company has sold its inventory 6,25 times during the year. A good inventory ratio is between 5 and 10, so it should be considered as decent with a lot of room for improvement.

Tremendous lost in sales was recorded back in 2020, with a more than 4 million euro. Any euro in lost sales is a sign of efficiency, so whatever the improvements would cost, it seems to be worth it.

Average lead time to customers is heavily dependent on available stock, courier agreements and warehouse performance on order fulfillment. The standard days indicate the agreed delivery time with couriers, when the internal processes are clicking and warehouse works ideally.

Table 21. Lead time from warehouse to customers

Direction	Standard, days	2020 average
LT	1	1,43
LV	1	1,78
EE	1	1,82
FIN	3	4,69
PL	1	1,97
DE	2	3,11
UK	3	5,43
		2,89

From the table it could be seen that the average delivery from the central to the customers is 2,89 days. Even though customers in Baltics and Poland usually get their shipments on time or with a single day delay, it is still a late delivery and a bad feedback from the customer.

Talking about transportation, the logistics costs could be one of the primary reasons for inefficient supply chain and poor profit. It was chosen to calculate the average inbound logistics costs per shipment, keeping in mind that majority of deliveries are completed by the supplier itself.

Table 22. Inbound shipping costs calculation

Total inbound costs, 2020	71 943,24 €
Inbounds shipments, 2020	313
Average cost per shipment	229,85 €

From the total of 313 arrivals that company group organized itself, the average cost per shipment is 229,85 euro. Shipping costs could be either saved by planning and consolidating bigger quantities or minimizing cases of urgent deliveries.

The average accuracy of demand forecasting from 2016 to 2020 is 86%, which shows the need for technological improvements as the Judgmental method alone, where a responsible person decides on quantities, does not work efficiently enough.

Table 23. Average accuracy of demand forecasting from 2016 to 2020

Sales	Forecasted	Factual	Plan reach	Accuracy
2016	5 499 324 €	4 993 008 €	91%	91%
2017	8 745 404 €	8 070 797 €	92%	92%

2018	12 165 583 €	10 891 464 €	90%	90%
2019	15 319 237 €	13 959 478 €	91%	91%
2020	17 321 196 €	23 501 455 €	136%	64%
				86%

Last year, the accuracy was at the lowest rate in 5 years, making only 64% from the primary plan. With that said, it is seen that growth of the company group was unexpected, rather than planned. Such numbers indicate the quickly increasing need for planning tools, as the company grows rapidly.

Table 24. Potential improvements after the system installation

Efficiency parameter	Efficiency result	System improvements
Inventory turnover ratio	6,25	7,5
Lost sales, 2020	4 052 144,90 €	2 026 072,45 €
Lead time to customer, days	2,89	1,45
Inbound logistics costs, per shipment	229,85	-
Demand forecasting accuracy, average	86%	99,9%

With clear supply chain efficiency parameters, approximate calculations could be made and potential results after the system installation are found. Talking about the inventory turnover ratio, it is known from theory, that higher turnover ratio means a quicker selling of goods, so the organizations overstock is minimized. Lost sales should be reduced by half, which saves around 2 million of euros yearly. Also, with optimal stock levels and less stock-out goods, average lead time to customers should be reduced to 1,45 days, which is excellent number for a company that operates in many different markets. Unfortunately, inbound logistics costs per shipment cannot be evaluated correctly due to potential increase in purchases, which affects the costs as the natural outcome. Apart from that, a systematic approach on forecasting seems like the most important aspect to be improved and should reach an excellent result in 99,9% of accuracy.

Expected results are based on inventory management system installation, which should cover such solutions:

- Providing whole range of methods for efficient inventory management.
- Accurate purchase forecasting and timely ordering.
- Reduced lost sales and other supply chain costs.

