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Real-time Balance Management in Omnichannel Retail

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Abstract

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The purpose of the engineering thesis was to study the effects of the client's balance management on the customers of the e-commerce store. The aim was to identify possible tools and methods to achieve the desired level of balance management. Research and piloting on this topic have been carried out in the target company, so the material has been created to support an ongoing development project.

The work was carried out based on interviews, store visits and sampling. In addition, the material on the various technologies developed for balance management was identified, and their possible new/further developed uses in the future were considered.

Based on this research, a list of potential tools was drawn, and their suitability was evaluated for companys needs. The company can use the material in its development project by eliminating technologies found to be unsuitable and by further researching and piloting alternatives that may work.

Keywords:	balance management, eCommerce, omnichannel retailing

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Insinöörityön tarkoituksena oli tutkia työn tilaajan saldonhallinnan vaikutukset verkkokaupan asiakkaisiin. Työn tavoitteena oli selvittää mahdolliset työkalut ja metodit, joiden avulla saldojenhallinnassa päästäisiin tavoitetulle tasolle. Kohdeyrityksessä on tehty tästä aiheesta tutkimusta ja pilotointeja, joten työn materiaali on luotu tukemaan käynnissä olevaa kehitysprojektia.

Työ toteutettiin haastatteluiden, myymälävierailun ja otannan pohjalta. Lisäksi kartoitettiin materiaalia eri saldonhallintaa varten kehitetyistä teknologioista ja pohdittiin näiden mahdollisia uusia/edelleen kehitettyjä käyttötarkoituksia tulevaisuudessa.

Tutkimuksen pohjalta yritykselle laadittiin listaus mahdollisista työkaluista sekä niiden sopivuudesta heidän tarpeisiinsa. Yritys voi hyödyntää materiaalia kehitysprojektissaan poissulkemalla sopimattomaksi todetut teknologiat sekä tutkimalla lisää ja pilotoimalla mahdollisesti toimivat vaihtoehdot.

Avainsanat: saldonhallinta, verkkokauppa, kaikkikanavainen vähittäiskauppa

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List of Abbreviations

OSA: On-shelf availability

OOS: Out-of-stock

IRI: Inventory Reconciliation Inaccuracy

SURF: Speeded-Up Robust Features

1 Introduction

With digitalization and the rise of online shopping, businesses can better reach consumers. In addition to brick-and-mortar stores, eCommerce enables enterprises to engage in omnichannel commerce, which in the best case, increases sales. However, brick-and-mortar stores should not be underestimated, as most sales still occur in a physical store.

Accurate balance management is essential not only to maintain customer satisfaction but also to underpin the work of the procurement department. Customers want to order products online quickly and easily; if this is not the case, the company can lose sales and customer loyalty. eCommerce also allows customers to check product availability before going to a brick-and-mortar store, so omnichannelling guides and facilitates the shopping process for customers.

In this thesis, the subject of the study is real-time balance management in company x, which is engaged in omnichannel trade. The background is the company's need to find the best possible way to monitor balances in real-time throughout the order-supply chain. The company also wishes to improve their customer satisfaction both in the brick-and-mortar store as well as the online shop.

The topic has already been studied and approaches piloted in another branch of the chain, but no single model has been established. Therefore, the aim is to provide the company with more information and suggestions to support the tests and results already carried out, to bring the company closer to its goal of real-time balance management.

The research was conducted as qualitative and quantitative research. This included reviewing the source materials, discussions with people working on the topic, a shop visit and sampling.

1.1 The aim of the study

The thesis aims to examine the current state of balance management and possible tools and methods to facilitate it. The work is limited to focusing on eCommerce and customer satisfaction, mainly how Balance Management affects both and how the most common challenges could be addressed.

2 Industry change and business models

In order to make intelligent and successful investments, an organization needs to understand the change in the industry. The internet's disruptive change came as a shock to many companies, and the resulting transformational measures are still being taken, perhaps somewhat belatedly. Put simply; industries are evolving along four different trajectories - radical, progressive, creative, and intermediate (Table 1.). These four trajectories set the boundaries of what can generate profit for a company, and innovation outside these boundaries can result in losses. No innovation strategy will work for every firm in every industry but must be tailored to the nature of the change taking place in the industry. (McGahan, 2004.)

Table 1. Industry change model (McGahan, 2004)

		Core activity	
		Threatened	Not threatened
Core assets	Threatened	**Radical change:** All in the open e.g., landlines, travel agencies, express mail	**Creative change:** The industry is constantly changing and developing its resources and value e.g., films, investment banks
	Not threatened	**Intermediating change:** Sensitive relationships e.g., car dealers, auctions	**Progressive change:** Companies implement gradually and adapt to the situation e.g., aircraft construction, commercial airlines, freight transport

Radical change occurs when core activities and core assets are threatened with obsolescence. In industry, this is relatively unusual but possible, for example, after the mass introduction of new technology. Changes in legislation or customer tastes can also drive radical change. An industry on this changing path will be forced to change completely, but clear and implemented change usually takes decades. The result can be a wholly reconfigured but weakened industry unless a company starts a staged change strategy early on, if only they recognize that they are on the radical business frontier early enough. (McGahan, 2004.)

Intermediate change is more common than radical change. In this transformation path, the industry's core business is threatened, but the core assets retain most of their value if they are used in a new way. Companies on the intermediate change path should find new ways to extract value from their core assets, such as by starting a new business or industry. Another option would be to sell assets to former competitors. Organizations that identify a change path in their industry can use the relatively slow-moving need for change to transform their organization strategically. Companies can manage the intervening change by reconfiguring old assets in new ways. (McGahan, 2004.)

Industries undergoing creative change tend to have stable relationships with customers and suppliers, but assets are unstable. Companies on this transformation path can continue to sustain their performance over the long term through creative solutions and innovation. The best performers in this transformation path are those who have been in business for a long time and can exploit their networks and know-how. They can also outsource development and project management if they lack innovation skills in-house. (McGahan, 2004.)

In progressive development, core competencies and core functions are not in danger of becoming obsolete, but change is taking place in the industry. Technological advances within a business can drive business quickly, but generally, significant changes and improvements are gradual over time. Progressive change industries aim to build resources and capabilities steadily and incrementally. Where the risk of displacement is low, innovation can occur

calmly and deliberately, and firm performance depends on a rapid response to feedback. (McGahan, 2004.)

2.1 Business Models

A business model is a way a company conducts its business, i.e. how it generates revenue. It describes how a business makes money by defining where it is positioned in the value chain. As organizations compete for customers and resources, a good business model emphasizes specific activities and approaches that enable a company to succeed - to attract customers, employees and investors and to deliver products and services profitably. (Petrovic, Kittl and Teksten, 2001.)

There are very different types of models depending on the sector of the business (Appendix 1). The simplest include selling a good or service to a customer and making a profit when sales revenues exceed operating costs, the more complex include, for example, the entertainment sector. In addition to the traditional models, Internet commerce has given rise and continues to give rise to new business models. (Rappa, 2001.)

2.2 eBusiness Models

eBusiness models are essentially the same as traditional business models, but the trade is conducted online, increasing the variety of ways to trade. The main difference is how the business model is used to create value. How the business reaches its customers and how the customer engages with the business. When choosing a business model, it should be known what is being sold and to whom. (Osterwalder and Pigneur, 2002.)

eCommerce enables nine distinct business models, including the most commonly known B2B and B2C models.
  - B2G: where a business offers products and/or services to government agencies

- C2B: where consumers sell products and/or services to businesses, for example, social media influencers
- C2C: transactions between consumers
- C2G: a small segment in which consumers may supply to government agencies
- G2B: mostly government agencies providing service and support to businesses instead of commercial activity
- G2C: paying taxes, registration and similar transactions
- G2G: not considered as eCommerce but mainly electronic communication between government agencies and sharing of information resources, etc. (Janamanchi, 2011.)

The primary business model categories are intermediation, advertising, information broker, retailer, manufacturer (direct), partner, community, subscription, and utility. These models can be implemented in different ways, and a company can combine several of them as part of its Internet business strategy. For example, a combination of advertising and subscription models is common for content-driven businesses such as entertainment. (Rappa, 2001.)

2.3 Chain Business

Chain business refers to the operational chain of retail stores and a chain unit operating in a uniform manner. Its objective is a consistent assortment, marketing, purchasing and logistics throughout the chain. Coherent, strategic choices and decisions shape the final chain concept in the different areas. Chain operations give the company a number of advantages, such as extensive sales and nationwide promotion. These advantages result from centralized purchasing, efficient decision-making, and total sales with low unit costs. (Puolimatka, 2020 [Kautto & Lindblom & Mitronen 2008, 118].)

There are two types of chain structures: contractual and proprietary chains. The latter's management is more straightforward because, as a centrally owned chain, its management relationships, organizational structure, and decision-

making mechanisms extend clearly and directly to the retail level. In other words, all major decisions affecting all aspects of the chain's operations, such as marketing, purchasing and pricing, are centralized in a single management body. As a result, the chain's strategy and its customer promise can be implemented in all individual stores precisely as defined. (Puolimatka, 2020 [Kautto & Lindblom & Mitronen 2008, 100].)

The economic and image benefits of the chain are achieved through centralized operations and purchasing and customer processes. In order to create and maintain a credible chain brand, all parts of the chain must be committed to the decisions made by the chain unit and act accordingly at the customer interface. The cornerstones of chain operations are cost efficiency and customer satisfaction. (Puolimatka, 2020 [Kautto & Lindblom. 2004, 15, 133].) However, with the development of technology, new requirements have emerged alongside cost-efficiency and productivity, such as customer orientation, management and staff skills and knowledge intensity. (Puolimatka, 2020 [Kuusela & Neilimo. 2010, 22].) In today's context of continuous development, the centralized approach works well because when changes occur, it is easy to train the chain's staff through standard training programmes, and the participation rate of stakeholders is practically 100 %. (Puolimatka, 2020 [Kautto & Lindblom. 2004, 146].)

3   Omnichannel Retail

"Omni" means all, so omnichannel refers to a seamless experience using all channels. It's combining a brand's marketing, customer data collection and sales efforts across all the channels their customers are using, online and IRL, into one clever cohesive strategy. The dominant feature of omnichannel retailing is multiple channels of interaction between the consumer and the store to transact. For example, the situation where a consumer is in a brick-and-mortar store and uses the company's online store or mobile app to search for product information, compare product prices or use a discount voucher. (Lazaris and Vrechopoulos, 2014.)

The differences are pretty slight if we compare the terms omni and multi (Table 3). In multichannel, attention is mainly focused on the growth of online channels and their impact on traditional channels such as stores and catalogues. The different channels have been developed and managed separately in this evolution, with no effective integration. In the omnichannel space, the online channels have been joined by mobile devices and the change they have brought/enabled in retail. One of the main differences between omni- and multichannel is blurring the boundaries between the channels, i.e., their integrated development and management. In addition, omnichannel includes more channels. (Verhoef, Kannan and Inman, 2015.)

Table 2. Multichannel versus omnichannel management (Verhoef, Kannan and Inman, 2015)

	Multichannel	**Omni-channel**
Channel focus	Interactive channels only	Interactive and mass-communication channels
Channel scope	Retail channels: store, online website, and direct marketing (catalogue)	Retail channels: store, online website, direct marketing, mobile channels, social media Customer touchpoints (incl. mass communication channels: TV, Radio, Print)
Separation of channels	Separate channels with no overlap	Integrated channels providing seamless retail experiences
Brand versus channel Customer relationship focus	Customer – Retail channel focus	Customer – Retail channel – Brand focus
Objectives	Channel objectives (i.e., sales per channel; experience per channel)	Cross-channel objectives (i.e., overall retail customer experience, total sales over channels)

In an omnichannel environment, customers have more choices and ways to shop, and the company can control its operations, for example, by controlling product

content. The customer's channel choice depends on the breadth and depth of choice available in each channel. In an omnichannel environment, different ranges are sought and purchased through various channels, so the extent of each channel will affect the competitiveness of the firm. In addition, multichannel retailers can better control inventory costs by having a more comprehensive range of products online than in brick-and-mortar stores, for example, by offering a wider range of colours of a particular product only online. (Agatz, Fleischmann and van Nunen, 2008.)

In omnichannel commerce, consumers' channel switching, decision-making, and brand loyalty are essential considerations. Consumers want to get the best possible deal, for which they compare multiple channels and are willing to switch to another supplier to get their purchase. To combat this behaviour, retailers should offer omnichannel benefits that differentiate them from competitors. A well-managed online channel can engage consumers with the retailer to increase the number of in-store purchases. (Lazaris and Vrechopoulos, 2014.)

3.1   eCommerce

Over the years, trade has experienced significant turning points. The first is the emergence of department stores, the second is mail order, the third is the development of discount stores, the fourth is the emergence of eCommerce, and the fifth is digitalization and multichannel commerce. (Valli *et al.*, 2015.) eCommerce is defined in VanHoosen's book as "Using a computer-mediated electronic network such as the Internet as a mechanism for transferring ownership of or rights to use goods and services". In other words, it is an online commerce that both businesses and consumers can conduct. eCommerce is therefore open to all and can be used for B2B, B2C, and C2C trade. (VanHoose, 2011.)

A company offering its services on an online platform can exploit the digital footprint left by the consumer through an external file called a 'cookie' downloaded from the web server. The company can see how the consumer

behaves on the website and whether and how often they use it. Cookies enable the analysis of consumer behaviour and the development of a more pleasant online experience for potential customers. At the same time, not all consumers want their data stored without permission. Cookies can keep the consumer's ISP address, email address and even physical address, so there are obvious privacy concerns. (VanHoose, 2011.)

For omnichannel operators, brick-and-mortar stores still play a significant role, although online sales are becoming increasingly common. eCommerce is still widely used to access information, while shops are still used to buy products. Therefore, it offers businesses opportunities to better serve customers by supporting their purchasing decisions, mainly by providing essential product information. (Valli *et al.*, 2015.) eCommerce, therefore, enables businesses to understand consumer behaviour better, compare products and make it easier for customers to buy.

3.1.1 Opportunities for eCommerce

eCommerce and the internet have created many opportunities for companies to improve their business. For example, using social media for marketing can boost a company's sales. Other ways to boost sales include email campaigns, search marketing or online advertising. Online marketing can reach a broader customer base, as the distance between the shop and the customer is irrelevant. The speed of service also attracts customers to make a purchase, as the product can be ordered and paid for easily, and delivery is quick. (Menaka and Seethal, 2018.)

In addition to home delivery, click and collect can be a more profitable method if it can add orders to regular deliveries. The service allows shoppers to pick up products at locations of their choice and receive them themselves, probably more quickly and at a lower cost than the home delivery option. (Chapman, 2014.)

Duncombe, Heeks and Abraham (2005) list in eCommerce for Small Enterprise Development that eCommerce increases brand awareness among customers by

making it easier to share information about new products and services with a broad audience. In addition, customer loyalty can be increased by offering customers a more responsive order-taking and after-sales service.

3.1.2 Issues of eCommerce

One of the problems of eCommerce is the low average order prices against high overheads. Minimum order values could remedy this problem, but it is best done subtly, for example, by encouraging customers with special offers. (Chapman, 2014) In addition, eCommerce can divert customers away from brick-and-mortar stores, whose continued operation is still essential. (Duncombe, Heeks and Abraham, 2005) If this happens, the business may become unprofitable.