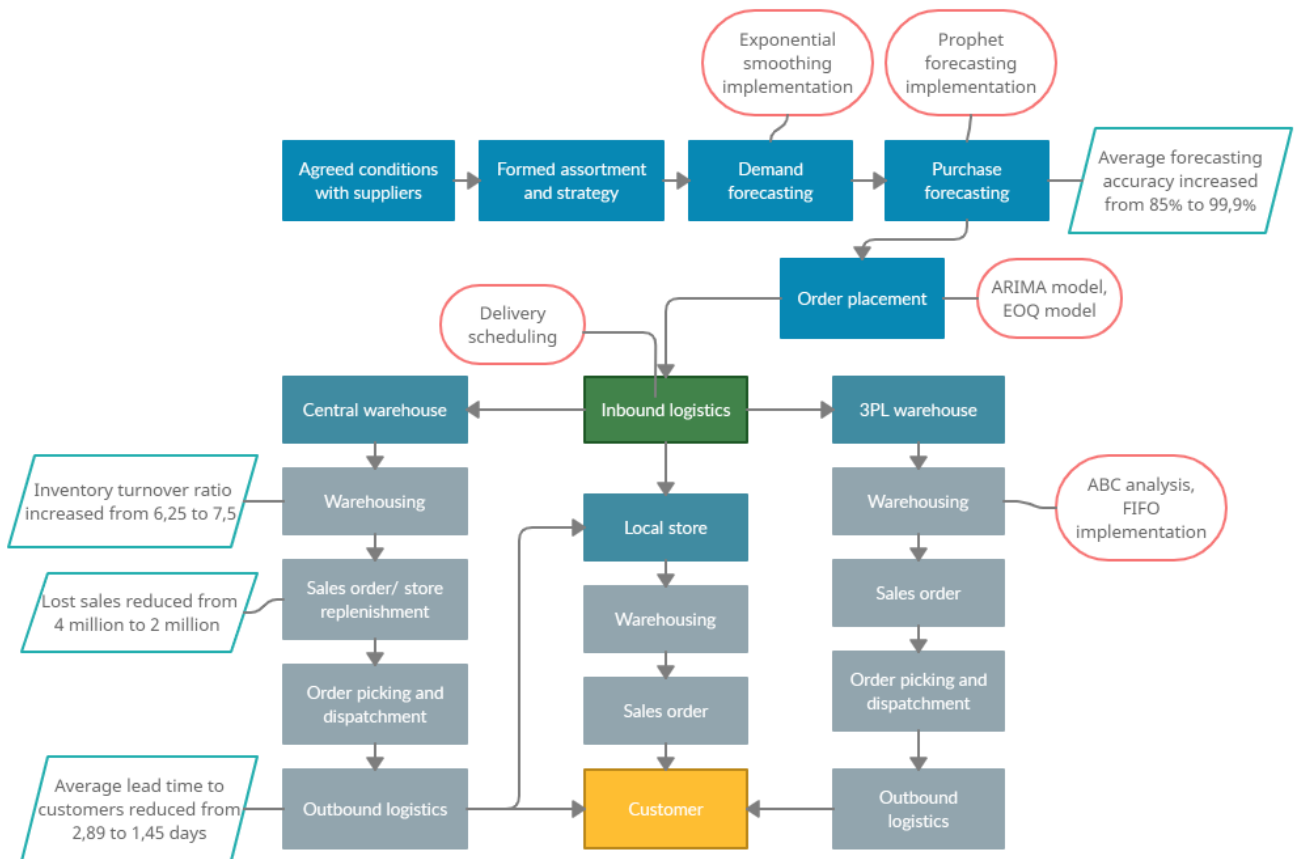


Fig. 22. Improved parts of “Coffee friend” group supply chain

From the visualized potential improved parts of the supply chain, organizations supply chain efficiency should improve through purchase forecasting and inventory management. As stated before, demand forecasting is the fundamental aspect to accurate planning and execution, so the exponential smoothing method implementation would help to improve the accuracy to 99,9%. What is more, purchase forecasting is fully depended on demand forecasting, so minimizing the mistake rate when planning sales, would eventually result in more accurate purchases. Also, as ordering processes requires a systematic approach, ARIMA and EOQ models would help in process of ordering. To add, inbound logistics are suffering from information absence, so delivery scheduling would mean better information flow, which helps to prepare the warehouse for incomings. On top of that, inventory management part lacks methods to deal with goods efficiently, so ABC analysis and FIFO method implementation would be a much needed upgrade for more efficient inventory management.

Conclusions

Supply chain is the driving force of the company, as it covers mix of processes to deliver products or services from manufacturing to end customer. To evaluate the efficiency of supply chain, theory was analyzed and specific parameters were chosen according to it.

1. Results from the problem analysis on “Coffee Friend” group suggested the need for more accurate sales prognosis and purchase forecasting, as forecasted versus factual purchases vary even up to 82%. Also, better inventory management, as warehouse space usage reaches 100% during last months of the year, which also suggests the possible influence of campaigns and seasoning.
2. Theoretical part on supply chain efficiency parameters was analyzed and the main elements suggested, which include sales and profit, lost sales, inventory turnover ratio, lead time, transportation costs, forecasting accuracy and technological advancement.
3. Theoretical methods of purchase forecasting were analyzed and several methods were found, such as ANN, Prophet forecasting, Moving average, Exponential smoothing, Visionary forecasting.
4. Theoretical tools of inventory management were analyzed and several methods were found, such as ABC analysis, LIFO and FIFO, Just-in-Time, Drop shipping, Stock-taking, Third-party logistics, fast, slow and non-moving analysis.
5. With clear stated problems, theoretical solutions model was introduced, while using analyzed purchase forecasting and inventory management methods.
6. Qualitative research and secondary data analysis were implemented to understand what kind of purchase forecasting and inventory management methods organization is using and its received experience from the current supply chain. It was found that primary reasons of inefficiency are poor demand planning, lack of systematic approach on purchasing process, lack of methods for inventory management and campaign and seasoning effect.
7. Supply chain efficiency improvements were suggested and potential results evaluated through defined parameters. To solve the existing problems, an inventory management system installation was suggested. According to the system manufacturers, several improvements should be reached: improved forecasting accuracy to 99,9%, reduced lost sales to 2 million, reduced lead time to customers to 1,45 days and increased turnover ratio to 7,5.

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