Security and privacy concerns can make people afraid to order online. Customers have to provide personal information such as their name and address for delivery and credit card details for payment. If a company's online store suffers a data leak, it could lose its customers altogether, even if the problem is fixed. (Menaka and Seethal, 2018.)

3.1.3 The customer's buying process

Consumer purchasing behaviour has changed with the development of technology. The internet is increasingly used at every stage of the shopping process (Figure 1), as many customers research products online before buying in-store. (Valli *et al.*, 2015.) Therefore, it would be helpful for companies to identify the different stages of the process so that the online platform can be designed to meet customer preferences and needs at different stages of the process. By creating a customer profile, the company can understand the customer's interests and channels and use this information in its communications. (Partanen, 2019 [Kananen 2013, 62].)
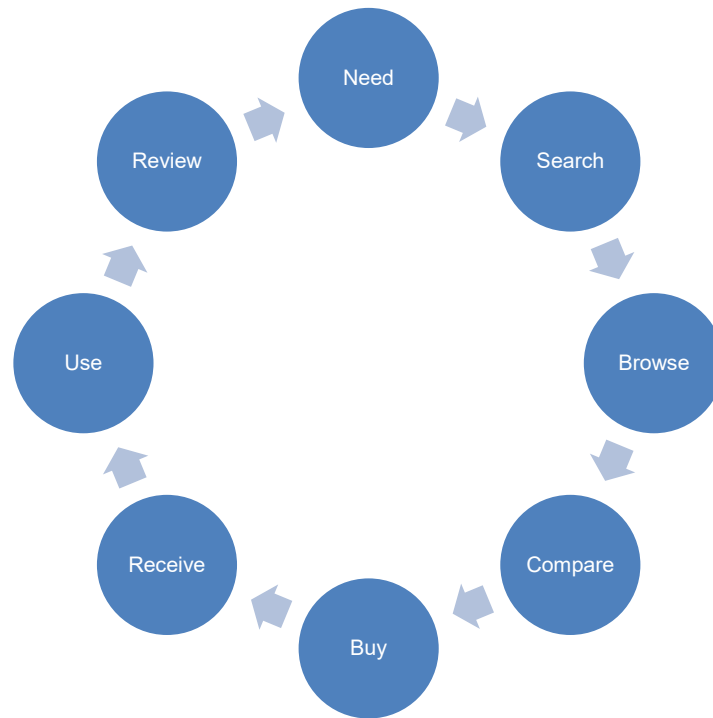
Figure 1: Shopping process (Valli *et al.*, 2015)

Although the consumer's shopping process has remained the same for years, the rise of online sales has brought new facets and convenience. From the consumer's point of view, the buying process can be divided into five different stages:

1. Arousal of interest.

2. The search for information.

3. Finding and buying the product.

4. Picking up, delivering and returns.

5. After-sales and reviews.

Traditionally, customer interest has been generated through shop windows and catalogues, but nowadays, it is also generated through websites and social media. The search for information has expanded from in-store customer service

to online product reviews and price comparison sites. Thanks to online shopping and the availability of information, finding and buying have become more accessible. Omnichannel commerce makes it possible to get a product delivered to your home, for example, and there is no need to go all the way to the store to return it. Finally, the product can be reviewed on different websites, sharing information more widely. (Valli *et al.*, 2015.)

4   Operations Management

Operations management is about how organizations create and deliver services and products. It's the activity of managing the resources that create and deliver services and products. The operations function is the part of the organization responsible for this activity. Every organization has an operations function because every organization creates some type of service or product. However, not all types of organizations will necessarily call the operations function by this name. Operations managers are the people who have particular responsibility for managing some, or all, of the resources which comprise the operations functions. (Slack, Brandon-Jones and Johnston, 2010.)

Operations in the organization

The operations function is central to the organization because it creates and delivers services and products, which is its reason for existing. The operations function is one of the three core functions of any organization. These are:

- The marketing (including sales) function is responsible for communicating the organization's services and products to its markets to generate customer requests.
- The product/service development function is responsible for developing new and modified services and products to generate future customer requests.
- The operations function is responsible for creating and delivering services and products based on customer requests.

In addition, the support functions enable the core functions to operate effectively. These include, for example, the accounting and finance function, the technical function, the human resource function, and the information systems function. (Slack, Brandon-Jones and Johnston, 2010.)

Operations performance objectives

To ensure the proper allocation of resources to an operation, the operation must be monitored through its performance. The main task is identifying appropriate performance measures related to internal and external factors relevant to the organization's competitiveness. The performance of an organization can be measured by five different objectives; quality, speed, reliability, flexibility and price. (Greasley, 2007.)

From a customer and operational perspective, quality means slightly different things. Quality is about reliability, performance and aesthetics for the customer, but for operations, quality is about how closely a product or service meets its intended specification. Good quality benefits an organization's competitiveness, for example, by increasing the reliability of the delivery process, reducing the cost of repairing defects and increasing customer satisfaction through high-quality products or services. (Greasley, 2007.)

Speed refers to the time it takes for a customer to receive their request. A storage system can potentially reduce the order-to-delivery time to the customer, but there are risks that need to be considered. These include product obsolescence, working capital costs and reduced ability to react quickly to changes in demand. The advantage of speed is improved customer satisfaction through shorter delivery times. (Greasley, 2007.)

Reliability means consistently meeting the delivery date promised to the customer. In some situations, the customer may be happy with faster delivery. Still, in the case of retail, for example, too fast delivery can be detrimental to the customer if storage space is limited. So customer satisfaction is not necessarily affected by faster delivery of a product or service but by the fact that it is delivered as expected. (Greasley, 2007.)

Greasley (2007) describes flexibility as the ability of an organization to change its operations quickly. Depending on the organization's business, this can mean, for

example, the ability to respond quickly to changing customer needs by changing product or service models or adjusting production volumes to meet demand. (Greasley, 2007) By changing its operations quickly, a company avoids the additional costs that could result from, for example, an inappropriate product mix and overproduction.

Costs are the financial resources used to cover the activities of an organization. Costs can be divided into several categories, the most important of which are personnel, facilities (including overheads) and materials. In a price-competitive market, it is essential that the cost base of an organization is lower than that of its competitors. In this case, if the price is the same as the competitor's, the firm will make more profit, or if the price is lower, it will increase its market share. Strategically, the cost can affect the ability to offer a product or service in a market where competitors cannot offer the same. Thus, by keeping costs close to or below the market average, the organization can prevent competitors from entering the market and maximize its profits. (Greasley, 2007.)

Although the aim of organizations is to reduce costs and maximize profits, immediate cost cutting is not recommended as it can damage the operations ability to function. A better strategy would be to address other performance objectives first, as improving these can already reduce costs. It has been recommended that the improvement strategy should address performance objectives in order of quality, reliability, speed, flexibility and lastly cost. (Greasley, 2007.)

4.1 Supply chain management

Supply chain management coordinates all company activities on the supply and demand side to satisfy the end customer (Figure 2). To achieve this, the supply chain must achieve appropriate levels of the five performance objectives: quality, speed, reliability, flexibility and price. Supply and demand management deals with the interface of activities in the supply market. In contrast, logistics management focuses on the flow of materials and information through the

distribution channel to retailers or directly to consumers. Material management refers to the flow of materials and information only through the immediate supply chain. (Slack, Brandon-Jones and Johnston, 2010.)
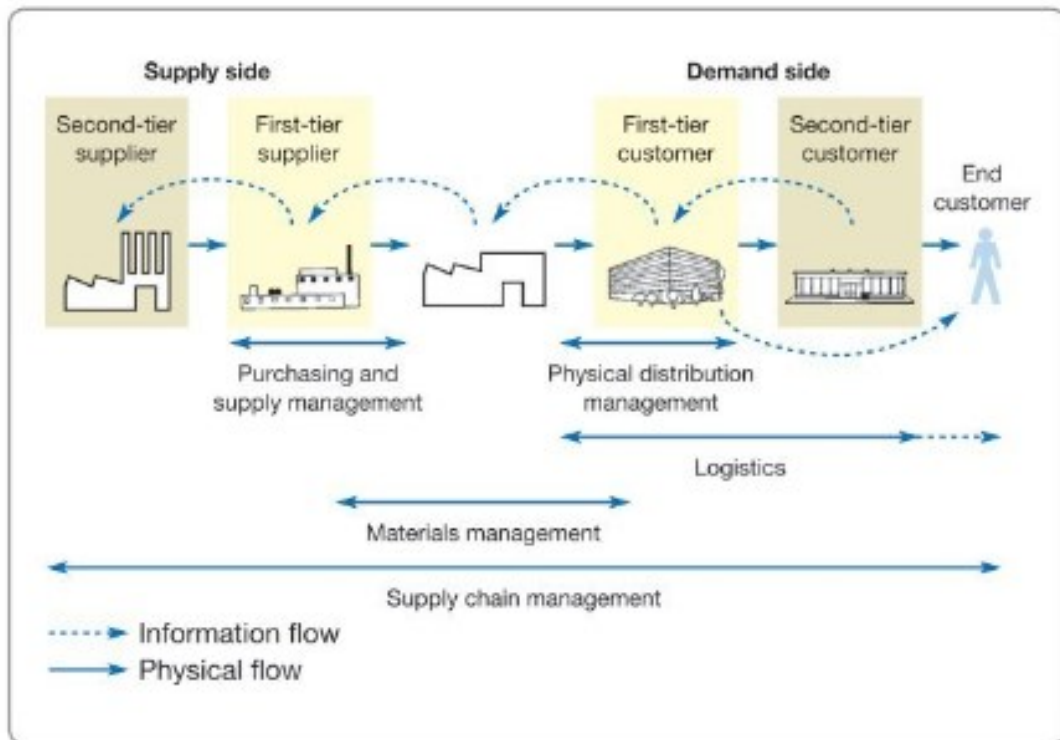

Figure 2. Management in different parts of the supply chain (Slack, Brandon-Jones and Johnston, 2010)

4.1.1 Supply and demand management

Every purchase made by a company starts with the identification of a need. Supply management includes supply planning, i.e. product mix, quantity, budgeting and sales forecasting. The goal is to get the correct quantity of the right product, at the right time and place, to the end customer for purchase. Factors to consider include trends, seasonality and regional differences. (Mentzer *et al.*, 2007.)

The role of procurement is to operate within the constraints of supply to ensure the availability of products or services. Availability management aims to maintain

a timely flow of materials to meet the firm's and its customers' needs. This includes maintaining good relationships with existing suppliers and developing other sources of supply where necessary. In addition, purchases must be made efficiently but judiciously to achieve the best value for every euro spent. (Baily *et al.*, 2015.)

Other considerable objectives that are listed by Baily et al., include:
- Selecting the best possible suppliers
- Maintaining a quality/value balance
- Monitoring the supply market
- Environmentally responsible procurement management

4.1.2 Inventory management

The storage of products involves a wide range of costs, generally divided into ordering fees and storage costs. The latter includes rent, wastage, tied-up capital costs and product handling costs such as staff. Considering these costs, the main reasons for holding inventory are predictability, fluctuations in demand, the unreliability of supply, price protection and volume discounts, and lower ordering costs. In other words, stockholding is a way of anticipating changes that could otherwise lead to a loss of sales. (Muller, 2011.)

Companies often have several different warehouses with different functionalities, such as buffer, pre-stocking, and transfer/transit warehouses. The buffer stock serves to compensate for uncertainties in supply and demand. Advance stock is created for the upcoming season, campaign, or novelty launches, such as Christmas calendars and sunscreens. However, if sales do not go as expected, this can lead to wastage, i.e., loss of money, if there are stock goods with an exceeded shelf life. Stock in transit refers to the balance in transit from outside to inside the company or from the warehouse to the store/customer. Transit stock also refers to the balance moving within the enterprise and the balance in transit (direct from the supplier to the store). In some cases, the transfer/transit stock

balance may appear in the company's systems as a balance before it has physically arrived, which causes problems in the accounting. (Muller, 2011.)

When there is a discrepancy between the quantity recorded in the inventory management system and the quantity physically available, this is known as Inventory Reconciliation Inaccuracy (IRI). IRI can cause significant problems in retail, such as lost revenue due to stock-outs or unnecessary replenishment orders. The inaccuracy cost can be substantial for a firm, as it can disrupt the performance of the entire supply chain. IRI should ideally be zero, but it is impossible to reduce it to zero. (Shabani *et al.*, 2021.)

An accurate balance management system is needed to ensure that a company receives the right products at the right time and place and in the correct quantity. Uncertainty in demand and too low an inventory balance can cause a firm to lose sales, while too high an inventory can cause additional costs and an outdated product mix. In addition, low product availability can undermine a company's reputation in the eyes of its customers. In particular, IRI for seasonal products may delay the necessary replenishment order, resulting in the product no longer being available or reasonable to stock or in the activation of an unnecessary order, leading to an overstocking of the product. (Shabani *et al.*, 2021.)

Stock control

As there is usually more than one product in the warehouse, it is necessary to distinguish which products are the most critical to the operation compared to others. Some products may have a very high utilization rate, and running out of stock would cause customer disappointment. On the other hand, some products may be particularly valuable, so too much stock would be too costly. One way to take account of these differences is to rank them in order of usage value. This way, products with a high usage rate are more likely to be closely monitored, while low-value and low-usage products can be ignored. (Baily *et al.*, 2015.)

In general, only a relatively small proportion of the products in a warehouse make up a large part of its total value. This phenomenon is often called the 80/20 rule and is known as Pareto's law. The 80/20 designation comes from the fact that typically only 20% of the products in an inventory make up 80% of a company's inventory value. Pareto analysis can be used to focus on the inventory items that are most important in terms of value in use. (Baily *et al.*, 2015.)

One of the tools used to distinguish between products is ABC analysis, which can outline minimum-maximum stock levels for products of different values, either by utilization rate or product cost value. ABC policies can also be used to determine drop rates, negotiate with suppliers, and estimate the total value of inventory. The result of a product analysis based on the quantity needed traditionally indicates that:

- A products - fast-moving = high volume, few order lines
- B products - average speed = average volume, the average number of order lines
- C products - slow-moving = low volume, high number of order lines (Baily *et al.,* 2015.)

If the analysis is based on the value of the products, the company may have the following purchase/inventory situation:

- A products - high-value products = low stock situation, continuous deliveries/JIT or replenishment system periodic checks
- B products - average value products = minimum-maximum or continuous checking system
- C products - low-value products = replenishment of the two-tank system in which an empty tank indicates the need for filling order and another tank is used to meet demand. (Baily *et al.*, 2015.)

In essence, the most crucial task is to achieve a balance between the value and cost of the inventory. If an organization has too little stock, it can suffer from delays in production, poor customer service or an inability to meet new demands.

On the other hand, too much inventory ties up an organization's resources, reducing investment opportunities or diverting consumption. (Baily *et al.*, 2015.)

EOQ – Economic order quantities

To calculate the economic order quantity, a formula EOQ has been created, which can be derived from any combination of variables - price, utilization/demand and internal costs. EOQ thus gives the order quantity with the lowest total cost of the variables. In other words, if the EOQ is low relative to ordering and delivery costs, the formula indicates that orders should be placed infrequently. In contrast, orders should be placed frequently if it costs more to hold a month's inventory than to order. Properly used, the EOQ formula reduces inventory and orders but not service. (Baily *et al.*, 2015.)

$$EOQ = \sqrt{\frac{2 \times \text{annual usage quantity} \times \text{ordering cost}}{\text{unit cost} \times \text{stockholding}}}$$

Writing u for annual demand or usage quantity;
p for the paperwork and administrative cost associated with an order;
c for unit cost or price each;
s for the cost of holding stock as a decimal fraction of average stock value, the formula becomes:

$$EOQ = \sqrt{2up/cs}$$

Alternative versions of the formula can be derived, showing, for example, how many weeks or months of supply are covered by a single order or how many orders are placed in a year. The formula assumes that the number of orders does not affect demand and that neither the buffer stock nor the price is affected by the number of orders. The total variable cost is then the sum of the storage costs and the costs associated with the order. Unfortunately, the formula cannot be used when the price fluctuates, the usage/demand rate is not approximately constant, or the delivery time is long and uncertain. (Baily *et al.*, 2015.)

Shelf availability

High shelf availability is essential for retailers. When customers cannot find a product on the shelf, it might lead to lost sales and may reduce consumer loyalty. Improving shelf availability is, therefore, essential for retail profitability. Out-of-stock (OOS) is mainly caused by stock inaccuracies, unexpectedly high demand, stock replenishment density and poor shelf tracking. (Moorthy and Behera, 2015.)

On-shelf availability (OSA) is the number of saleable products available to customers when they expect to find them and when they want to buy the product. Shelf availability is mainly detected and measured by visually checking the shelves. Automatic detection of accurate shelf availability would be very valuable. Maintaining OSA or reducing OOS helps improve store inventory management and are retail performance indicators. (Moorthy and Behera, 2015.)

One of the most significant causes of OOS is apparent inventory. Apparent stock is created when an inventory management system indicates that a product is available when the product is not on the shelf. That can be due to the product being damaged or stolen, the product being in the customer's shopping cart, on the wrong shelf, or the product still being in the back. Figure 3 shows the primary causes of OOS. (Moorthy and Behera, 2015.)
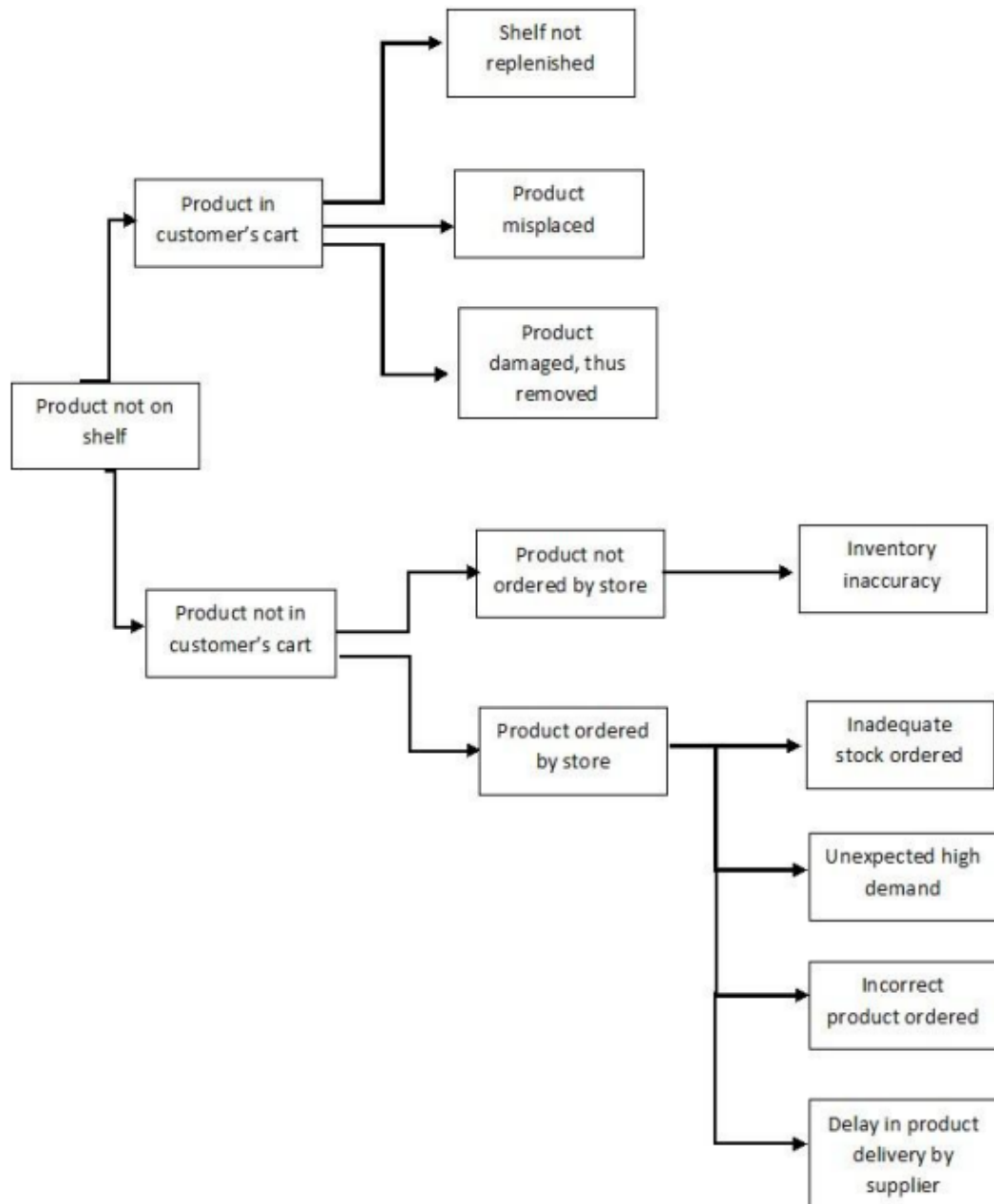
Figure 3. Reasons for OOS (Moorthy and Behera, 2015)

OOS directly impacts trading and customer reactions (Figure 4). A product may be missing from the shelf even if the order forecast was correct and the delivery has taken place correctly. In such a situation, according to article On-Shelf Availability in Retailing, 40% of customers will not buy the product at all from the store in question, which can lead to heavy losses for the company and a shift in sales elsewhere. (Moorthy and Behera, 2015.)

Figure 4. Customer behaviour during OOS (Moorthy and Behera, 2015)
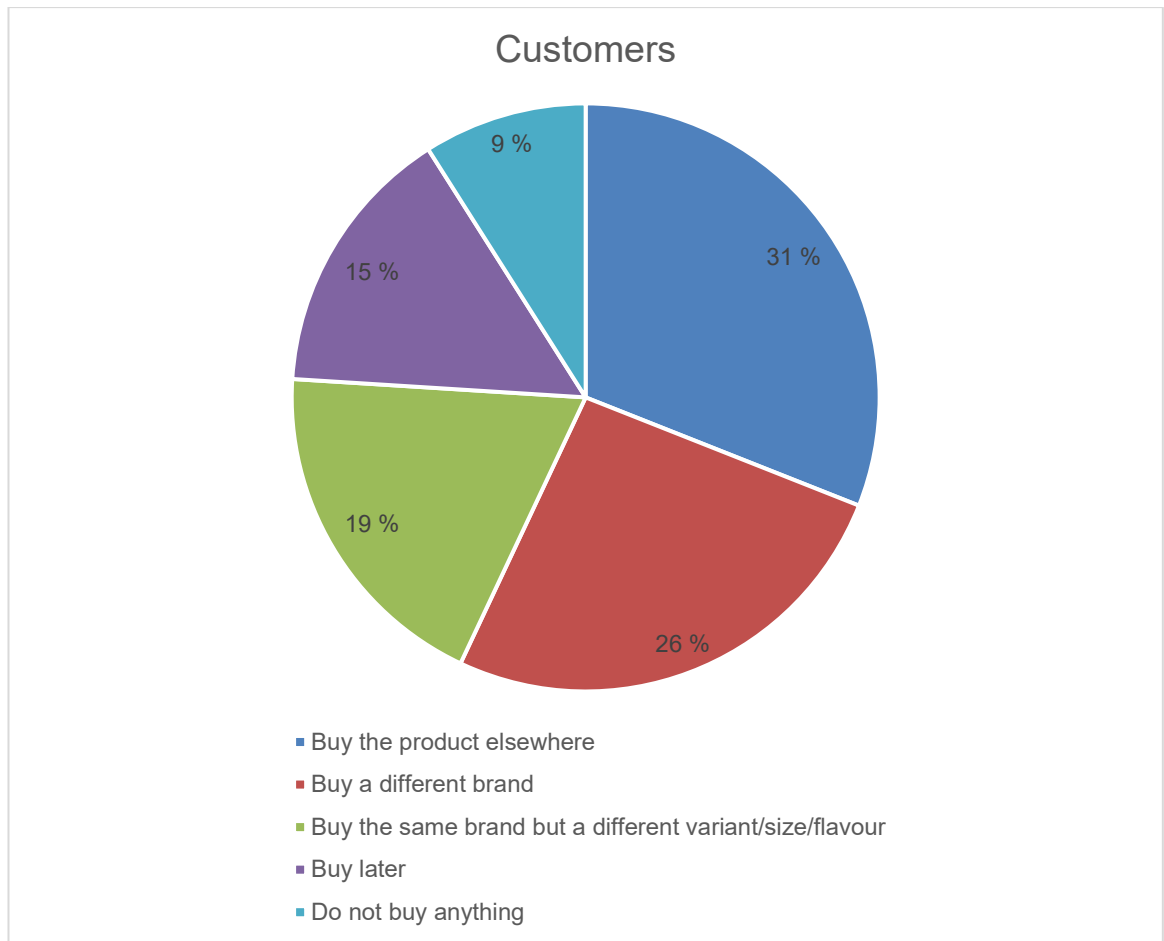
If the OOS situation is recurrent, the customer will likely change the provider altogether. That means an average annual loss of thousands of euros for one customer alone. If popular products are missing from the shelves, a much larger number of customers may already be affected. That is why stores must ensure a high OSA to retain loyal customers. However, the solution is not to directly increase safety stock, which can lead to increased wastage and order-to-delivery costs. (Moorthy and Behera, 2015.)

4.1.3 Logistics management

Logistics management is defined in David Grant's book, "Logistics management" as follows:

> "That part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in an orderly manner to meet customer needs."

Logistics includes five main functions: transportation, warehouse, storage, information technology and production/operations management. These include:

- Inbound and outbound transport,
- in-house fleet management or management of outsourced third-party logistics providers
- material handling and order fulfilment
- logistics network planning
- packaging and assembly
- supply and demand planning
- international sourcing and procurement (Grant, 2012.)

Among these, inventory management considers the volumes of initial processing of orders based on demand, procurement functions and stock accounting. As a result, inventory management must be coordinated, optimized and integrated with other areas of the company's activities, such as marketing, sales, purchasing, finance and IT. (Grant, 2012.)

Third-party transportation

Companies can use third-party companies to organize and manage their transport needs. These service providers are called 3PLs for short. A company's logistics can be outsourced in whole or in part, for example, just transport or warehousing. The most common reasons for outsourcing include:

- to avoid investing in logistics assets
    - a current cost instead of a capital cost
- to reduce labor costs
- better logistical expertise offered by 3PLs
- geographical coverage offered by 3PLs (Grant, 2012.)

However, there are also disadvantages to outsourcing logistics activities to a 3PL, such as loss of control to 3P and partial loss of direct contact with customers. Guidelines and techniques have been developed to mitigate these disadvantages, such as involving the 3PL in designing the company's logistics system, which could enable a full or partial switch to in-house logistics operations. However, if this is not viable/possible for the company, keeping 3PL contracts short and reducing the number of 3PLs used would be advisable. (Grant, 2012.)

Models of logistics performance

There are several different models for measuring performance, of which the three most popular are the balanced scorecard, the supply chain performance reference model SCOR and the performance prism. These three also focus on other aspects of performance in addition to purely financial measures. (Grant, 2012.)

The Balanced scorecard is a strategic planning and management model used by companies, governments, and non-profit organizations to adjust their business activities to the organization's strategy, improve internal and external communication and monitor organizational performance. It originated as a performance measurement framework that added non-financial performance measures, such as customer service, to traditional financial measures to provide a more "balanced" view of organizational performance. Although the balanced scorecard has evolved from its early use as a simple performance measurement framework into a complete strategic planning and management system, it is old. Thus, there has been criticisms of the scorecard and its applications, including the exclusion of people and competitive environments. (Grant, 2012.)

The SCOR model is a process benchmarking tool that combines three concepts: business process redesign and modelling, process mapping and

measurement, and performance benchmarking to identify best practices for similar processes. SCOR is based on five management processes (Figure 5):
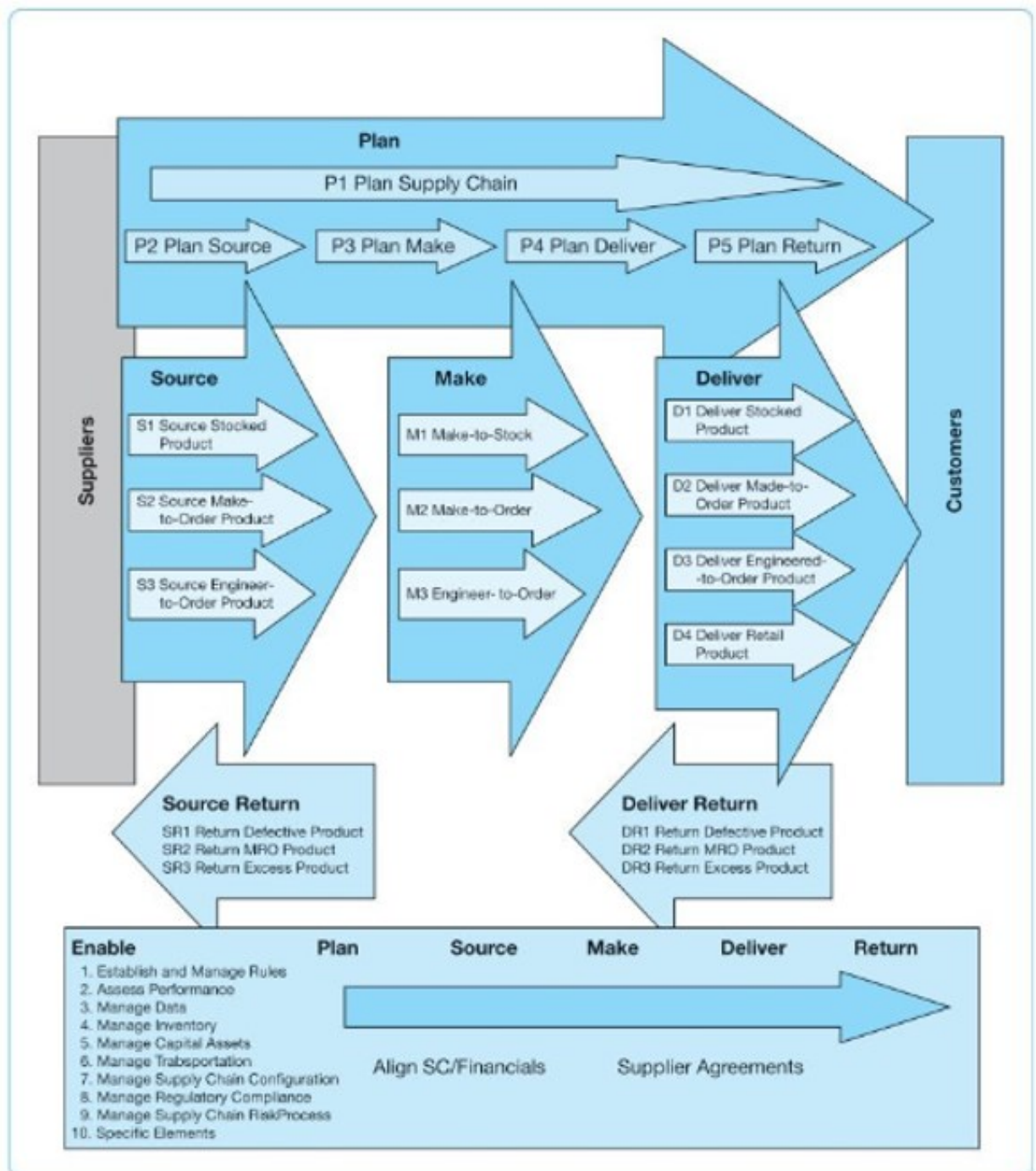

Figure 5: SCOR model (Grant, 2012)

- Plan - consider overall supply and demand and sources of information to meet sourcing, production and delivery requirements.

- Source - consider the locations and products to be sourced to meet demand.
- Make - consider production locations and methods to convert products to a finished state to meet demand.
- Deliver - consider channels, inventory deployment, and processes to provide finished goods to meet demand.
- Return - consider locations and processes for returning or receiving returned products. These processes span post-delivery customer support. (Grant, 2012.)

While the SCOR model is a valuable tool for understanding a company's capability to provide customer service, it does not attempt to cover every business process or activity. It doesn't include sales and marketing or demand generation and some elements of post-delivery customer support that are also relevant to a company's customer service strategy. (Grant, 2012.)

The performance prism (Figure 6) has been developed to meet the needs and wishes of all stakeholders in the company. It consists of five "sides" of the prism, identified together with five measurement design questions:

- Stakeholder satisfaction - who are the key stakeholders, and what do they want and need?
- Strategies - what strategies does the company need to put in place to meet the wants and needs of these key stakeholders?
- Processes - what critical processes does the company require to implement these strategies?
- Capabilities - what capabilities does the company need to operate and improve these processes?
- Stakeholder input - what input does the company require from its stakeholders to sustain and enhance these capabilities? (Grant, 2012.)
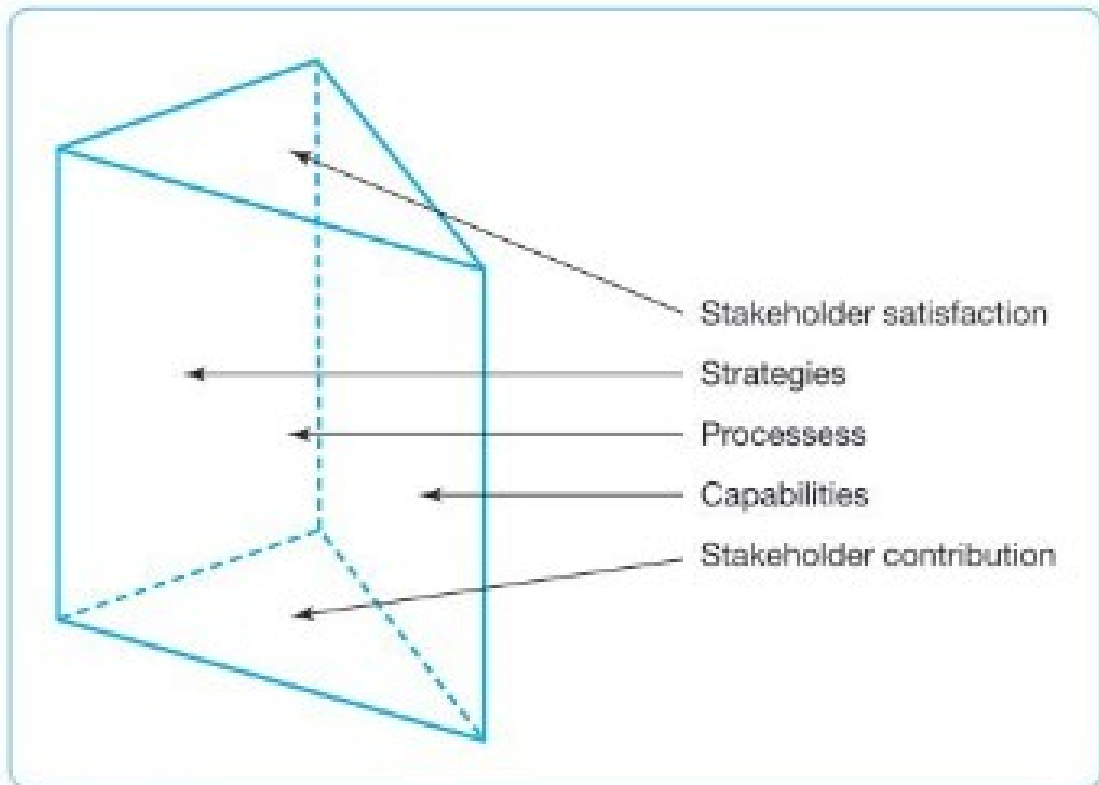
Figure 6.The facets of the performance prism (Grant, 2012)

The performance prism's primary objective is to identify all stakeholders and assess their requirements before deciding on strategy and performance indicators. (Grant, 2012.)

eCommerce logistics

With orders from individual customers, eCommerce has dramatically increased the logistics of businesses, as products are no longer only transported from the warehouse to the store. Clicking buttons online is easy but delivering the products you order is challenging. Business logistics operations are evolving slowly and, therefore, remain a bottleneck for eCommerce. Logistics are challenged by problems such as slow or incorrect deliveries, lost packages and damaged goods. The logistics process in eCommerce can be divided into three stages; the first is the replenishment of goods from manufacturers to distribution centres or warehouses. The second stage involves processing orders, i.e. sorting, picking

and packing at distribution centres. The third stage is the delivery of orders to customers. (Huang, de Koster and Yu, 2020.)

5 Possible Methods and Tools

Currently, information on tools to facilitate balance management is almost exclusively available for shelf availability. That could lead to the conclusion that omnichannel is still so new that the available data and research have either not been created or is not yet willing to be shared. We need to speculate on possible future options to compare different technologies for the problem at hand.

5.1 RFID

RFID is an identification system that enables the real-time tracking of products in the supply chain. It consists of three elements: tags, readers and software that communicate with each other. Using RFID technology, individual products can be identified and monitored throughout the supply chain, meaning their physical location is known. As a result, inventory accuracy and OSA in stores would significantly improve. In addition, the technology makes it possible to track best-before dates and remove unsaleable products from the shelf before the customer. (Moorthy and Behera, 2015.)

5.2 Weighted sensor shelves

The weight-sensing shelf is based on a mat placed on the shelf that detects the weight. The system integrates an RFID reader and a transmitter that sends and receives radio waves. Sensors on the mat can measure the number of products on the shelf based on weight, and their sensitivity can be adjusted according to the product type. Its benefit to the store is detecting the need to replenish the shelf and sending an SMS or email to a staff member to take corrective action. (Moorthy and Behera, 2015.)

However, pressure sensor shelving has its challenges/disadvantages. One of the biggest of these is the cost of installing the sensors and the limited data available. Weight sensors may not detect too light products, and they may not see products

that are misplaced. In addition, they make it challenging to make store layout changes due to sensor adjustments. (Moorthy and Behera, 2015.)

5.3   Computer vision systems

One technology that measures shelf availability is the computer vision system. It can assess stock levels, detect misplaced products and identify empty shelves (Figure 8). For example, the data collection cameras can be placed in fixed locations or integrated into smartphones, shopping trolleys/baskets, or mobile robotic platforms. The camera image is sent to a system that identifies anomalies and alerts the store manager(s) depending on the processing technology. (Milella *et al.*, 2020.)

Store Product Images

Video or Camera device to capture shelf image

Matching reference image with target image

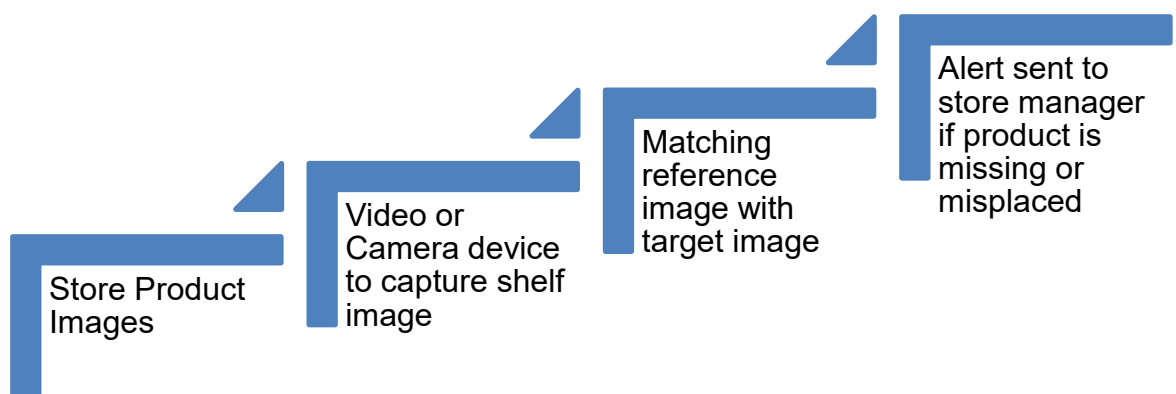Alert sent to store manager if product is missing or misplaced

Figure 7. Flowchart of the Computer vision system (Moorthy and Behera, 2015)

Therefore, image processing techniques have different characteristics but are mainly based on model-based matching algorithms that search for anomalies. One example is a technique using SURF (Speeded-Up Robust Features) features, where the current image of a shelf can be matched to a reference image, allowing the availability of the shelf to be estimated and misplaced products to be detected. However, this technique is expensive as it requires the creation of several models for a product (different lighting, angle, and distance). (Milella *et al.*, 2020)

The 3D shelf monitoring system is a newer version, which also uses depth in the images. This system can estimate the number of products available on the shelf, providing more accurate and timely information on the status of the shelf. The system detects out-of-stock products early and provides updated information on product availability for eCommerce and stock inventory. (Milella *et al.*, 2020.)

At least according to a study by Milella et al., the system has a minimum detection accuracy of 84.5%, and the price depends a lot on the camera used. This could be considered for piloting again, as even if it does not help the whole distribution chain, it could significantly improve store balance management.

5.4   Mobile apps and QR codes

One of the options for balance management presented in Moorthy and Behera's study would be mobile apps and QR codes. They found that customers increasingly use their smartphones to check prices and reviews when shopping in a brick-and-mortar store. Based on this assumption, retail shelf availability could be developed to communicate directly with customers about a product shortage, for example, by using a mobile app. For example, a customer could use the company's app, take a picture of an empty shelf, which would be updated in the database and send an alert to the store manager. The store manager could then react by ordering more products or shelving the stock balance. (Moorthy and Behera, 2015.)

Another option would be to use QR codes or a combination of the two. For example, the QR code could be a link to a website where the customer could see the current status of the product and when more of the product might be coming into the store. The website could also provide more detailed information about the product, such as ingredients and information about the supplier. The QR code scanning could also be reported to the store manager so that the shelf availability information would be taken into account and appropriate action could be taken. (Moorthy and Behera, 2015.)

However, Moorthy and Behera argue that these options are too customer-centric and that the customer would instead buy the product from another store than not buy the product. That may have been true in 2015 when the survey was conducted, but what about today or the future.

5.5   Click & Collect

The Click & Collect service connects the eCommerce customer and the brick-and-mortar store. The service allows the customer to take advantage of online shopping at a lower cost by eliminating postage costs and allowing the order to be picked up from the nearest store. At the same time, this reduces the cost of transport to the store and the number of complaints about late deliveries. On the other hand, the maintenance of the service, i.e. store collection, should be covered by some additional pricing or possibly compensated by increased sales. (Milioti, Pramatari and Kelepouri, 2020.)

The customer's purchase decision process in an online environment consists of two separate decisions: the decision to order the product and, upon receipt, to keep or return the product (Bernon, Cullen and Gorst, 2015). Although this process will not change with the introduction of Click & Collect, it may reduce the number of returned products if it is still possible to make changes to the order at the pick-up stage. In addition, the service would eliminate handling and logistics costs for uncollected products and balance delays by allowing the product to be returned to balances directly in the store where the order is waiting to be collected.

6   Summary and Conclusion

The purpose of the final thesis was to investigate the impact of balance management on eCommerce customers and explore what tools are available to facilitate balance management. It also looked at the future potential of existing technologies and how they could serve company x. The aim would be to increase customer satisfaction, reduce balance errors and improve availability management.

The literature review identified balance data's impact on the company and the customer. In an omnichannel environment, the risk of losing a customer to a competitor in the event of a product shortage is increased because it is easy for the customer to change the channel from which he orders the product. Omnichannel also increases the customer's ease of use, as product information (e.g., price, availability, etc.) can be checked from a smartphone while in the store.

6.1   Thesis evaluation

The validity and reliability of the final results are disputed. During the research, it was found that there is relatively little information available on the subject. That may be due to the freshness of the subject and the fact that not much research has been done yet. Or the high value of the results for companies makes them unwilling to share the information. The results are not yet ready for general dissemination, as they can provide a significant competitive advantage in the market. Achieving real-time balance management seems too expensive at this stage, and the technology's novelty is prone to failure. Therefore, the outcome of this work is more speculation than factual information.

The thesis will give the reader an insight into the factors that influence the availability of an omnichannel company. There are certainly more possible methods for achieving real-time balance management than those listed in this thesis, and I believe that new ones are constantly being developed.

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Appendix A: Business models

Type of Model	Description
Brokerage Model	Brokers are market-makers: they bring buyers and sellers together and facilitate transactions. Brokers play a frequent role in business-to-business (B2B), business-to-consumer (B2C), or consumer-to-consumer (C2C) markets. Usually, a broker charges a fee or commission for each transaction it enables. The formula for fees can vary
Advertising Model	The web advertising model is an extension of the traditional media broadcast model. The broadcaster, in this case, a website, provides content (usually, but not necessarily, for free) and services (like email, IM, blogs) mixed with advertising messages in the form of banner ads. Banner ads may be the broadcaster's primary or sole source of revenue. The broadcaster may be a content creator or a distributor of content created elsewhere. The advertising model works best when the volume of viewer traffic is large or highly specialized.

Type of Model	Description
Infomediary Model	Data about consumers and their consumption habits are valuable, mainly when that information is carefully analyzed and used to target marketing campaigns. Independently collected data about producers and their products are helpful to consumers when considering a purchase. Some firms function as infomediaries (Information intermediaries) assisting buyers and sellers in understanding a given market.
Merchant Model	Wholesalers and retailers of goods and services. Sales may be made based on list prices or through an auction.